CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDICES

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APPENDIX A
HYDROLOGY AND HYDRAULICS

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APPENDIX A
HYDROLOGY AND HYDRAULICS

PURPOSE OF REPORT

This study presents hydrology and hydraulic analyses to evaluate existing conditions and proposed alternatives related to flood risk management.

DATUM INFORMATION

The project mapping and water levels at Cedar Rapids use the 1988 North American Vertical Datum (NAVD). Geographic Information System (GIS) contour information obtained from the city is in this datum. Older drawings are in city datum; to convert City Datum to 1988 NAVD add 627.34 feet to City Datum. To convert 1929 National Geodetic Vertical Datum (NGVD) datum to 1988 NAVD datum subtract 0.08 feet from 1929 NGVD datum. In some cases the conversion from 1929 to 1988 was not made since the difference was not consequential.

PREVIOUS HYDROLOGY STUDIES

The following paragraphs list previous studies that are relevant to flooding at Cedar Rapids, Iowa.

Review of Reports (Preliminary Examination) *for Flood Control on the Iowa and Cedar Rivers*, Iowa and Minnesota, War Department, Corps of Engineers, Rock Island District, 1 July 1946. This is an inventory of flood control structures built along the Iowa and Cedar Rivers prior to 1946.

House Document No 166, 89th Congress, 1st Session, Letter from the Secretary of the Army Transmitting a Letter from the Chief of Engineers, dated January 26, 1965; submitting a report, together with accompanying papers and illustrations on an Interim Report on the Iowa and Cedar Rivers, Iowa and Minnesota requested by Resolution of the Committee on Flood Control, House of Representatives, adopted July 16, 1945, the Committee on Commerce, United States Senate, adopted August 6, 1845 and the Committee on Public Works, House of Representatives, adopted July 29, 1955. Damages resulting from the 1961 flood along the Cedar River in Cedar Rapids are discussed, along with the proposed flood risk management alternatives for the City. After a review of the options and their adverse impact on the scenic attraction of the river, the City decided not to participate in the implementation of the levee and floodwall system.

Flood Plain Information, Cedar River, Linn County, Iowa, prepared for the State of Iowa, Iowa Natural Resources Council, by the U.S. Army Corps of Engineers, Rock Island District, October 1967. This study provided additional river discharges and elevations and substantiated the Corps' conclusions that an out-of-bank event is a rare event.

Iowa-Cedar River Basin, Stage 2 Document, U.S. Army Corps of Engineers, Rock Island District, March 1980. This is a collection of working papers that addresses problems and potential solutions under the "Iowa-Cedar Study Authorities." The document concludes that further study is warranted for reservoirs at Floyd and Finchford and that local flood protection work should be evaluated for the cities of La Porte City, Cedar Falls, and Waverly, Iowa. Regarding the Cedar Rapids area, the conclusion reached was that although there are flood protection options with benefit-cost ratios (BCRs) of between 0.9 and 1.1, the City was unwilling to implement them as they would detract from aesthetics of the riverfront. However, the City did support channel improvements, but there was no economic justification to support a Federal interest. Continuing the City's existing floodplain management program was the only remaining acceptable alternative.

*Iowa-Cedar River Basin Feasibility Report, Main Repor*t, June 1982, U.S. Army Corps of Engineers, Rock Island District. As it pertains to Cedar Rapids, this report again mentions the reluctance of the city to construct a levee system.

Flood Insurance Study, County of Linn, Unincorporated Areas, June 15, 1982, Community No. 190829, Federal Emergency Management Agency. This study provides planners and decision makers with the basis to make knowledgeable decisions regarding land use and development in the floodplain.

Flood Insurance Study, City of Cedar Rapids, Iowa, Linn County, Revised March 18, 1991, Community No. 190187, Federal Emergency Management Agency. This study provides planners and decision makers with the basis to make knowledgeable decisions regarding land use and development in the floodplain.

DISCUSSION OF FLOOD RISK MANAGEMENT OPTIONS

Floodplain Management

The City of Cedar Rapids is part of the National Flood Insurance Program. It also passed and published ordinance No.81-87 in 1987 which contains provisions dealing with floodplain management standards. This ordinance requires all new, or substantially improved, residences to have the lowest floor one foot above the 0.01 exceedance probability flood level.

Flood Warning System

The Corps of Engineers evaluates flood warning systems used to operate Federal Projects and operated as independent systems by the local sponsor when no project is justified. Flood warning systems that stand alone do not reduce the risk of damage to structures within the floodplain. But the system can reduce the risk to life and if property is easily transportable it can reduce the damage potential.

During periods of raising river stages and frequent rainfall, Cedar Rapids along with other cities on the Cedar River can access forecasts of predicted crests from the National Weather Service (NWS). The city can also monitor the river stage USGS gage at Cedar Rapids and together with a Flood Response Manual initiate various response actions corresponding to various stages. The manual and links to the USGS gage at Cedar Rapids and to the National Weather Service forecasts appear on the city website (http://www.cedar-rapids.org/engineering/).

In 2008 the Waterloo gage (05464000) was the nearest automated gage upstream of Cedar Rapids on the Cedar River. The travel time between these two points is about two days. As of March 2009 two automated USGS stream gages have been added in the reach between Waterloo and Cedar Rapids.

One gage is located at Vinton (05464315) and the other is at Blairs Ferry Road at Palo (054464420) as shown in Figure A-1. These new gages will provide improvements in forecasting flood heights at Cedar Rapids due to flash floods between Waterloo and Cedar Rapids and should provide at least 6 to 12 hours of warning time. In view of these additions, relying upon the National Weather Service appears to be the more practical and cost effective than developing and operating an independent flood warning system.

Following the 2008 flood, the Iowa Flood Center has also studied the Cedar River (www.iowafloodcenter.org). One goal of the Iowa Flood Center project is to create a static library of flood inundation maps to more effectively communicate flood impacts to the public. Each map would correspond to a regular stage interval at a nearby stream gage. This would allow the public to visualize the extent and severity of flooding associated with National Weather Service (NWS) forecasts for that gage. The NWS publishes this information on the Advanced Hydrologic Prediction Service (AHPS) website. Funding for these modeling efforts comes from the Iowa Flood Center. Some of this work may also be beneficial for Cedar Rapids.

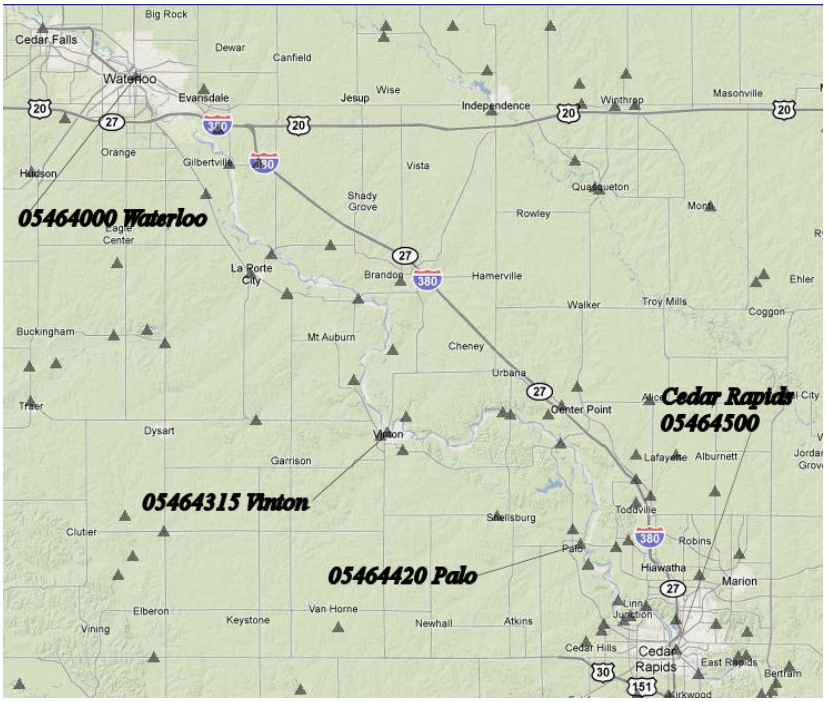

Figure A-1 Cedar River Gages between Waterloo and Cedar Rapids

The next two tables provide additional information about the basin. The five rainfall gages listed in Table A-1 are in or near the Cedar River Basin between Waterloo and Cedar Rapids.

Table A-1 NWS Rainfall Gages in upstream of Cedar Rapids

Number	Description	Lat	Lat		Long	Long		Start	End
131314	CEDAR RAPIDS AP	41	52		91	42		1953	2007
131319	CEDAR RAPIDS 1	42	2		91	35		1892	2007
131704	CLUTIER	42	5		92	24		1973	2007
134049	INDEPENDENCE 2NNE	42	28		91	52		1955	2007
138706	WATERLOO MUNICIPAL AP	42	32		92	24		1950	2007

The drainage area of the Cedar River between Waterloo and Cedar Rapids is 1,364 square miles. The 24 tributaries listed in Table A-2 drain about 80% of this area. As can be seen, except for Wolf Creek which has a gage, most of the tributaries are small.

Table A-2 Tributaries between Waterloo and Cedar Rapids

Tributary Entering Cedar River	Tributary Drainage Area (Sq.Mi.)	Cedar River Drainage Area Square Mile
USGS Waterloo		**5146 *(05464000)***
Elk run at mouth	37.40	5203
Sink Creek at mouth	8.25	
Poyner Creek at mouth	17.30	
Indian Creek at mouth	23.20	
Millers Creek at mouth	67.20	5327
Mud Creek at mouth	14.10	
Big Slough at mouth	6.94	
Wolf Creek at mouth *(05464220 299 sq mi)*	328.00	5683
Rock Creek at mouth	38.40	
Spring Creek at mouth	60.90	5794
Spring Creek 2 at mouth	14.00	
Black Hawk Co/ Benton Co line		5814
Lime Creek at mouth	41.90	
Bear Creek at mouth	61.30	5940
Pratt Creek at mouth	49.90	
Hinkle Creek at mouth	30.40	
USGS Vinton		6040 *(05464315)*
Prairie Creek at mouth	20.20	6062
Mud Creek at mouth	45.30	
Blue Creek at mouth	63.00	6206
Spring Creek at mouth	6.65	
Nelson Creek at mouth	7.52	
Opossum Creek at mouth	98.60	6342 (*05464420)*
Dry Creek at mouth	27.30	
Lone Tree Creek at mouth	5.85	
Morgan Creek at mouth	27.00	6486
USGS Cedar Rapids		**6510 *(05464500)***

Levee Alternatives

Many levee arrangements were examined at Cedar Rapids and the important alternatives (1, 1A, 4, and 10) are defined and mapped in the Main Report. An abbreviated version of the levee alternatives appears in Table A-34 (page A-38 Flood Damage Analysis Section). Economic damage reaches for downtown Cedar Rapids are also shown on Plate A-1. Alternatives 1 and 1A both consist of levees on both sides of the river through the downtown area. The HEC-RAS model for these plans is referred to as the West Setback Option since the upstream west levee segment is setback from the river bank. Additional alternatives addressed a levee only on the west bank, a levee only the east bank, and several ring levees.

HYDROLOGY

Basin Description and Historic Floods

The Cedar River flows through northern and central parts of eastern Iowa and drains an area of 7,819 square miles at its mouth. It is a major tributary of the Iowa River. The Iowa River in turn enters the Mississippi River between Muscatine, Iowa, and Burlington, Iowa. The drainage area of the Cedar River at the City of Cedar Rapids is 6,510 square miles. Historically, major floods have been caused either by heavy rainfall or by a combination of rainfall and snowmelt. The largest 10 floods at the Cedar Rapids gage are listed in Table A-3. This gage (05464500) is approximately 400 feet upstream of the 8th Avenue Bridge. The zero gage elevation is 700.46 feet NGVD or 700.38 NAVD (1988). The USGS has recorded peak stages at the Cedar Rapids gage since 1903.

Table A-3 Cedar River Floods of Record at Cedar Rapids

Year	Discharge (cfs)	Gage Height (feet)	Elev. NAVD (feet)
2008	140,000	31.12	731.50
1961	73,000	19.66	720.04
1993	71,000	19.27	719.65
1965	66,800	18.51	718.89
1929	64,000	20.00	720.38
2004	62,500	18.30	718.68
1999	62,300	18.31	718.69
1933	58,400	18.60	718.98
1947	56,200	18.23	718.61
1906	55,700	17.60	717.98

The flood of record occurred on 13 June 2008. The peak water surface elevation was 731.50 feet NAVD from a discharge of about 140,000 cubic feet per second (cfs). Based upon the discharge-frequency analysis discussed later this flood was in excess of the .002 exceedance probability event yet less than the estimated Standard Project Flood discharge. This elevation was 4 to 5 ft above the 500-year Flood Insurance Study (FIS) flood (Reference 1). To understand this flood one must appreciate that "timing and location of rainfall conspired to maximize flood intensity." It takes about seven days for water to travel along the Cedar River from the basin divide to the Cedar Rapids. "Rain in the upper watershed falling on June 8 moved downstream to combine with rain falling" north of Cedar Rapids on June 12 (Reference 20). NOAA observed daily rainfalls during this travel time interval at gages located within the upper, middle and lower third of the basin appears in the Table A-4 to define this event.

Table A-4 Rainfall (inches) contributing to 2008 Flood

Date	Mason City Gage 14940	Waterloo Gage 94910	Cedar Rapids Gage 14990
6 Jun	0.24	0.46	0.18
7 Jun	1.39	1.52	T
8 Jun	4.91	1.90	2.41
9 Jun	0.03	0.15	0.14
10 Jun	0	T	0.42
11 Jun	0.99	0.60	0.06
12 Jun	0.44	1.41	1.73
13 Jun	0	0	0

The rainfall source is: http://cdo.ncdc.noaa.gov/ulcd/ULCD). A Cedar Rapids basin appears as a figure in Main Report along with a rainfall distribution map for the month of June. The result of the two storms was a single well-defined peak at Cedar Rapids on June 13th. As this peak was building between the evening of the 11th and the afternoon of the 12th the river elevation rose 5.6 feet in 18.5 hours however no one drowned. The flood hydrograph is shown in Figure A-2

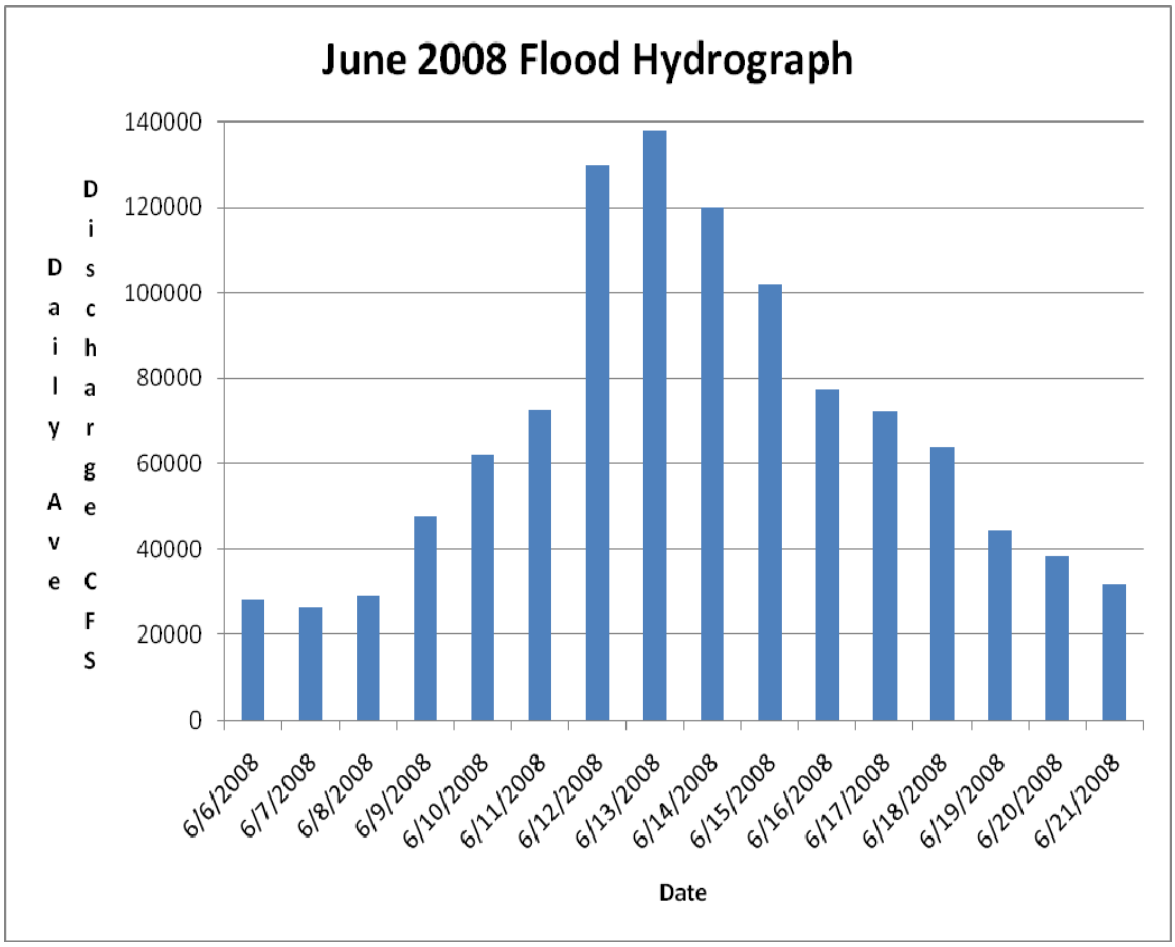

Figure A-2 Cedar River 2008 Flood Hydrograph at Cedar Rapids

The 1961 flood was the result of the rapid melting snow pack with rainfall. At Cedar Rapids the river crested on March 31st at elevation 721.04 feet NAVD. Based upon the discharge-frequency analysis discussed later this flood (73,000 cfs) is in excess of the 0.04 exceedance probability event yet less than the 0.02 exceedance probability. Heavy snowfalls on March 7th and 8th deposited 1¼ to 1½ inches of water content. Low temperatures prevented this snow from melting until March 24th when temperatures rose into the 60's (Fahrenheit) and remained high for 3 days. It was mainly this rapid runoff that produced the flood (Reference 5).

The 1993 flood was the result of a single storm falling within the saturated watershed 3 to 4 days before the peak discharge (71,000 cfs) was observed at Cedar Rapids on April 4th. The peak water surface elevation was 720.65 feet NAVD. Rain falling on March 30th and 31st deposited a total of 1.52, 1.78 and 0.65 inches at the Mason City, Waterloo, and Cedar Rapids air ports respectively. No other significant rainfall fell at Mason City or Waterloo after that. However 0.29 inches fell at Cedar

Rapids on the 1st of April. Based upon the discharge-frequency analysis discussed later this flood was in excess of the 0.04 exceedance probability event yet less than the 0.02 exceedance probability.

Discharge-Frequency Analysis of Cedar River

The starting point for analyzing flood risk and project benefits is the flow frequency relationship. The discharge-frequency relationship for the Cedar River use for downtown Cedar Rapids appears in Table A-5. These values were computed by analysis of peak discharges at the Cedar Rapids gage (USGS 05464500). The input data consisted of 106 annual peak discharges (1903 through 2008). The analysis detected no low outliers and no high outliers. The computed statistics were: mean 4.3779, standard deviation 0.2896, and skew -0.363. For purposes of comparison, the flood insurance study (Reference 1) lists 87,000 cfs for the 0.01 exceedance probability.

Table A-5 Discharge-Frequency Values for Cedar River at Cedar Rapids Gage 05464500

Exceedance Probability	Discharge (cfs)
0.995	3,420
0.99	4,250
0.95	7,470
0.9	9,940
0.8	13,800
0.5	24,900
0.2	42,200
0.1	54,500
0.04	70,300
0.02	82,200
0.01	94,100
0.005	106,000
0.002	122,000

The analysis results were approved by the Iowa Department of Natural Resources on 30 November 2008. The input data appear on Plate A-2 and A-3. The computed output is at the bottom of plate A-3 and the same data is plotted on Plate A-4. The USGS, the United States Army Corps of Engineers (USACE) and all Federal agencies are in agreement regarding the use of the Bulletin 17B systematic analysis (Reference 2). The discharges listed in this section of the appendix have been rounded as follows: discharges from 0 to 10,000 cfs were rounded to the nearest 10 cfs, from 10,001 to 100,000 cfs were to the nearest 100 cfs, and above 100,001 cfs to the nearest 1,000 cfs.

Future Conditions

Urbanization within the basin upstream of Cedar Rapids over the next 50 years is not expected to increase the discharges in the discharge-frequency curve. The proposed levee alternatives will not alter the existing condition, discharge-frequency relationship. For these reasons, the discharge-frequency curve for the existing condition is applicable for all levee alternatives and for the future condition (year 2059).

Discharge estimates are subject to uncertainty due to their nature which consists of estimating the magnitude of rare flood events from comparatively short periods of observation. In recognition of this characteristic, the flood damage analysis procedures discussed later incorporate uncertainty to determine the performance of alternatives.

The hydrologic analysis conducted for this feasibility study shows the 2008 flood as a very rare event. This estimate is based upon stationary hydrologic analysis utilizing historical data from the 106 year period of record. The projected influences of climate change are not included in the hydrologic analysis for this feasibility study. While climate models predict changes in the quantity and intensity of rainfall at large scales (global), the historical flow records do not demonstrate such a trend in the observed annual peak flood levels at Cedar Rapids. In addition, no accepted methods are currently available to incorporate such global predictions at a local scale. A USACE PDT (http://www.iwr.usace.army.mil/inside/products/climatechange/index.cfm) is addressing the issues of 'stationarity' and downscaling of global climate models. However, the results of these efforts will not be available within the time frame of this study.

Likewise a comparison of the latest rating curve for the Cedar Rapids gage with the earliest rating curve produced an insignificant variation. The channel is stable, there is no history of sediment deposition, and the presence of the gage eliminates much uncertainty as to future shifts in the rating curves within FDA. For these reasons, the stage-discharge curve for the existing condition is applicable for the future condition (year 2059).

Discharges Downstream of Cedar Rapids

Discharge-frequency values for the Cedar River downstream of the gage, below Prairie Creek to below Big Creek (Highway 30 Bridge), were adjusted for these tributaries by increasing the results from the flow-frequency analysis by a small amount. The adjusted discharges were used in computing water surface profiles downstream of Cedar Rapids. As shown in Figure A-3, four tributaries (Prairie Creek, Indian Creek, Pleasant Creek and Big Creek) enter the Cedar River between the Cedar Rapids gage and State Highway 30. The drainage area of the Cedar River at State Highway 30 is 6,955 square miles.

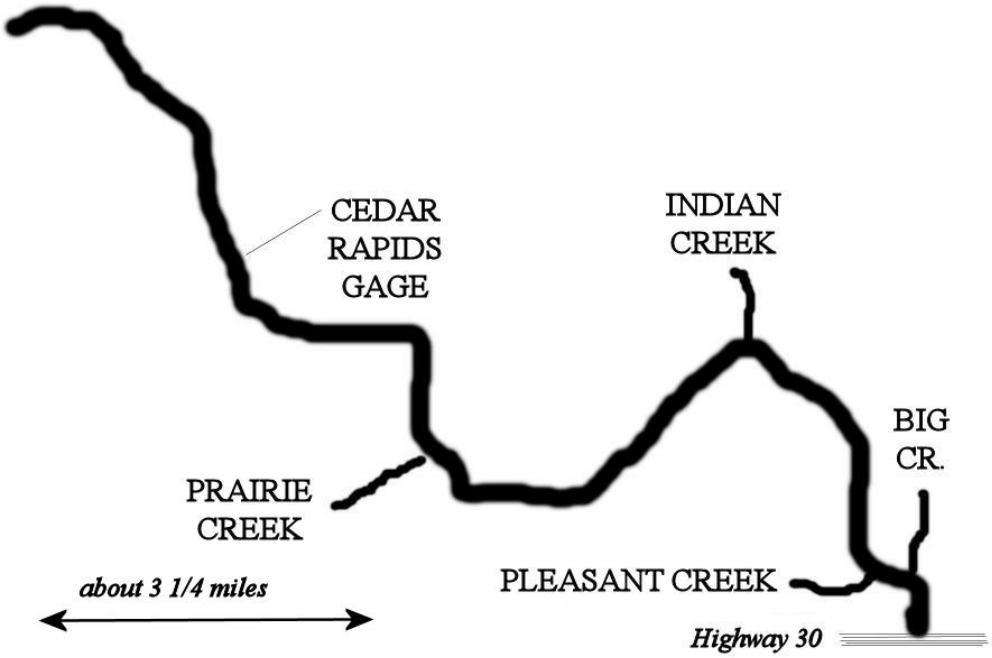

Figure A-3 Cedar River Tributaries below Cedar Rapids Gage

The discharges were adjusted for the increase in drainage area; adjustments were based upon equations from (Reference 3). The state discharge equation for region 2, which includes Cedar Rapids, is in the form:

$$Q = C * DA^{0.4}$$

Where, Q is the peak discharge and C is a constant that varies with the exceedance probability. The power to which the drainage area (DA) is raised varies from 0.54 for an exceedance probability of 0.5 to 0.389 for an exceedance probability of 0.002. A value of 0.415 for an exceedance probability of 0.01 was rounded to a value of 0.4 and used to adjust discharges for all exceedance probabilities. Rounding is appropriate as the adjustment applies to a variable with a significant uncertainty. The adjustment of flows at the gage to a downstream point uses the following equation:

$$Q_{pt} = Q_{gage} * \left(\frac{DA_{pt}}{DA_{gage}} \right)^{0.4}$$

Where, Q_{pt} is the flow at the downstream point; Q_{gage} is the flow at the gage; DA_{pt} is the drainage area at at the downstream point; and DA_{gage} is the drainage area at the gage. The data for the increase in drainage areas were obtained from a USGS e-mail and later confirmed using *Drainage Areas of Iowa Streams*, by O.J. Larimer, USGS, 1957 (Reference 4). The tributaries entering the Cedar River below Cedar Rapids are listed in

Table A-6. The drainage area ratio of gage to point of interest is also shown along with final adjustment factor. All areas listed in the table are in square miles. The tributaries of Pleasant Run and Big Creek enter the Cedar River so near each other that no adjustment was made for the reach between Pleasant Run and Big Creek. Likewise, Highway 30 is just below the mouth of Big Creek; and, therefore, the discharges below Big Creek were used for discharges below Highway 30.

Table A-6 Discharge Adjustment for Reaches below Cedar Rapids

Point (Pt) of Interest	**Tributary Drainage Area (DA) At Mouth of Tributary (mi^2)**	**Drainage Area Between Tributaries (mi^2)**	**Total Cedar River Drainage Area Below**	**Drainage Area Ratio: Point to Gage (DA Pt/DA G)**	**Adjustment Factor (DA Pt / DA G)^.4**
Cedar R. at Gage (G)			6,510	None	None
		6			
Prairie Creek	216		6,732	1.0341	1.0135
		6			
Indian Creek	93		6,831	1.0493	1.0194
		6			
Pleasant Run	7.33				
Big Creek (Highway 30)	111		6,955	1.0684	1.0268

The adjustment factors from

Table A-6 were multiplied by the discharges for the various exceedance probabilities at the Cedar Rapids gage to produce discharges downstream of Cedar Rapids. The adjusted values were used to compute water surface elevations downstream of Cedar Rapids. All the discharge values used for the Cedar Rapids study appear in Table A-7.

Table A-7 Cedar River Discharges Used in this Study

Exceedance Probability	Cedar Rapids USGS Gage (cfs)	Below Prairie Creek (cfs)	Below Indian Creek (cfs)	Below Pleasant & Big Creek (cfs)
0.995	3,420	3,460	3,490	3,510
0.99	4,250	4,310	4,330	4,360
0.95	7,470	7,570	7,620	7,670
0.9	9,940	10,070	10,130	10,210
0.8	13,800	14,000	14,100	14,200
0.5	24,900	25,200	25,400	25,600
0.2	42,200	42,800	43,000	43,300
0.1	54,500	55,200	55,600	56,000
0.04	70,300	71,200	71,700	72,200
0.02	82,200	83,300	83,800	84,400
0.01	94,100	95,400	96,000	96,600
0.005	106,000	107,000	108,000	109,000
0.002	122,000	124,000	124,000	125,000

Standard Project Flood

The Standard Project Flood is the largest flood expected from the most severe combination of meteorological and hydrologic conditions that are reasonably characteristic of a geographical region. The Standard Project flood for Cedar Rapids as published in 1967 has a discharge of 169,000 cfs (Reference 5) and is included in this appendix to provide a basis of comparison for the flood of 2008 (140,000 cfs).

INTERIOR FLOOD HYDROLOGY FOR LEVEE ALTERNATIVE

Observed discharge and rainfall data were examined at the beginning of the study to gain insight into the behavior of the interior areas landward of proposed levees. Later, elevation-frequency curves for interior areas were computed using results from HEC-HMS (Reference 6) and the coincident frequency method. Pump sizes were also examined that removed the runoff from the 3-month 24-hour duration storm with only minor flooding at each potential pump site. These sites were located at significant gravity outlets or collections of small gravity outlets. Pump performance was evaluated using the coincident frequency method. Two separate HEC-HMS models were developed for Cedar Rapids; one was developed for the east bank and another for the west bank.

Interior flooding was modeled in a modular fashion before the evaluation of the proposed alternatives had taken place. Information on gravity outlets and proposed pump stations follow within this section of the appendix. The material is organized by east bank and by west bank. The sites chosen for analysis are shown on plates A-6 and A-12. Each site represented a major storm sewer outfall and was a good choice for a pump station location. Each proposed pump station will have a small pond area to keep pumps from cycling on and off but no large pond areas are proposed. Modules used for the various alternatives appear in Table A-8. Economic damage reaches referenced in the table appear on Plate A-1. Economic Damage Reach 4B currently has an existing pump station and was not analyzed for this reason.

Table A-8 Interior Flood Control Features Incorporated in Various Alternatives

Alternative	Brief Description	Site Numbers included in Alternative
Without Project	No levees	None
1 and 1A	Levees both sides	19W, 33W, 44W, 55W, 64W, 75W, 35E, 45E, 55E, 65E, 75E
4	Levee on east bank only includes economic damage reaches 5C, 5B, 5A & 4B	35E, 45E, 55E, 65E, 75E
5	Ring levee, economic damage reach 5C	75E
7	Ring levee, economic damage reach 4B	Has existing pump facilities
10	Two ring levees, economic damage reach 4B and another at reach 5C	75E

Detailed information on various modules appears in Tables A-15, A-17, A-18, A-23, A-25, and A-26. This information is summarized in the Table A-9 below.

Table A-9 Interior Flood Control Features at Each Site

Site Number	Gravity outlet Feet H= high W= wide	Pump Capacity GPM	Closure Elevation Feet	Exceedance Probability of Closure	HEC-RAS Cross Section
19W	Two 4.5H 10W	13,500	723.7	.04	58820.71
33W	11H 13W	54,000	720.0	.06	55278.83
44W	6 Dia. and 6.83H 8W	24,000	721.2	.04	53799.27
55W	3 Dia.	1,500	715.0	.17	51667.35
64W	6 & 7 Dia.	17,000	715.0	.16	50037.51
75W	7 Dia.	6,000	716.0	.10	48339.74
35E	2.5, 2.5 & 3 Dia.	5,000	718.2	.10	53799.27
45E	3.5 Dia.	1,500	717.0	.12	53001.69
55E	9 Dia.	15,000	713.0	.30	50862.79
65E	3 Dia.	500	715.0	.13	48339.74

Cedar River Discharge Duration

A flow-duration curve for the Cedar River was developed from daily data at the Cedar Rapids gage. Daily average discharge from 1966 through 2008 was used to construct the flow-duration curve on Plate A-5. This served as the basis for stage-duration information. Initially, it was converted to stage using a 2007 rating curve. Later, the durations of certain discharges were paired with the computed HEC-RAS water levels for the same discharges to create a stage-duration relationship at cross-sections near potential pump sites. The later analysis is discussed in the coincident frequency analysis that follows and is used to prepare interior flood stage elevation frequency curves and is discussed under "Stage Duration at Outlet" on pages A-19 and page A-26.

Blocked Gravity Situations Based on Historic Data

Observed daily average stage for the period of 1991 through 2008 were obtained from the USGS website. Observed daily average discharge was converted to stage to extend the stage record back to 1966.

Instances of Observed High Water 1966-2008

For the most part, the ground elevation was used to determine gate closure elevations. The duration of blocked gravity conditions was determined using the estimated gate closure elevations and the historic river stage data. On the east side of the river the minimum ground elevations landward of the proposed levee are between elevation 715 feet and elevation 718 feet. On the west side of the river, minimum ground elevations landward of the proposed levee are between elevation 715 feet and elevation 724 feet. When these closure elevations are transferred to the USGS gage using the river slope the four outlets close at approximately elevation 715 feet, five close at approximately elevation 717 feet, and two outlets close at approximately at elevation 720 feet (all referenced to gage). These preliminary results were refined as the study progressed. The elevation database for the Cedar River gage was examined to determine the years the elevation equaled or exceeded, elevation 715 feet NGVD. Table A-10 shows the years and the count of days exceeding elevations equal to or higher than elevation 715 feet at the Cedar Rapids gage.

Table A-10 shows the Cedar River exceeded the target elevation, 715 ft NGVD, eight of the 43 years on record. During the other 35 years the river stages were not high enough to exceed ground surface elevations allowing gravity flow conditions to exist.

Table A-10 Count of Days Cedar River above Target Elevation (715 ft NGVD) at Gage

Elev.	**1969**	**1973**	**1990**	**1991**	**1993**	**1999**	**2004**	**2008**
730	0	0	0	0	0	0	0	1
725	0	0	0	0	0	0	0	3
720	0	0	0	0	0	0	0	7
719	0	0	0	0	1	0	0	7
718	0	0	0	0	3	1	1	9
717	0	0	0	0	6	2	3	10
716	3	0	0	0	10	3	3	11
715	6	1	2	2	16	4	3	13

In addition to illustrating the years during which blocked gravity conditions would have occurred (had the proposed levee existed) each flood event was summarized in Table A-11. Again, days with water above elevation 715 feet were counted. In this table the column “Start Date of Flood” records the day the river first exceeded 715 feet NGVD while “Duration above 715” provides the number of days the river remained above elevation 715 feet NGVD. The column “Peak Stage of Flood” provides the highest average daily elevation reached during that flood event. Also shown in the table is the value of the 5-day antecedent moisture; this is a sum of the Cedar Rapids rainfall during the 5 days before the start of the flood. While the last column records the amount of rainfall during the time the river stage exceeded elevation 715 feet. Floods that would not produce the yearly interior peak flood based upon duration have been struck through even if the peak Cedar River stage was higher than on other events during the same year.

During the flood of 11 July 1993 the river dropped briefly to elevation 714.71 feet but the event was treated as one flood event instead of two separate events and for this reason the total number of days above 715 do not agree between Table A-10 and Table A-11.

Table A-11 Tabulation of Historic, Blocked-Gravity Flood Events (1966 through 2008)

Year	Start Date of Flood	Duration above 715 (days)	Peak Stage of Flood (feet)	5 Day Antecedent Moisture (in)	Rainfall During Blocked Event (in)
1969	1 Jul 69	4	716.38	3.31	0.23
	~~12 Jul 69~~	~~2~~	~~716.66~~	~~2.23~~	~~0.00~~
1973	21 Apr 73	1	715.11	2.93	0.31
1990	1 Aug 90	2	715.25	1.66	0.00
1991	22 May 91	2	715.60	0.80	0.32
1993	~~2 Apr 93~~	~~5~~	~~719.63~~	~~0.94~~	~~0.00~~
	11 Jul 93	9	717.79	2.32	4.31
	~~20 Aug 93~~	~~3~~	~~717.09~~	~~2.67~~	~~0.43~~
1999	20 May 99	2	716.34	0.76	0.70
	25 Jul 99	2	718.07	2.03	0.52
2004	26 May 04	3	718.63	5.05	0.00
2008	~~28 Apr 08~~	~~2~~	~~717.10~~	~~2.51~~	~~0.01~~
	9 Jun 08	11	731.32	2.59	5.84

Two National Oceanic and Atmospheric Administration (NOAA) rainfall gages exist in Cedar Rapids. Table A-11 is based upon gage number 131319. This rainfall gage is northeast of the 8th Street USGS stream gage. The second rainfall gage in Cedar Rapids is located at the airport southwest of the USGS stream gage. The airport data is missing 3 years of data and recorded slightly less rainfall for several events. For gravity flow years the largest daily rainfalls occur in 1971 with 5.93 inches and 1993 with 6.63 inches. A 50-yr rainfall event for this region is 6.25 inches per day (Reference 7).

HEC-HMS Input Common to East and West HEC-HMS Models

This first section describes various input to the HEC-HMS models (Reference 6) that are common to both east and west bank models. These models were used to estimate peak interior water levels with the proposed levee in place. The specific parameters for each basin are described in later sections.

Synthetic Rainfall Data

The Table A-12 lists the rainfall from Bulletin 71 used for Cedar Rapids; data is for Iowa Region 6 (page 122 of Reference 7).

Table A-12 Synthetic Rainfall in Inches for Cedar Rapids

Storm Duration	Exceedance Probability of Storm							
	0.999	**0.50**	**0.20**	**0.10**	**0.04**	**0.02**	**0.01**	**0.002**
24 hrs	2.40	3.06	3.84	4.44	5.42	6.25	7.13	8.39
6 hrs	1.80	2.30	2.88	3.33	4.07	4.69	5.35	6.30

The rainfall amounts for storms of exceedance probabilities of 0.999 to 0.10 are for the partial duration series. These rainfall amounts are slightly larger than amounts for the annual series: 0.01 by 1%, 0.02 by 5%, and 0.05 by 10% (Reference 7, page 6). No data was published for the 0.002 exceedance probability; it was estimated by straight line extrapolation using log-probability paper. The 3-month synthetic rainfall is 1.15 inches for 6-hour duration storm and 1.54 inches for 24-hour duration storm.

The synthetic rainfall hyetograph was developed using the Huff distribution for a 2nd quartile storm. In his study of rainfall within the State of Illinois, Huff observed the distribution of rainfall and

divided storms into four quartiles (Reference 7). The 2nd quartile storm with the 6-hour duration was used to best model peak discharges for gravity discharge. The 2nd quartile storm was retained with the 24-hour duration to evaluate blocked gravity "no pump" and "with-pump" conditions.

Loss Rates

All HEC-HMS models for Cedar Rapids use an initial loss of 1.3 inches and a constant loss rate of 0.2 inches per hour regardless of the exceedance probability of the synthetic rainfall. Based upon past studies these values are representative of Iowa and Illinois. HEC-HMS applies loss rates only to the pervious portion of each subbasin. No losses are computed for impervious portions of a subbasin.

The maximum initial loss observed for small basins in north central Illinois was 1.6 inches as published in a 1987 study by the USGS (Reference 8). This USGS report was unable to establish a regional loss rate equation but did publish observed loss rate and runoff data for storms over many basins in Illinois. In addition a comparison of computed peak discharges by state regression equation with HEC-HMS models from earlier studies by Rock Island District revealed that the initial loss rate varied. The initial loss rate varies with storm frequency from 1.1 inch to 1.6 inch with an hourly loss of 0.2 inches per hour for a 6-hour storm duration using the 2nd quartile Huff distribution. This work is summarized in Table A-13. An initial loss of 1.3 inches was selected as a good average value.

Table A-13 Initial Loss Rates Used in Prior Studies

Recurrence Interval	Exceedance Probability	Initial Loss (in)
2 years	.50	1.1
5 years	.20	1.1
10 years	.10	1.3
25 years	.04	1.5
50 years	.02	1.6
100 years	.01	1.6
500 years	.002	1.6

Sensitivity runs were made using the HEC-HMS model with the SCS (Soil Conservation Service) loss rate method (Reference 9) in an effort to test the reasonableness of the east bank HEC-HMS model. Subbasin parameters including imperviousness were held constant while the SCS curve number was adjusted to obtain similar runoff peaks and volumes. This analysis revealed that similar peaks and volumes to a 1.3 inch initial loss and constant 0.2 inch per hour loss were obtained with an SCS curve number of 81. A curve number of 81 is higher than expected when using the impervious feature; this is because most parks, green space, and lawns making up the pervious areas within the city have curve numbers in the 61 to 71 range. This suggests that the model used in this study slightly overstated the peak discharge and peak water level.

Brief Overview of Coincident Frequency Computation Method

The coincident frequency method is described and illustrated with an example computation in Reference 15. This method was selected to evaluate peak interior stage at Cedar Rapids. Using this method a stage-duration curve for the exterior Cedar River stage is developed at the point of interest. This function is then divided into segments (see upper left hand plot in Figure A-4). At Cedar Rapids each curve was divided into five instead of the six intervals shown in the figure. The intervals at Cedar Rapids are numbered B1 through B5. An exterior stage value is selected as the representative or index river stage for each segment. Usually but not always this is the middle value of the interval. The interval width for the duration represents the probability of the interval. The sum of the

probabilities of all intervals must equal to 1. Next a series of hypothetical rainfall frequency events are analyzed for each of the index river stages. This is illustrated by the middle plot in Figure A-4. At Cedar Rapids the peak interior stages from synthetic storms with exceedance probabilities of 0.9999, 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, and 0.002 were computed using HEC-HMS. This provided eight points for each of the five interior stage curves. Lastly, the five interior stage curves at Cedar Rapids were combined into one interior stage verses coincident probability curve (or table) using the total probability theorem (see upper right hand plot Figure A-4).

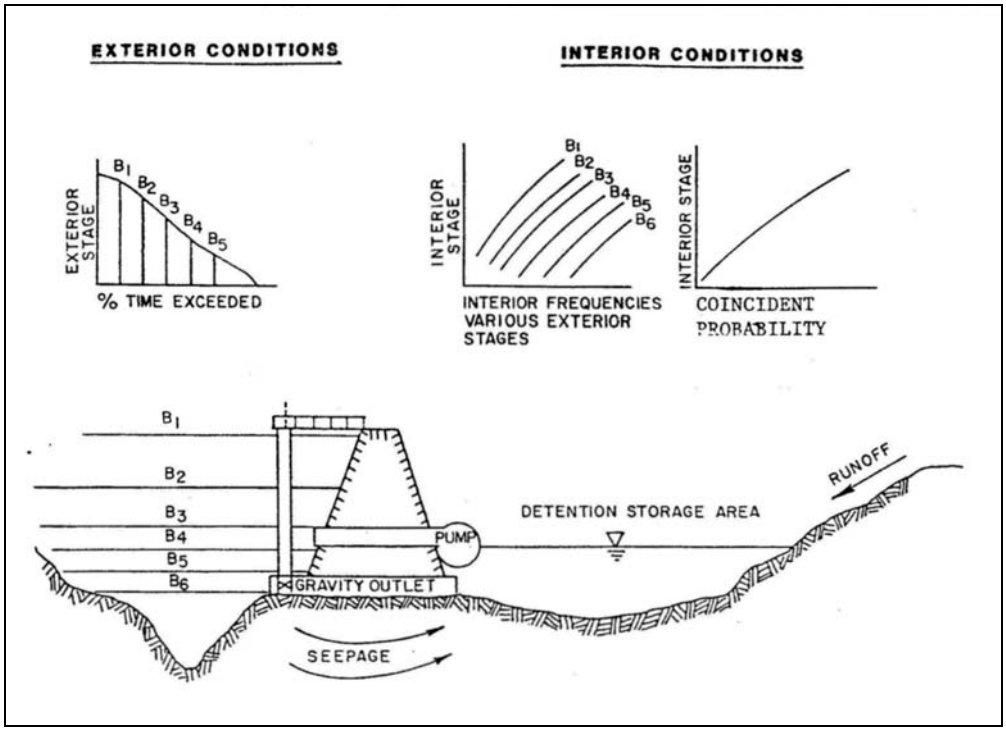

Figure A-4 Depiction of Coincident Frequency Method from Reference 15

At Cedar Rapids the only peak interior stage representing blocked gravity conditions is B1. Two situations were studied, one case was for no pumping and a second was for with-pumping. The "no-pump" case was called B1n and the "with-pump" case was called B1p. Both conditions occur during the interval B1. At Cedar Rapids the intervals B2, B3, B4, and B5 represented gravity flow conditions. For many locations at Cedar Rapids there was no difference in the computed peak interior water surface elevation between HEC-HMS runs using index river stage B4 and index river stage B5. They were identical because the invert elevation of the outlets was higher than the river stage; the discharge capacity for the outlet was by "inlet control" for these index river stages and thus both discharges and stages were identical. Curves B2 through B5 are for gravity conditions and thus the same for "no-pump" or "with-pump" cases.

At Cedar Rapids the curves for the five index river stages were plotted on stage-probability paper (one set for no pumping and another set with-pumping). Then lines were drawn at various random elevations parallel to the frequency axis (x-axis). The frequency of the intersection of this parallel line and B1 curve (Intersection 1) is recorded and multiplied by the duration of the B1 interval (the probability P{B1}). This procedure is followed for all bands (B1 through B5). The total probability or coincident probability is the sum of all these mathematical products {Sum (Intersection1xP(B1) + Intersection2xP(B2) + Intersection3xP(B3) + Intersection4xP(B4) + Intersection5xP(B5)}. The

elevation is the elevation of the parallel line. By repeating this procedure over a range of elevations a single curve is produced. For this study a table instead of a graph is displayed.

ELEVATION-FREQUENCY CURVES FOR EAST BANK INTERIOR AREAS

HEC-HMS East Bank Model

Except for the ring levee alternatives the east side levee alternative essentially follows the left descending bank of the river.

Subbasin Parameters

The subbasins are delineated based on the existing storm sewer layout. The subbasins appear on the map on Plate A-6 accompanied by a schematic of the HEC-HMS model. The runoff from a subbasin (or combination of subbasins) eventually enters the river through an outlet. The identification numbers shown on Plate A-6 for the outlet nodes on the east bank are followed by the letter "E" in this report to distinguish them from the nodes of the west bank outlets. Each outlet can consist of a pond area and a gravity outlet, a pond area and a blocked outlet, or a pond area and a pump depending upon the Cedar River stage and the alternative. All the subbasin areas were measured using the ArcGIS area measuring tool and areas appear in Table A-14.

The impervious percentage for each subbasin was estimated by studying a 2008 aerial photograph from http://maps.live.com/ for the existing condition. Conditions for estimated or induced development were not evaluated. For the east bank, the detail in the photograph was precise enough to estimate the impervious percentage for each block in the subbasin. The total imperviousness for the subbasin was found by computing the average value of all the blocks within a subbasin. Green space was given an impervious percentage of 3. The subbasin impervious values also appear in the table.

The Clark Unit Hydrograph parameters, time of concentration (*Tc*) and storage coefficient (*R*), were estimated using channel length and slope (Reference 10) and also appear in Table A-14. The formulas produce average stream velocities of 1 to 2 feet per second. No adjustment to the equations was made for urbanization.

Table A-14 East Bank Subbasin Parameters

Description	Sub Basin ID	Sub-basin Area (Sq. Mi.)	Impervious Existing (%)	Tc (hr)	R (hr)	Enters Outlet ID
Outlet 1st Ave NE	10	0.03039	94	0.3	0.3	35E
Outlet 2nd Ave SE	20	0.05356	96	0.5	0.5	35E
Outlet 3rd Ave SE	30	0.04493	90	0.4	0.9	35E
Outlet 5th Ave SE	40	0.04393	95	0.3	1.7	45E
Outlet 10th Ave SE	50	0.64523	63	1.1	1.0	55E
12th Ave Se to 9th St Se	60	0.04667	50	0.3	0.5	65E
East of 9th St SE	70	0.14291	35	0.2	0.3	75E

Routing

The diameters, lengths, invert elevations, and locations of the outlets used in the HEC-HMS model appear in Table A-15 with locations shown on Plate A-6. Some existing culverts were combined. On the east bank it was not necessary to upgrade any existing outlets for the minimum facility. In other words, there was no significant flooding at the .01 exceedance frequency during computed gravity conditions.

Table A-15 East Bank Culvert Input

HMS Outlet Node	Culvert Dia. (in.)	Culvert Invert El.	Assigned Length (ft.)
35E 1st Ave NE	30	715	300
35E 2nd Ave SE	30	715	300
35E 3rd Ave SE	36	708	150
45E	42	707.8	150
55E	108	705	250
65E	36	712	150
75E	36	710	150

The HEC-HMS models computed peak water levels landward of the proposed levee during gravity flow conditions. A range of five tailwater elevations were used. HEC-HMS computed routings based upon data describing the culvert (diameter, invert elevation, entrance and exit losses, n-value, and length). The peak interior pond elevation computations also required elevation-area tables landward of the levee. The pond areas represent the interior surface topography and do not include excavated storage basins. For the east bank model, the subbasins 10, 20 and 30 were combined into a single pond area. Other subbasins each had their own separate elevation-area table. The elevation-area tables appear in Table A-16.

Table A-16 East Bank Outlet Pond Elevation-Area Data

Elev. Pond 35E (feet)	Area Pond 35E (acres)		Elev. Pond 45E (feet)	Area Pond 45E (acres)		Elev. Pond 55E (feet)	Area Pond 55E (acres)
708.0	0.01		707.0	0.0000		710.0	0.01
722.0	0.01		719.8	0.0001		717.0	0.50
724.0	2.95		722.0	1.33		718.0	2.36
726.0	12.84		724.0	18.60		720.0	31.00
728.0	21.85		726.0	27.50		722.0	46.00
730.0	30.21		728.0	28.12		724.0	77.00
740.0	54.90		740.0	28.12		730.0	128.18
						740.0	200.00

Elev. Pond 65E (feet)	Area Pond 65E (acres)		Elev. Pond 75E (feet)	Area Pond 75E (acres)
712.0	0.01		710.0	0.1
715.5	0.01		713.5	0.1
716.0	0.50		714.0	0.3
718.0	5.91		716.0	1.0
720.0	19.41		718.0	4.8
722.0	26.52		720.0	9.0
734.0	29.87		722.0	31.4
740.0	29.87		732.0	49.5
			742.0	54.2

In addition to HEC-HMS gravity runs, two series of runs were made using another model that simulated blocked gravity conditions. These computations used the 24-hour synthetic storm duration. The one day time period was considered representative of normal blocked gravity conditions based on historic data. In the first series, the “no pump” case, the model had no pump discharge and thus no outflow. In the second series, the “with-pump” case, the model contained a pump sized to handle the 3-month synthetic 24-hour storm (Huff 2nd quartile). These models likewise used the initial loss of 1.3 inches and the hourly loss of 0.2 inch per hour. The pump-on elevation was determined by finding the

elevation where about one acre of the interior was flooded. At the time of this work the elevation for the start of damages was not known. The total capacities for the east bank pumps stations appear in Table A-17. The locations are shown on Plate A-7. For Alternative 1 it was assumed that Cedar Lake would act as a storage reservoir without the need for a pump in this area. For Alternatives 1, 1A, 4 and 7 and 10 it was assumed that the existing pump capacity used by Quaker is adequate.

Table A-17 East Bank Pump Capacities

HMS Model	HEC-HMS Outlet Node	Pump size (gpm)	Pump on Elev.	Pump off Elev.
East	35E	5,000	723.0	722.0
East	45E	1,500	721.5	719.8
East	55E	15,000	717.6	716.0
East	65E	500	715.0	713.0
East	75E	1,500	716.0	711.0

Model Results

The peak interior water levels were computed at each gravity outlet selected as a potential pump site. Computations were made to simulate conditions of blocked gravity flow with no pumping and blocked gravity flow with pumping along with several conditions of gravity flow. The output tables for computed peak interior stages appear on Plate A-8 and Plate A-9.

Two different runs were made for the interval of time that blocked gravity conditions occur (interval B1). The first set of runs computed peak stages (B1n) with outlets closed and no pumping. The second set of runs computed peak stage (B1p) with outlets closed and pumps running. The blocked gravity HEC-HMS runs used storm duration of 24-hour synthetic.

The computations for gravity flow were made for four tailwater conditions (B2, B3, B4, and B5). These computations used a 6-hour synthetic storm duration.

Interior Elevation-Frequency Data for East Bank

This section of the report discusses the computation of the peak interior water surface elevation-frequency curves at potential pump stations on the east bank. The coincident frequency method discussed earlier was used to combine synthetic elevation-frequency curves computed for various time durations into one peak interior stage-frequency curve.

Stage Duration at Outlet

Since the water surface profile of the Cedar River slopes through town; it was necessary to compute individual stage-duration curves for each potential pump station. The duration values for flood discharges with exceedance probabilities of 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.005 and 0.002 were determined from the discharge duration analysis and plotted against computed water surface elevations (HEC-RAS). The resulting stage-duration plots were used to determine the five index river stages and the associated probabilities for each index river stage. Stage duration plots for the coincident frequency method have an x-axis with values that range from 0 to 1. In the analysis at Cedar Rapids only the higher stages influence outflow. Detailed plots with an x-axis that ranges from 0 to 0.04 covered this region of concern. These plots appear on Plate A-10. Water levels for the region not shown in the plot result in the same outflow discharge and have been combined into one large probability interval. The intervals of the five segments (these values represent the probability of the interval) and the index river stage for the intervals appear in Table A-18. In addition to the index

(representative) stage, the stages that define the limits of the band (upper and lower) are also listed. Interval B1 represents blocked gravity conditions where the gravity outlet is closed. The gravity outlet gate closure elevation was based upon the ground elevation from contour maps along with engineering judgment.

Table A-18 East Bank Tailwater Index Values and Probability of Occurrence

HMS site	35E	45E	55E	65E	75E
Closure Elev.	718.25	717	713	715	715
B1 upper limit	730+	730+	730+	730+	730+
B1 lower limit	718.25	716.96	713	715	715
B1 index	Blocked	Blocked	Blocked	Blocked	Blocked
B1 probability	0.001337	0.001337	0.008600	0.002100	0.00111
B2 upper limit	718.25	716.96	713	715	715
B2 lower limit	715.69	714.42	712	714	714
B2 index	717	715.7	712.5	714.5	714.5
B2 probability	0.002037	0.002037	0.004100	0.000750	0.000740
B3 upper limit	715.69	714.42	712	714	714
B3 lower limit	713.7	712.7	711	713	713
B3 index	714.7	713.7	711.5	713.5	713.5
B3 probability	0.007326	0.006626	0.003550	0.002150	0.001050
B4 upper limit	713.7	712.7	711	713	713
B4 lower limit	711.7	710.48	710	712	712
B4 index	712.7	711.7	710.5	712.5	712.5
B4 probability	0.008200	0.008082	0.016667	0.003000	0.00160
B5 upper limit	711.7	710.48	710	712	712
B5 lower limit	705.3	704.4	704	703	702
B5 index	711.7	708	708	712	710
B5 probability	0.981100	0.987978	0.967083	0.992000	0.99550

Final Interior Water Level-Frequency Curves for Outlets "No Pump"

The peak interior water surface elevations were computed for synthetic storms with exceedance probabilities of 0.9999, 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, and 0.002 at each gravity outlet identified as a potential pump site. Five conditions were evaluated; B1 represented the blocked gravity condition while B2 through B5 represented various tailwater stages at gravity flow conditions.

The first interval (B1) represented blocked gravity with no pumping. The actual HEC-HMS model to evaluate interval (B1) included pumps but the pump capacities were all set at zero. Four tailwater values (B2 through B5 in Table A-18) were used to compute families of curves using the HEC-HMS gravity flow model. For many of the computations there was no difference in maximum interior water surface elevation between models using index river stages B4 and B5. They are identical because the invert elevations of the outlets are higher than the river stages and flow is inlet controlled for these index river stages. For a summary of computed peak interior elevations, see columns B1n (no pump) through B5 on Plate A-8 and Plate A-9.

These data were plotted on stage-probability paper so that the frequencies of all interior water surface elevations could be read from the graph. The five peak interior water surface elevation-frequency curves were combined into one peak interior stage-frequency curve using total probability theorems outlined in Reference 15. The frequency of various interior water surface elevations were multiplied by the probability of the various index river stages and then summed. A sample computation appears in Reference 15. Final results for the minimum facility at all east bank pond areas are summarized in Table A-19.

Table A-19 East Bank Interior Stage Frequency Data for Minimum Facility (no pump)

Interior Pond 35E Elev. (ft)	Exceedance Probability		Interior Pond 45E Elev. (ft)	Exceedance Probability		Interior Pond 55E Elev. (ft)	Exceedance Probability
712.0	1.00000		709.7	1.00000		709.1	1.00000
714.1	0.31323		711.0	0.03281		710.7	0.30370
715.9	0.09099		711.7	0.01955		711.7	0.10579
717.3	0.02296		711.8	0.01502		712.6	0.05152
718.0	0.01061		712.8	0.01001		714.0	0.01957
719.0	0.00430		713.6	0.00669		715.0	0.01159
720.0	0.00204		715.0	0.00338		715.6	0.01007
721.0	0.00150		715.6	0.00236		720.6	0.00860
722.0	0.00134		716.6	0.00134		720.9	0.00688
725.8	0.00134		722.5	0.00134		721.0	0.00430
726.2	0.00067		722.7	0.00064		721.2	0.00344
726.4	0.00040		722.8	0.00045		721.4	0.00258
726.6	0.00020		723.0	0.00020		722.4	0.00043

Table A-19 East Bank Interior Stage Frequency Data for Minimum Facility (no pump), continued

Interior Pond 65 Elev. (ft)	Exceedance Probability		Interior Pond 75 Elev. (ft)	Exceedance Probability
713.5	1.00000		711.6	1.00000
714.0	0.50143		712.6	0.47239
714.6	0.16239		713.6	0.16247
715.0	0.07700		714.6	0.05684
715.5	0.03204		715.6	0.02370
716.0	0.00809		716.6	0.00513
716.5	0.00235		717.0	0.00262
717.1	0.00210		717.5	0.00151
717.4	0.00105		718.1	0.00111
717.7	0.00068		718.5	0.00056
718.0	0.00042		719.0	0.00022
718.25	0.00011		719.6	0.00010

Final Interior Water Level-Frequency Curves for Outlets "With-Pump"

A similar procedure to the "no pump" case was used to evaluate the "with-pump" case except this HEC-HMS model used pump capacities listed in Table A-17 to compute peak interior water levels for the B1 interval. The computed peak interior stages appear in the "B1p w/pump" column on Plate A-8 and Plate A-9. These data were plotted on stage-probability paper so that the frequency of various interior water surface elevations could be determined and combined using the total probability method. See Table A-20 for the final results of the "with-pump" case at potential sites.

Table A-20 East Bank Interior Stage Frequency Data for With-Pump Alternative

Interior Pond 35E Elev. (ft)	Exceedance Probability		Interior Pond 45E Elev. (ft)	Exceedance Probability		Interior Pond 55E Elev. (ft)	Exceedance Probability
712.0	1.00000		709.7	1.00000		709.1	1.00000
714.1	0.31706		711.0	0.03281		710.7	0.30370
715.9	0.09267		711.7	0.01955		711.7	0.10579
717.3	0.02311		711.8	0.01502		712.6	0.05152
718.0	0.01068		712.8	0.01001		714.0	0.01957
719.0	0.00433		713.6	0.00669		715.0	0.01159
720.0	0.00205		715.0	0.00338		715.6	0.01007
721.0	0.00151		715.6	0.00236		718.5	0.00860
722.0	0.00134		716.6	0.001343		719.4	0.00370
724.1	0.00134		722.1	0.00134		720.0	0.00215
724.4	0.00080		722.2	0.00064		720.6	0.00077
724.6	0.00042		722.25	0.00045		721.2	0.00034
724.9	0.00023		722.3	0.00020		721.8	0.00017

Table A-20 East Bank Interior Stage Frequency Data for With-Pump Alternative, continued

Interior Pond 65E Elev. (ft)	Exceedance Probability		Interior Pond 75E Elev. (ft)	Exceedance Probability
713.5	1.00000		711.6	1.00000
714.0	0.50143		712.6	0.47239
714.6	0.16239		713.6	0.16247
715.0	0.07700		714.6	0.05684
715.5	0.03204		715.6	0.02370
716.0	0.00809		716.6	0.00513
716.4	0.00260		717.0	0.00259
716.6	0.00199		717.5	0.00092
716.7	0.00105		717.7	0.00067
717.0	0.00068		718.1	0.00028
717.2	0.00042		718.5	0.00017
718.0	0.00011		718.85	0.00010

The residual interior flood elevations for the 0.01 exceedance probability event at the various sites appear in Table A-21. The results are similar for the "no pump" case and the "with-pump" case because the probability of B1 (blocked conditions) is so small for Cedar Rapids. At flood projects on the Mississippi River blocked gravity conditions occur much more frequently, about 10 percent of the time (or a probability of 0.1). At Cedar Rapids the difference between no pumping and pumping is not apparent except for large, infrequent events with an exceedance probability smaller than 0.002. This trend is confirmed by a study of the historic data. The only significant area flooded by the 0.01 exceedance probability event for the east basins is within subbasin 75E. The area of flooding for this subbasin has been superimposed over a photograph of the area and appears on Plate A-11.

Table A-21 East Water Surface Elevations for 0.01 Exceedance Probability Interior Flood

Pond 35E Elev. (ft)	Pond 45E Elev. (ft)	Pond 55E Elev. (ft)	Pond 65E Elev. (ft)	Pond 75E Elev. (ft)
718.0	712.8	715.6	715.9	716.3

Pumps at all pump sites will be used infrequently and, therefore proposed pumps were designed on concrete pads as opposed to traditional pump facility buildings. Although existing storm sewer capacity is small for Alternative 4C the city streets running perpendicular to the river quickly convey runoff down to the river. Only pumping during blocked gravity will lower the residual water level. Justification of pumping should also consider maintaining city services during the rare periods of blocked gravity flow in addition to economic theory.

ELEVATION-FREQUENCY CURVES FOR WEST BANK INTERIOR AREAS

HEC-HMS West Bank Model

The evaluation of interior flood elevations is based upon the West Setback Option (Alternative 1).

Subbasin Parameters

The subbasins were delineated based on existing stream and storm sewer paths. The subbasin map for the west bank appears on Plate A-12, while the HEC-HMS schematic is shown on Plate A-13. Runoff from each subbasin (or combination of subbasins) eventually enters the Cedar River through an outlet. The names (numbers) shown on Plate A-12 of the outlet nodes on the west bank area are followed by the letter "W" to distinguish them from the east bank outlets. Each outlet can consist of: a pond area and a gravity outlet, a pond area and a blocked gravity outlet, or a pond area and a pump depending upon the Cedar River stage and the alternative being modeled. All the subbasin areas were measured using the Arc GIS area measuring tool and appear in Table A-22.

Table A-22 West Bank Basin Parameters

Description	HMS Basin ID	Sub-basin Area (sq. mi.)	Impervious Existing (%)	Tc (hr)	R (hr)	Enters Outlet ID
Tributary basin along Ave. O into interior area 17	10	1.0946	25	1.8	1.1	19W
Riverfront interior north outlet at Ave. N	17	0.2893	40	1.0	1.9	19W
Tributary basin along Ave. F flows into interior area 26	20	2.7798	35	2.7	1.8	33W
Riverfront interior north central outlet near I-380	26	0.7394	45	1.0	2.0	33W
Tributary basin along 1st Ave. into interior area 26	30	0.8520	45.0	1.6	1.1	33W
Area around Jefferson High School flows into area 42	40	1.0209	45.0	1.6	1.3	44W
Riverfront interior central outlet near 3rd Ave SW	42	0.5357	55.0	1.2	1.5	44W
Adjacent to river 6th Ave SW to A St	50	0.0924	75	0.4	2.0	55W
Area around 6th St. to 13th St. flows into area 62	60	1.0291	45	0.9	1.0	64W
Riverfront interior south central outlet near 12th Ave. SW	62	0.2184	55	1.4	2.6	64W
Mallory St. bluffs into interior area 72	70	0.3057	45	0.7	0.8	75W
Riverfront interior south outlet at 21st Ave. SW	72	0.0933	35	0.2	0.5	75W

The impervious percentages for the subbasins were estimated by viewing 2008 aerial photographs from a website at http://maps.live.com/. West bank subbasins were larger than those of the east bank and impervious values were determined by sampling representative areas within the subbasin. Time of concentration (*Tc*) and storage coefficient (*R*) values were estimated using channel length and slope (Reference 10) and appear in Table A-22. The formulas produce average stream velocities of 1 to 2 feet per second. No adjustment to *Tc* was made for urbanization.

Routings

The diameters, invert elevations, lengths, and location descriptions of outlets used in the HEC-HMS model appear in Table A-23. Approximate locations are noted in Plate A-12. Outlet information for 55W does not exist, therefore, sensitivity runs were performed to determine an appropriate size. The remaining outlet data were furnished by City of Cedar Rapids. The size of the 19W outlet was increased from one to two 4.5' x 10' box culverts for the minimum facility because the existing culvert resulted in residual flooding at the 0.01 exceedance probability level.

Table A-23 West Bank Culvert Input

HMS Node Location description	Culvert Dimension (ft.)	Culvert Invert El. (ft.)	Assigned Length (ft.)
Existing = 19W Parallel to N Ave. NW	4.5H 10W	715.84	670
Min facility =19W Parallel to N Ave. NW	Two 4.5H 10W	715.84	670
33W Outlet downstream I-380 Br.	11H 13W	703.29	950
44W Outlet downstream 3rd Ave. Br.	6 Dia.	708.34	270
44W Parallel to 4th Ave SW	6.83H 8W	705.07	330
55W Outlet downstream 8th Ave. Br.	3 Dia.	704.00	160
64W Outlet downstream 12th Ave Br.	6 Dia.	702.76	75
64W Outlet downstream 12th Ave Br.	7 Dia.	704.51	80
75W Parallel to 21st Ave. SW	7 Dia.	702.99	209

HEC-HMS models determined peak water levels landward of the proposed levee for gravity flow conditions. A range of five tailwater elevations were used. For the gravity flow models the outlet was the existing culvert outlet diameter with a culvert length from levee to river. HEC-HMS computed routings based upon data describing the culvert (diameter, invert elevation, entrance and exit losses, n-value, and length). The peak interior pond elevation computations also required elevation-area tables for the storage landward of the levee. The elevation-area tables, seen in Table A-24, have generally been rounded to the nearest tenth acre.

Table A-24 West Bank Outlet Pond Elevation-Area Data

Elev. Pond 19W (ft)	Area Pond 19W (ac)		Elev. Pond 33W (ft)	Area Pond 33W (ac)		Elev. Pond 44W (ft)	Area Pond 44W (ac)
716.2	0.00		703.8	0.00		705.2	0.000
718.0	0.007		704.0	0.003		706.0	0.001
720.0	0.008		706.0	0.004		708.0	0.002
722	0.16		710.0	0.035		710.0	0.005
724	3.3		712.0	0.04		712.0	0.01
726	37.1		714.0	0.045		714.0	0.02
728	66.0.		715.0	0.05		716.0	0.03
730	86.9		716.0	0.055		718.0	0.04
732	98.5		718.0	0.06		720	0.20
734	110.8		720.0	0.13		722	2.5
738	125.4		722.0	1.5		724	22.8
744	137.9		724.0	32.9		726	62.6
750	147.3		726.0	88.8		728	106.9
			728.0	146.8		730	170.1
			730.0	205.1		732	203.3
			732.0	256.6		734	221.6
			738.0	318.6		736	236.2
			744.0	346.8		738	245.3
			750.0	373.7		744	266.4
						750	287.1

Table A-24 West Bank Outlet Pond Elevation-Area Data, continued

Elev. Pond 19W (ft)	Area Pond 19W (ac)		Elev. Pond 33W (ft)	Area Pond 33W (ac)		Elev. Pond 44W (ft)	Area Pond 44W (ac)
704.6	0.000		702.8	0.00		703.2	0.0000
705.0	0.006		704.0	0.005		704.0	0.006
706.0	0.0065		706.0	0.006		706.0	0.007
708.0	0.007		708.0	0.007		710.0	0.0075
710.0	0.0075		710.0	0.008		712.0	0.008
712	0.3		712.0	0.009		714.0	0.03
714	1.9		714.0	0.04		716	0.80
716	5.7		716	1.8		718	11.1
718	9.3		718	8.0		720	21.8
720	12.8		720	14.5		722	28.6
722	15.2		722	22.7		724	39.0
724	18.9		724	33.6		726	79.4
726	22.4		726	63.8		728	113.3
728	29.3		728	98.8		730	121.2
730	41.1		730	152.6		732	125.7
732	52.2		732	206.4		734	130.1
734	58.4		734	230.9		736	134.2
736	58.9		736	246.0		738	137.4
738	59.0		738	257.2		744	144.8
750	59.01		744	279.8		750	151.8
			750	296.5			

In addition to gravity runs, two series of runs were made using an HEC-HMS model that simulated blocked gravity conditions. These computations used the 24-hour synthetic storm duration. The one day time period was considered representative based on an examination of historic data. In the first series, the "no pump" case, the model had no pump discharge and thus no outflow. In the second series, the "with-pump" case, the model had a pump sized to discharge the 3-month synthetic 24-hour storm (Huff 2nd quartile). These models also used the initial loss of 1.3 inches and the hourly loss of 0.2 inch per hour. The pump-on elevation was determined by finding the elevation where about one acre of the interior was flooded. The total pump capacity used for each west pump site appears in Table A-25 with locations shown on Plate A-7.

Table A-25 West Bank Pump Capacities

HMS Model	HEC-HMS Node	Pump size (gpm)	Pump on Elev.	Pump off Elev.
West	19W	13,500	724.3	723.2
West	33W	54,000	722.4	721.4
West	44W	24,000	722.4	721.9
West	55W	1,500	714.4	713.5
West	64W	17,000	716.3	715.4
West	75W	6,000	717.5	715.9

Model Results

The maximum interior water level was computed at each gravity outlet selected as a potential pump site. Computations were made to simulate blocked gravity flow with no pump, blocked gravity flow

with a pump, and several gravity flow conditions. The computed peak interior stages appear on Plate A-14 and Plate A-15.

Two different runs were made for the interval of time that blocked gravity conditions occur (interval B1). The first set of runs computed peak stages (B1n) with outlets closed and no pumping. The second set of runs computed peak stages (B1p) with outlets closed and pumps running. The blocked gravity runs used the 24-hour storm duration.

The computations for gravity flow were made for four tailwater conditions (B2, B3, B4 and B5). These computations used the 6-hour synthetic storm duration.

Interior Elevation-Frequency Data for West Bank

This section of the report discusses the computation of the peak interior water surface elevation-frequency curves at potential pump stations on the west bank. The coincident frequency method discussed earlier was used to combine synthetic elevation-frequency curves computed for various time durations into one peak interior stage-frequency curve.

Stage Duration at Outlets

Since the water surface profile of the Cedar River slopes through town, it was necessary to compute stage-duration curves at each potential pump station. The duration values for flood discharges with exceedance probabilities of 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.005 and 0.002 were determined from the discharge duration analysis and plotted against computed water surface elevations for these same discharges using HEC-RAS. The resulting stage-duration plots were used to determine the five index river stages and the associated probabilities for each index river stage. Stage duration plots for the coincident frequency method range from 0 to 1. In the analysis at Cedar Rapids only the higher stages influence outflow. Detailed plots from 0 to 0.04 cover the region of concern and these plots appear on Plate A-16. Water levels for the region not shown in the plot result in the same outflow discharge and have been combined into one large probability interval. The intervals of the five segments (these values represent the probability of the interval) and the index river stage for the intervals appear in Table A-26. In addition to the index (representative) stage, the stages that define the limits of the band (upper and lower) are also listed. Interval B1 represents blocked gravity conditions where the gravity outlet is closed. The gravity outlet gate closure elevation was based upon the ground elevation from contour maps along with engineering judgment.

Table A-26 West Bank Tailwater Index Values and Probability of Occurrence

HMS site	19W	33W	44W	55W	64W	75W
Closure Elev.	723.7	720	721.18	715	715	716
B1 upper limit	730+	730+	730+	730+	730+	730+
B1 lower limit	723.7	720	721.18	715	715	716
B1 index	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
B1 probability	0.00051	0.00095	0.00051	0.00285	0.00285	0.00134
B2 upper limit	723.7	720	721.18	715	715	716
B2 lower limit	722.7	719	720	714	714	715
B2 index	723.2	719.5	720.6	714.5	714.5	715.5
B2 probability	0.00024	0.0003	0.00031	0.00207	0.00207	0.00086
B3 upper limit	722.7	719	720	714	714	715
B3 lower limit	721.7	718	718	713	713	714
B3 index	722.2	718.5	719	713.5	713.5	714.5
B3 probability	0.00025	0.00075	0.00051	0.00373	0.00373	0.00090
B4 upper limit	721.7	718	718	713	713	714
B4 lower limit	719.3	716	715.5	710.5	710.5	712
B4 index	720.6	717	716.8	711.75	711.75	713
B4 probability	0.00237	0.0023	0.00204	0.00943	0.00943	0.00570
B5 upper limit	719.3	716	715.5	712	712	712
B5 lower limit	709	706	705	704	704	703
B5 index	718	714	713.5	710	710	710
B5 probability	0.99663	0.9957	0.99663	0.98192	0.98192	0.99120

Final Interior Water Level-Frequency Curves for Outlets "No Pump"

The peak interior water surface elevations were computed for synthetic storms with exceedance probabilities of 0.9999, 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, and 0.002 at each gravity outlet identified as a potential pump site. Five conditions were evaluated; B1 represented the blocked gravity condition while B2 through B5 represented various tailwater stages for gravity flow conditions.

The first interval (B1) represented blocked gravity with no pumping and was used to evaluate the minimum facility condition. EM 1110-2-1413 defines the minimum facility as the starting point from which additional enhancements like pumps will be incrementally justified (Reference 15). The minimum facility aims to create a response at the site with the proposed levee that is similar to the response at the site without the proposed levee in place. For this case the HEC-HMS model was set up with pumps but then the pump capacity was set at zero. Four tailwater values (B2 through B5 in Table A-26) were used to compute families of curves using the HEC-HMS gravity flow model. For many of the computations there was no difference in the peak interior water surface elevation between models using index river stages B4 and B5. They are similar because the invert elevations of the outlets are higher than the river stages and flow is inlet controlled for these index river stages. For a summary of computed peak interior elevations, see columns B1n (no pump) through B5 on Plate A-14 and Plate A-15.

These data were plotted on stage-probability paper so that the frequencies of all interior water surface elevations could be read from the graph. The five peak interior water surface elevation-frequency curves were combined into one peak interior stage-frequency curve using total probability theorems

outlined in Reference 15. The frequency of various interior water surface elevations were multiplied by the probability of the various index river stages and then summed. A sample computation appears in Reference 15. Final results for the minimum facility at all west bank pond areas are summarized in Table A-27.

Table A-27 West Bank Interior Stage Frequency Data for Minimum Facility (no pump)

Interior Pond 19W Elev. (ft)	Exceedance Probability		Interior Pond 33W Elev. (ft)	Exceedance Probability		Interior Pond 44W Elev. (ft)	Exceedance Probability
718.4	1.00000		714.1	1.00000		713.7	1.000000
720.7	0.08808		717.1	0.00500		717.0	0.025296
721.8	0.04606		718.6	0.00203		719.2	0.007391
722.8	0.02982		719.6	0.00128		720.8	0.003079
723.8	0.01657		721.0	0.00096		722.0	0.000663
724.2	0.01154		724.3	0.00095		724.0	0.000515
724.4	0.00953		726.6	0.00095		724.4	0.000512
725.0	0.00402		727.3	0.00048		725.0	0.000510
725.6	0.00202		727.6	0.00036		725.6	0.000510
726.3	0.00091		728.0	0.00024		725.8	0.000510
727.0	0.00028		728.2	0.00015		726.4	0.000224
727.1	0.00018		728.8	0.00010		726.9	0.000102

Table A-27 West Bank Interior Stage Frequency Data for Minimum Facility (no pump), continued

Interior Pond 55W Elev. (ft)	Exceedance Probability		Interior Pond 64W Elev. (ft)	Exceedance Probability		Interior Pond 75W Elev. (ft)	Exceedance Probability
710.2	1.00000		710.2	1.00000		710.1	1.00000
712.0	0.03772		711.9	0.10645		712.1	0.02169
712.5	0.01979		713.7	0.03370		713.1	0.01227
713.0	0.01305		714.7	0.01942		714.1	0.00405
713.5	0.01031		716.0	0.00917		714.6	0.00354
714.0	0.00660		718.0	0.00341		715.1	0.00250
714.5	0.00518		718.8	0.00297		715.6	0.00228
715.3	0.00300		722.2	0.00285		717.1	0.00134
715.8	0.00288		723.0	0.00211		718.7	0.00134
716.5	0.00097		724.0	0.00077		719.3	0.00060
716.9	0.00040		725.0	0.00027		719.9	0.00027
717.4	0.00019		726.1	0.00010		720.5	0.00010

Final Interior Water Level-Frequency Curves for Outlets "With Pump"

A similar procedure to the "no pump" case was used to evaluate the "with-pump" case except the HEC-HMS model used the pump capacities from Table A-25 to compute peak interior water elevations for the B1 interval. The computed peak interior stages appear in the "B1p w/pump" column on Plate A-14 and Plate A-15. These data were plotted on stage-probability paper so that frequency of various interior water surface elevations could be determined and combined using the total probability method. See Table A-28 for the final results for the "with-pump" case at potential sites.

Table A-28 West Bank Interior Stage Frequency Data for Pump Alternative

Interior Pond 19W Elev. (ft)	Exceedance Probability		Interior Pond 33W Elev. (ft)	Exceedance Probability		Interior Pond 44W Elev. (ft)	Exceedance Probability
718.4	1.00000		714.1	1.00000		713.7	1.000000
720.7	0.08808		717.1	0.00500		717.0	0.025296
721.8	0.04606		718.6	0.00203		719.2	0.007391
722.8	0.02982		719.6	0.00128		720.8	0.003079
723.8	0.01657		721.0	0.00096		722.0	0.000663
724.2	0.01154		724.3	0.00095		724.0	0.000515
724.4	0.00953		725.0	0.00086		724.2	0.000508
725.0	0.00400		725.4	0.00047		724.4	0.000471
725.6	0.00174		725.8	0.00036		724.8	0.000225
726.3	0.00052		726.3	0.00024		725.2	0.000143
726.8	0.00025		726.9	0.00015		725.5	0.000102
727.0	0.00015		727.3	0.00010			

Table A-28 West Bank Interior Stage Frequency Data for Pump Alternative, continued

Interior Pond 55W Elev. (ft)	Exceedance Probability		Interior Pond 64W Elev. (ft)	Exceedance Probability		Interior Pond 75W Elev. (ft)	Exceedance Probability
710.2	1.00000		710.2	1.00000		710.1	1.00000
712.0	0.03772		711.9	0.10645		712.1	0.02169
712.5	0.01979		713.7	0.03370		713.1	0.01227
713.0	0.01305		714.7	0.01942		714.1	0.00405
713.5	0.01031		716.0	0.00917		714.6	0.00354
714.0	0.00660		718.0	0.00341		715.1	0.00250
714.5	0.00518		718.8	0.00297		715.6	0.00228
715.3	0.00271		720.4	0.00143		717.1	0.00134
715.8	0.00106		723.0	0.00211		717.5	0.00127
716.2	0.00058		721.6	0.00077		718.1	0.00060
716.6	0.00024		723.1	0.00027		718.6	0.00027
717.0	0.00011		724.7	0.00010		719.5	0.00010

The residual interior flood elevations for the 0.01 exceedance probability event at the various sites appear in Table A-29. The results are similar for the "no pump" case and the "with-pump" case because the probability of interval B1 is so small for Cedar Rapids. At Cedar Rapids the difference between no pumping and with pumping is not apparent except for large, infrequent events with an exceedance probability smaller than 0.002. This trend agrees with the study of historic data. If the existing outlet at 19W is used with the proposed levee the resulting interior 0.01 exceedance probability flood is elevation 726.5 feet and floods about 49 acres. Since the proposed levee results in increased flooding over the gravity condition the outlet was increased for the minimum facility condition. The minimum facility 0.01 exceedance probability flood level is lower and appears in Table A-29. This improvement results in only about 3 acres being flooded which are mostly roads. Another flooded subbasin is 64W; the location and area of flooding is shown on Plate A-17. For outlet locations see Plate A-12 which also shows subbasins.

Table A-29 West Water Surface Elevation for 0.01 Exceedance Probability Interior Flood

Pond 19W Elev. (ft)	Pond 33W Elev. (ft)	Pond 44W Elev. (ft)	Pond 55W Elev. (ft)	Pond 64W Elev. (ft)	Pond 75W Elev. (ft)
724.4	716	718.6	713.5	715.9	713.3

Pumps at all pump sites will be used infrequently and, therefore proposed pumps were designed on concrete pads as opposed to pump facility buildings. Creeks and storm sewer capacity on the west bank may limit peak discharge but city streets running perpendicular to the river convey runoff down to the river. Only pumping during blocked gravity will lower the residual water level. Justification of pumping should also consider maintaining city services during the rare periods of blocked gravity flow in addition to economic theory.

HYDRAULICS

Water Surface Profile Models and Datum

The Existing Condition model (Without-project) simulates the conditions along the river for year 2009.

None of the alternatives evaluated at this point in the study involve dredging, channel bypass, bridge improvement or bridge replacement. Thus all the levee alternatives were built from the same without-project HEC-RAS model. They all had the same effective flow area, same roughness values, same bridges and same existing dams as the without-project model.

Each alternative differed as to levee alignment. Levees were located in the flood fringe area on the overbank (or overbanks) depending upon the alternative. None of the levees in any of the alternatives encroached upon the floodway determined using the .01 exceedance probability discharge and the without-project HEC-RAS model. All proposed levees were modeled in HEC-RAS using the levee feature.

Several HEC-RAS models were created to evaluate alternatives. The Rivers Edge model simulated proposed levees that run along both east and west river banks of Cedar Rapids. This alternative was eliminated from consideration at the beginning of the study. The West Setback model (Alternative 1 see figure in Main Report) simulates a proposed levee on the west bank that is setback upstream of Mays Island while the levee on the east bank remains next to the river bank. Later, additional models were added to evaluate new alternatives.

The modified West Setback model (Alternative 1A see figure in Main Report) simulates a proposed levee on the west bank that is setback upstream of Mays Island while the levee on the east bank remains next to the river bank but does not extend as far upstream as Alternative 1. The West Levee Only model simulates a proposed levee on the west bank with no levee on the east bank. This alternative was also eliminated from consideration during the study. The East Levee Only model simulates a proposed levee on the east bank with no levee on the west bank (Alternative 4 see figure in Main Report).). Models were also created to model several ring levees on the east bank. Alternative 5 (not shown in Main Report) simulates a proposed ring levee around economic damage Reach 5C (see Plate A-1) on the east bank of the lower downtown area. Alternative 7 (not shown in Main Report) simulates a proposed ring levee around economic damage Reach 4B (see Plate A-1) on the east bank of the upper downtown area. Alternative 10 (see Main Report) contained the ring levee of Alternative 5 and the ring levee of Alternative 7. The ring levee Alternatives 5 and 7 were removed from consideration

All models were developed using HEC-RAS Version 4.0.0 (Reference 11). Eight water surface profiles were computed for several purposes including use in the Flood Damage Analysis program (HEC-FDA). The exceedance probabilities for the discharges used to compute the water surface profiles were 0.50, 0.20, 0.10, 0.04, 0.02, 0.01, 0.005, and 0.002.

Topographic mapping accuracy depended upon the location of the cross section. Within the downtown area of Cedar Rapids, 2-foot contour interval mapping was available to construct cross sections, while outside the city 5-foot contour interval mapping existed to construct cross sections. Topographic mapping from 2005 was provided by the city in GIS format. The projection of these data is NAD 1983 while the elevation is in NAVD 88 datum.

River bottom elevations between the left and right banks were surveyed during June and November of 2008 by Corps of Engineers hydrographic survey. Over-bank elevations were obtained from the GIS data provided by the City of Cedar Rapids. All data were geo-referenced and the model built with the cross sections looking downstream. Bridge data were furnished by the City of Cedar Rapids, the State of Iowa Department of Transportation, and the Corps of Engineers Survey Branch augmented by field observations and photographs.

HEC-RAS Model Development

The Cedar River models begin at cross section 79.38 located about 200 feet downstream of the twin bridges of Highway 30. Cross-section numbers are determined by adding the distance between cross sections, in feet, to the downstream cross-section number. The study model simulates about 14 miles of river. It ends upstream of Edgewood Road bridge at cross section 75,651.64 located above the City of Cedar Rapids. The model was prepared from 92 surveyed channel sections. The existing condition Cedar River modeling and mapping was completed in 2009. The blocked obstruction feature was used in the overbank. This option removes, or blocks out, the cross-sectional area of structures in the overbanks from the total cross-sectional area available for conveying water. The existing condition HEC-RAS model was then modified by adding left and right bank encroachments to simulate the various levee alternatives. Table A-30 summarizes the common features of the HEC-RAS models.

The split flow option was used for discharges passing on the east and west side of Mays Island. This involved 10 cross-sections (cross-section numbers 53001 through 54749); the island and cross-sections are shown on Plate A-24. The reaches were named east and west respectively. For the without-project case and for each alternative new discharges were determined around the island using the flow optimization feature in HEC-RAS. Once the discharges were optimized and showed good agreement the optimization was disabled and the discharges entered in the respective alternative in the same manner as the other discharges.

Table A-30 Summary of HEC-RAS Model

Feature	Stream Cedar River
Stream length first to last excluding split flow	75,572 feet
Number of reaches	4
Number of cross sections	138
Number of bridges including all reaches	20
Channel "n"-value	0.019-0.057
Overbank "n"-value	0.074-0.148

Known (specified) starting water surface elevations were used in all HEC-RAS models to produce profiles representative of the two observed flood events. These events included the largest flood of 2008 and a lesser flood of 1993. The starting conditions of the model have a minor influence on computed water levels within downtown Cedar Rapids. Cross-section locations appear on Plate A-18 through Plate A-26. Inundation limits are also shown on these plates; the floodway is marked by a

light green line, the 0.01 exceedance probability by a red line and the 0.002 exceedance probability by a blue line.

HEC-RAS Calibration and Verification

The existing condition model was calibrated using observed water levels from floods of 1993 and 2008. A plot of measured discharges, the current gage rating curve and HEC-RAS computed water surface elevations appear in Figure A-5. This figure shows good agreement among the three data sources

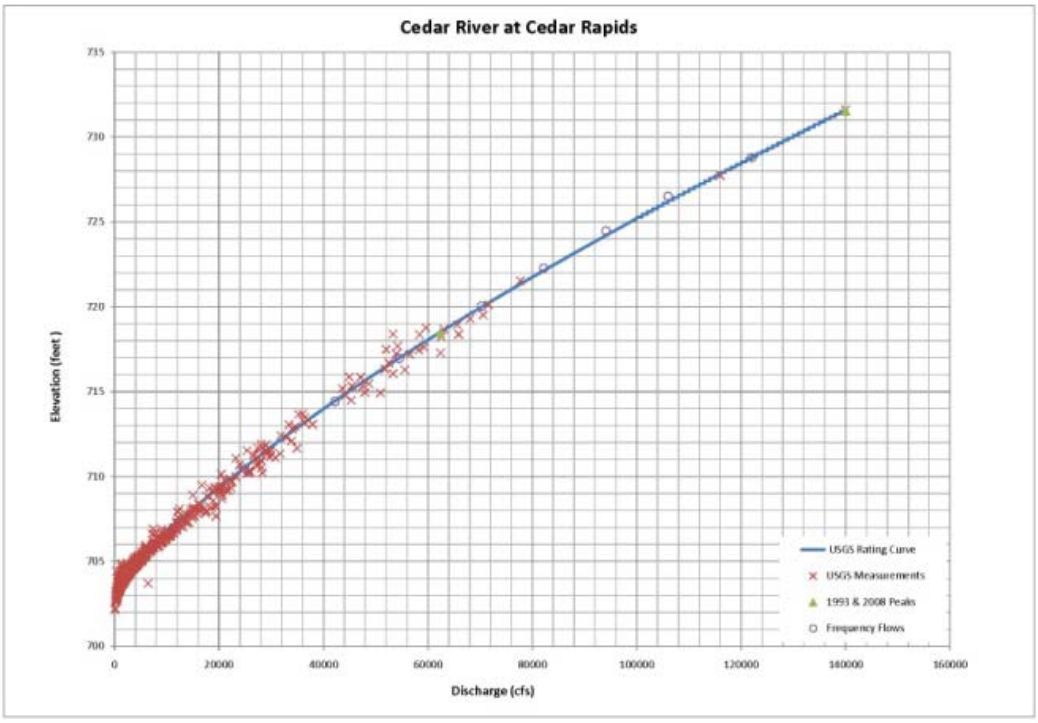

Figure A-5 Comparison of Rating Curve, Measured Discharges and Computed Discharges at Cedar Rapids

The model calibration was based upon high water marks provided by USACE and FEMA. In 1993 after a peak discharge of 71000 cfs, the Corps of Engineers surveyed 9 high water marks. A comparison of observed and computed water levels revealed the following statistics. For the 9 locations the standard deviation of the difference in water levels was 0.32 feet. The observed water level was 0.05 feet higher than the computed value at the Cedar Rapids gage near 8th Street.

In 2008 after a peak discharge of 140,000 cfs, the Federal Emergency Management Agency (FEMA) surveyed 14 high water marks while the Corps of Engineers surveyed 12 high water marks. Five high water marks had similar locations resulting in 21 unique locations. The high water marks at the five similar locations were averaged. Examining the difference between the observed water level and the water level computed with HEC-RAS revealed a standard deviation of 0.29 feet. The raw data appears on Plate A-36. As can be seen from Figure A-5 several USGS discharge measurements were made during the flood. On June 11 a measurement of 77,700 cfs was made. The stream control was clear of any obstructions and the estimate was judged to be within 5%. On June 13 a second estimate of 140,000 cfs was obtained. The stream control was submerged and the discharged was adjusted to

account for bypass flows; this estimate was within 8%. Finally, on June 14 the last measurement of 116,000 cfs was made. The stream control was submerged and the estimate was within 5%.

Computed Water Surface Profiles

Existing condition water surface profiles for the Cedar River are shown on Plate A-28 through Plate A-35.

Inundation Maps

A comparison of the FEMA Flood Insurance Rate Map effective April 5, 2010 and the feasibility study HEC-RAS inundation mapping is shown on Plate A-27. Due to updated hydrology and more detailed hydraulic modeling and mapping; the USACE Flood Risk Management study's results show larger areas inundated at greater depths than the effective FEMA Flood Insurance Rate Maps. Water surface profiles with exceedance probabilities of 0.01 and 0.002 were used to produce inundation maps. Areas inundated by the 0.01 exceedance probability (red line) and 0.002 exceedance probability (blue line) also appear on cross-section maps shown on Plate A-18 through Plate A-26. The floodway is shown on these maps as a light green line. No proposed alternatives encroach into the floodway. Thus no variance from the state guidance is required to build any of the proposed alternatives. The proposed alternatives do extend into the flood fringe area but this is totally acceptable and requires no state permission. Inundation mapping for the existing condition will be provided to the City of Cedar Rapids for integration into their Geographic Information System (GIS).

With Project Impacts

The volume at the peak water surface elevation for a discharge of 140,000 cfs landward of Alternative 4 between the downstream and upstream cross-sections making up the levee is about 2,700 acre feet. This value is based upon output from HEC-RAS for the without-project case and for Alternative 4. The volume of water conveyed above the bank full assuming an elevation of 715 feet (45,000 cfs) during the 2008 flood was 864,990 acre-feet. This is based upon converting daily average discharge into acre-feet. The volume removed from storage by building Alternative 4C is less than 0.3% of the total 2008 overbank flood volume. Alternative 4C will not increase discharges downstream due to elimination of storage.

The State of Iowa guidance for construction permits restricts the increase in water level to 1.0 foot for the 0.01 exceedance probability event. All alternatives produce water surface levels conforming to this guidance thus project impacts are acceptable for all alternatives. Table A-31 summarizes changes in water surface elevation for alternatives in the final economic evaluation. See Plate A-1 for location of economic damage reaches. The average increase in water surface elevation for economic damage Reach 4A would be similar to economic damage Reach 2A listed in the table below.

The main alternatives are described in detail in the Main Report. Alternative 1 (see figure in Main Report) is the west setback alternative while 1A (see figure in Main Report) is a minor variation on that alternative. Alternative 4 (see figure in Main Report) is the East Only levee. Alternative 5 (not shown in Main Report) is the lower east bank ring levee; while Alternative 7 (not shown in Main Report) is an upper east bank ring levee. Alternative 10 (discussed in Main Report) is a combination of the Alternatives 4 and 7 ring levees on the east bank. The average (Ave.) increase is a weighted average between cross sections 48339.74 through 61371.18. The Maximum (Max.) increase is the largest computed difference between the existing condition water surface and the alternative water surface.

Table A-31 Increase in Water Surface Elevation for Various Alternatives

Alt.	Economic Damage Reach	Exceedance Probability .04 Increase (ft)	Exceedance Probability .02 Increase (ft)	Exceedance Probability .01 Increase (ft)	Exceedance Probability .005 Increase (ft)	Exceedance Probability .002 Increase (ft)
1 & 1A	2A	0.02	0.08	0.31	1.32	3.12
1 & 1A	1	0.02	0.05	0.20	0.92	2.14
4	2D	0.01	0.02	0.13	0.32	0.55
4	2C	0.02	0.03	0.23	0.61	0.89
4	2B	0.01	0.06	0.24	0.25	0.56
4	2A	0.01	0.06	0.22	0.24	0.50
4	1	0.00	0.02	0.12	0.14	0.31
5 & 10	2D to 2A	Insignificant	0.01	0.08	0.16	0.19
7	2D to 2A	Insignificant	0.00	0.01	0.01	0.01

The HEC-RAS study models used in HEC-FDA extended upstream of the Cedar Rapids gage for 4.4 mile; this is upstream of Edgewood Bridge. To explore increases in the water surface elevations above Edgewood Bridge some sensitivity models were made by adding cross-sections up to 176,855.7 to several HEC-RAS study models. This new upstream location is above Lewis Access Road near Center Point, Iowa (Linn County). All 103 cross-sections added upstream contained overbank portions cut from 5-foot contour mapping. The channel portion of 71 cross sections (76,944.14 through 118,708.54 and 159,953.8 through 176,855.64) was estimated. For 32 cross sections (119,979.01 through 158,657.38), the channel portion came from Iowa Institute of Hydraulic Research (IIHR) bathymetry data furnished by the University of Iowa. There are four bridges in this reach. Lewis Access Road and Blairs Ferry were coded from bridge plans. The railroad bridge (cross-section 94,694) was approximated with no piers added. The Chain Lakes Road (multiple channels at cross-section 115,445) was not included. The extended portion of the model was calibrated to the 2008 flood using 4 high water marks that were surveyed by the Corps of Engineers. The “n” values in the channel ranged from 0.021 to 0.050 and 0.060 to 0.120 in the overbank areas.

The HEC-RAS sensitivity model for Alternative 1 (levees on both banks) used a levee crest in excess of the year 2008 water surface level so the proposed levees confine all flood discharges. As can be seen from Figure A-6 the most significant influence extends upstream about five river miles or about a mile above economic damage Reach 1, since the upstream boundary of economic damage Reach 1 is 4.4 miles above the gage. The influence of the project dissipates rapidly by a distance of sixteen river miles above the gage and has all but disappeared after twenty-three river miles above the gage. For the more commonly occurring exceedance probabilities the discharges are contained within the channel and since they are not influenced by the proposed levees there is no increase in water surface elevation. The most significant increase obviously occurs at largest discharge.

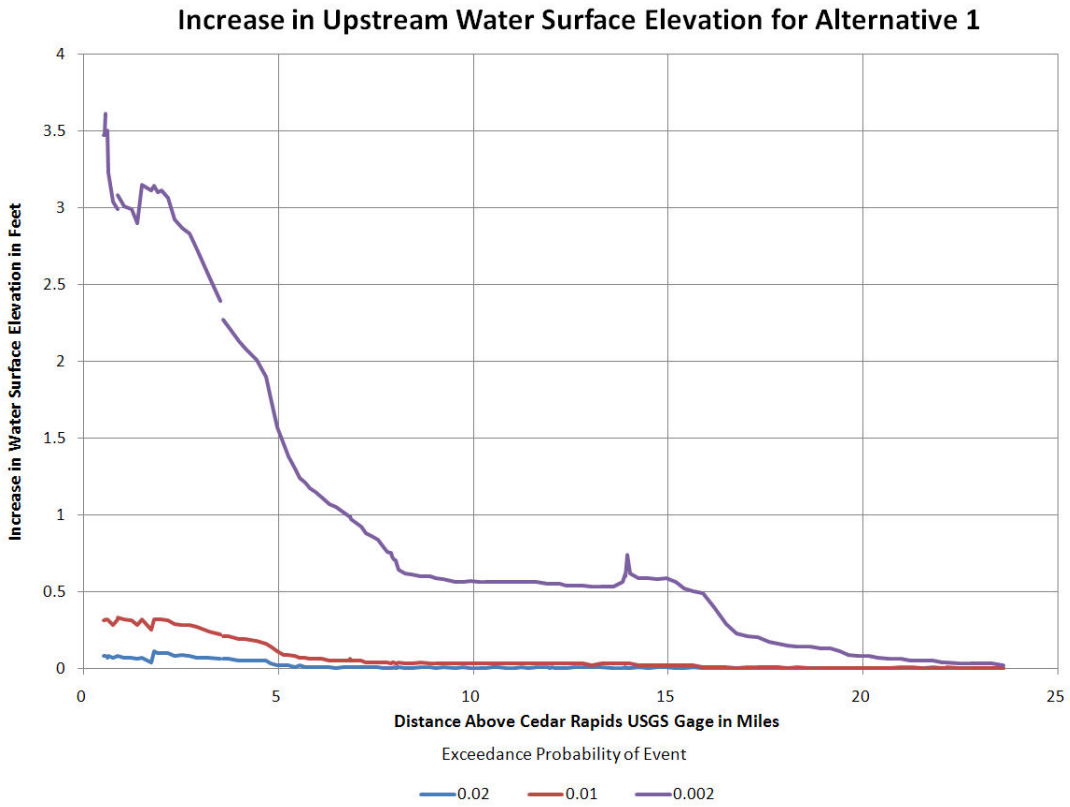

Figure A-6 Project Impacts of Alternative 1

In a similar manner the sensitivity model for Alternative 4 (levee on east bank) used a levee crest is in excess of the year 2008 water surface level so the levee confines all flood events. As can be seen from Figure A-7, once the profile extends upstream one mile from economic damage Reach 1 the increase in water surface elevation due to the alternative has disappeared for profiles of exceedance probabilities 0.2 to 0.02. The increase in water surface elevation for events smaller than an exceedance probability of .01 (large floods) is less than 0.1 foot. At the time study data was being gathered this was considered to be a minor induced influence and it was decided not to collect information on the few residences along the river that extends one mile upstream from economic damage Reach 1.

A review of the HEC-RAS results comparing average channel velocity from the without-project and with-project shows very little increase in velocity due to the proposed project. There was an insignificant change from the 50% chance event through the 4% chance event; this is not surprising as the channel contains these events. The 2% chance event had a maximum increase a one cross-section of 0.15 feet per second which increased to a maximum of 0.68 feet per second for the .2% chance event. In no case did the velocity change from a non-erosive to an erosive velocity. Any natural erosion and sediment over the life of the project will not be amplified by the proposed project (Alternative 4C).

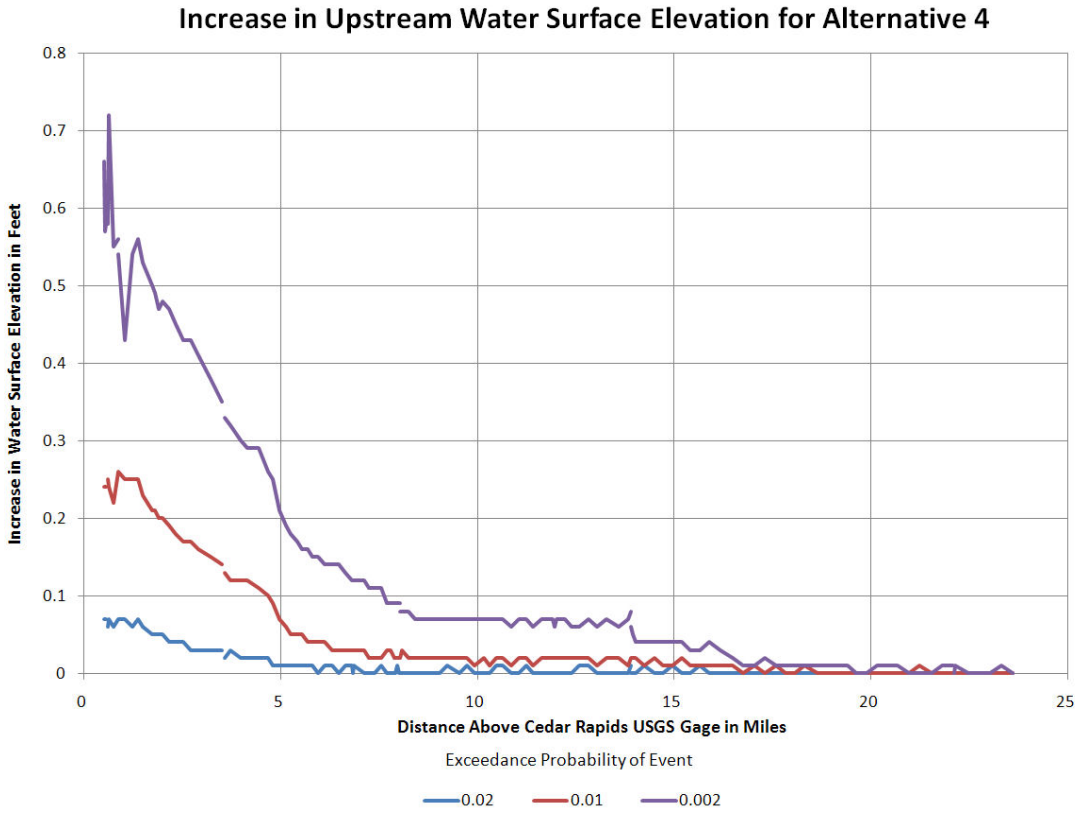

Figure A-7 Project Impacts of Alternative 4

CLOSURE STRUCTURES

Closure Structures are temporarily placed where railroads or streets cross through the levee. Care must be taken to insure that time is available to recognize a threat and complete the closure. Swing and roller gates are appropriate for situations of short closure time. These gates are proposed for Cedar Rapids. Table A-32 summarizes closure type, size and location for Alternative 4C. Also included are the sill elevation and the exceedance probability of the sill elevation using water surface profiles for Alternative 4. Fortunately all closures will not be made during the same time interval. Also the City of Cedar Rapids has a large workforce and can make the desired closures on time. An operation and maintenance document will be provided to the city during plans and specifications instructing the city when to install each closure based upon river stage and rate of rise at Waterloo and Cedar Rapids. This document will also notify the city of the need for annual examination and testing of all closures along with writing post flood evaluation reports. No sand bag closures were considered in this study due to the nature of the Cedar River at Cedar Rapids. Closures meet guidance contained in Draft ETL 1110-2-570 *Certification of Levee Systems for the National Flood Insurance Program (NFIP)*, 12 Sept 2007. The two railroad closures are just downstream (d/s) of cross-section 57813.67 while the other cross-section are located at the upstream end of the opening.

Table A-32 Description of Closure Structures making up Alternative 4C

Crossing Description	Type of Closure	Gate: Height x Width (Feet)	HEC-RAS cross section	Sill Elevation (Feet)	Exceedance Probability of Sill Elevation
Railroad	Swing	19 x 40	d/s 57813.67	722.0	0.065
Railroad	Roller	14 x 40	d/s 57813.67	728.3	0.013
1st Ave	Roller	10 x 90	54749.42	728.4	0.009
2nd Ave	Roller	11 x 80	54332.53	721.0	0.050
3rd Ave	Roller	11 x 80	53929.38	725.9	0.012
8th Ave	Roller	9 x 75	51927.49	725.4	0.009
Railroad	Roller	11 x 20	51479.29	723.9	0.014
12th Ave	Roller	12 x 60	50219.63	720.0	0.040
14th Ave	Roller	12 x 50	49457.12	719.9	0.035
Otis Rd	Swing	12 x 90	43800.70	717.9	0.035

FLOOD DAMAGE ANALYSIS

This section summarizes the exceedance probability, discharge, and elevation data entered under the "HydEng" tab of the HEC-FDA (Flood Damage Analysis) computer model (Reference 12). A summary of computed project performance for Alternatives 1, 1A, 4, 5, 7, and 10 appears in Table A-38 through Table A-41. A discussion of damages prevented and benefits is contained in the Economic Appendix. A description of Alternatives 1, 1A, 4, and 10 can be found in the Main Report.

Economic Reaches

Table A-33 lists data defining the economic reaches. Each property in the economic data base is defined with a river distance that is consistent with cross-section numbers from HEC-RAS and a right (west) or left (east) bank indicator. Each economic damage reach is also defined by downstream (cross-section number), upstream (cross-section number) and a representative or index station (cross-section number).

Table A-33 Economic Damage Reaches and HEC-RAS Cross-section References

Economic Reach	Description (Right = Right Bank Left = Left Bank)		Downstream X-section	Index X-section	Upstream X-section
1	Right	Area upstream of Edgewood Dr.	71,108.29	73,295.84	75,651.64
2A	Right	Ellis Lane to O Avenue	59,539.50	61,371.18	62,789.52
2B	Right	O Avenue to 1st Avenue	54,547.42	56,909.09	59,539.50
2C	Right	1st Avenue to 8th Avenue	51,667.35	53,297.19	54,547.42
2D	Right	8th Avenue to Skejskal Park	47,445.66	50,037.51	51,667.35
3	Right	Area at mouth of Prairie Creek	34,185.03	35,451.68	35,451.68
4A	Left	Long Bluff Rd. to Southern edge of Cedar Lake	57813.87	59,539.50	66,550.02
4B	Left	Southern edge Cedar Lake to I-380	55,278.83	56177.15	57,813.87
5A	Left	I-380 to 8th Avenue	51,667.35	53,297.19	55,278.83
5B	Left	8th Avenue to 12th Ave. SE	48,339.74	50,219.63	51,667.35
5C	Left	12th Ave. SE to Van Vechten Park	43,800.70	45228.10	48,339.74
6	Left	Otis Road to Otis Avenue	34,185.03	37,573.16	41,572.89
7	Left	Bertram Rd. Water Pollution Control Facility	12,161.44	13,835.67	15,530.17
9		Mays Island similar to 5A	51,667.35	53,297.19	55,278.83

HEC-FDA uses this information along with other data to compute stage damage functions for each reach keyed to the index station. The index station is usually located in the middle of the damage reach and is representative of the change in water surface elevation with discharge for that reach. For this study all reaches on the left bank (east) were organized into one HEC-FDA model while all reaches on the right bank were organized into a second model. Reach 9 consists of properties on Mays Island in the middle of the river. These properties were included in the left bank model but were designated as being located on the right bank. Reach 8 was not modeled in HEC-FDA but this area does appear on maps; it covers the site of fresh water intake wells used by the city. A map of the downtown economic damage reaches appears on Plate A-1.

Alternatives Evaluated

Over twelve alternatives were evaluated during the course of this study. The alternatives selected for summary in this appendix are outlined in Table A-34 and include some not described in the Main Report. To evaluate the selected alternatives HEC-FDA employed the input from many HEC-RAS models: a) a without project model (existing condition), b) a model simulating Alternatives 1 and 1A with levees on both banks of the Cedar River (West Setback Option), c) a model simulating a levee on the west bank but no levee on the east bank (West Levee Only which was eliminated), d) a model simulating Alternative 4 with a levee on the east bank but no levee on the west bank (East Levee Only), e) A model simulating Alternative 5 with a ring levee downstream on the east bank (which was eliminated), g) a model simulating Alternative 7 ring levee upstream on the east bank (which was eliminated) and g) a model simulating Alternative 10 with both Alternative 5 and 7 ring levees on the east bank (which was eliminated).

The eight water surface profiles loaded into HEC-FDA were computed for the 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, 0.005, and 0.002 exceedance probabilities. Table A-34 lists the HEC-RAS models used to evaluate the various alternatives in HEC-FDA. Results for alternatives 1, 4, 5, and 7 and 10 are summarized near the end of this section of the appendix. The alternatives that were eliminated from consideration for economic reasons during the early preliminary analyses are not discussed. The entry under "FDA Model" explains which side of the river the proposed levees are on. HEC-FDA runs (discussed later) computed negative benefits (induced damages) for economic damage reaches 1, 2a, 2b, 2c, and 2d on the opposite side of the river (for alternatives with no west bank levee).

Table A-34 Profiles Used for Various Alternatives

Alternative	Brief Description	FDA Model	HEC-RAS Model Used (left bank=east bank; right bank=west bank)
Without project	No levees	Left & Right	Existing Condition Model (Without Project)
1	Levees both sides	Left & Right	West Setback Option profile
1A	Levees both sides; east levee does not go as far upstream as Alternative 1	Left & Right	West Setback Option profile
4	Levee on east bank only Quaker to Cargill	Left	New Alt 4 profile 11 Feb 2010
5	Cargill Ring levee or Reach 5C only	Left	New Alt 5 Ring Levee profile 11 Feb 2010
7	Quaker Ring levee or Reach 4B only	Left	New Alt 7 Ring Levee profile 11 Feb 2010
10	Both 5 and 7 Ring levees	Left	Both Ring Levees profile 11 Feb 2010

Exceedance Probability Functions with Uncertainty

The presence or absence of levees at Cedar Rapids does not alter the discharge-frequency relationship. For this reason the exceedance-probability function with uncertainty for a reach was identical for both the without-project and the with-project runs. For damage reaches within the downtown Cedar Rapids area this function was generated using the "analytical feature" with a mean of 4.3779, a standard deviation of 0.2896, a skew of -0.360, and an equivalent record length of 106. At the damage reaches downstream of Cedar Rapids (3 and 7) the "graphical feature" was used since statistics do not exist for the discharges adjusted for drainage area. Normally, the 0.004 exceedance probability discharge value is used as input into HEC-FDA. However, in this instance the 0.005 exceedance probability discharge was desired for other uses. Therefore, the HEC-FDA program was set up to accept the 0.005 exceedance probability input. In all cases the goal was to replicate the discharge-frequency data explained in "Discharge Frequency Analysis of Cedar River" appearing earlier in this appendix. Table A-35 lists the probability and discharge input used in the HEC-FDA "graphical feature" with a period of record of 106 years to generate probability, discharge, and uncertainty.

Table A-35 Input Data to Generate Graphical Discharge Probability Relationships

Exceedance Probability	Reach 3 Below Prairie Cr (cfs)	Reach 7 Below Indian Cr (cfs)
0.999	2,150	2,150
0.950	7,570	7,620
0.900	10,070	10,130
0.800	14,000	14,100
0.500	25,200	25,400
0.200	42,800	43,000
0.100	55,200	55,600
0.040	71,200	71,700
0.020	83,300	83,800
0.010	95,400	96,000
0.005	107,000	108,000
0.002	124,000	124,000

Stage-Discharge Functions with Uncertainty

Stage discharge probability functions were based upon profiles specified in Table A-34. The actual tables used in the model for the without-project case are reproduced in Table A-36. The lowest discharge of 0.0 cfs occurred at the minimum elevation of the channel and was assigned a standard deviation of error of 0.0 feet. All other values were initially assigned a value of 0.7 feet. In using the "analytical feature" (discharge-frequency) the highest discharge that could be generated by HEC-FDA was about 230,000 cfs. Since the .002 exceedance probability flood was only 124,000 cfs, all the tables were supplemented to include discharges (and stages) of 140,000 cfs, 190,000 cfs and 230,000 cfs. Damage Reach 9 is similar to Damage Reach 5A and therefore was assigned the same table as Damage Reach 5A. Later it was realized that the minimum damage elevation for one reach was near the 25,400 cfs discharge. Stages for a discharge of 20,000 cfs were then added to all tables (with a standard deviation of error of 0.04) to insure the tables contained an elevation below the start of damage.

Two methods were examined in early 2008 to evaluate uncertainty of stage (Reference 16, Chapter 5 Table 5-2). The first method analyzed the rating curve for the Cedar Rapids gage received on 2009-04-02 (rating curve identification number 25). The standard deviation for 69 observed measurements yielding a standard deviation of 0.6 feet. Where:

$$\text{Standard deviation} = \sum_{i=1}^{N}\left(\frac{(x_i - m)^2}{N-1}\right)^{0.5}$$

$x_i = \text{observed measurement};$

$m = \text{mean of observed measurements};$

$N = \text{total number of observations};$

A second method analyzed the uncertainty of computed water surface profiles. Water surface profiles were calibrated to the 1993 flood and 2008 flood. Data describing these events are considered fair. The standard deviation of the stage based on these observed and computed profiles is 0.7 feet. This higher value was used to represent uncertainty in all HEC-FDA runs since it would result in a higher value for damages prevented.

Damage Reaches 2C and 5A were modeled in HEC-RAS (water surface profile model) as split flow around Mays Island. HEC-FDA is not set up to accept split flow output from HEC-RAS. For this reason HEC-FDA used the total river discharges in the discharge frequency tables and all stage discharge tables represented water levels computed for the east side of the island. The Without-Project and West Setback Option runs from HEC-RAS used in the HEC-FDA were generated in September 2009 other runs were computed in February 2010.

Table A-36 Without-Project Stage Discharge Functions

Discharge (cfs)	Reach 1 Elevation (ft)	Reach 2A Elevation (ft)	Reach 2B Elevation (ft)	Reach 2C Elevation (ft)	Reach 4A Elevation (ft)	Reach 4B Elevation (ft)	Reach 5A&9 Elevation (ft)
0	710.70	707.65	700.14	702.05	706.94	703.31	702.05
20,000	719.62	716.32	714.25	710.09	714.87	713.98	710.09
24,900	721.30	718.87	718.04	711.01	718.18	717.91	711.01
42,200	724.05	720.40	718.49	714.97	718.80	718.11	714.97
54,500	725.87	721.97	719.85	717.52	720.17	719.36	717.52
70,300	728.48	724.77	723.13	720.59	723.38	722.69	720.59
82,200	730.53	727.17	725.76	722.86	726.02	725.37	722.86
94,100	732.89	729.95	728.75	725.06	729.05	728.35	725.06
106,000	735.04	732.29	731.16	727.24	731.51	730.59	727.24
122,000	736.86	733.66	732.90	729.62	733.28	732.51	729.62
140,000	739.19	735.67	734.86	732.18	735.28	734.34	732.18
190,000	744.84	741.14	740.44	737.83	740.84	739.95	737.83
230,000	747.70	743.98	743.32	740.78	743.73	742.72	740.78

Note: Table A-36 is continued on next page.

Table A-36 Without-Project Stage Discharge Functions (continued)

Discharge (cfs)	Reach 5B Elevation (ft)	Reach 2D Elevation (ft)	Reach 5C Elevation (ft)	Reach 6 Elevation (ft)
0	698.79	699.58	695.97	692.06
20,000	708.86	708.74	707.19	705.71
24,900	710.20	710.07	708.41	706.77
42,200	714.27	714.11	712.28	710.39
54,500	716.88	716.68	714.72	712.73
70,300	720.00	719.76	717.61	715.53
82,200	722.22	721.93	719.61	717.46
94,100	724.27	723.95	721.47	719.29
106,000	726.15	725.83	723.22	720.96
122,000	728.48	728.17	725.54	723.20
140,000	731.51	731.28	728.22	725.67
190,000	736.98	736.75	733.45	730.72
230,000	739.70	739.38	735.55	732.26

Table A-36 Without-Project Stage Discharge Functions (continued)

Reach 3 Discharge (cfs)	Reach 3 Elevation (ft)	Reach 7 Discharge (cfs)	Reach 7 Elevation (ft)
0	695.91	**0**	684.76
20,000	705.08	**20,000**	699.84
25,200	706.06	**25,400**	701.20
42,800	709.75	**43,000**	705.11
55,200	712.12	**55,600**	707.32
71,200	714.85	**71,700**	709.79
83,300	716.60	**83,800**	711.33
95,400	718.22	**96,000**	712.81
107,000	719.70	**108,000**	714.68
124,000	722.19	**124,000**	717.55
140,000	725.01	**140,000**	720.36
190,000	730.30	**190,000**	725.17
230,000	731.83	**230,000**	727.00

Stage-discharge tables similar to the "Without-Project" were created for each alternative. Tables for all levee alternatives used the without-project stages for discharges of 190,000 cfs and 230,000 cfs. This is because even levees built to crest elevation D (explained in the next section) will be overtopped by these floods. For elevations Z and A the stages for discharges of 122,000 cfs and 140,000 cfs were also set equal to equivalent without-project stages. These levee crests are very low and are overtopped by these discharges. Once levees are overtopped they will fail and the water surface elevation will revert to the without-project condition. When a floodwall is overtopped the response is similar to a levee. If the water level is low it is possible to erode the fill material landward of the wall at the base. Once this material is removed the wall can tip over. In both cases the assumption that the water level for extreme events that overtop the levee will approach the without-project case is valid.

Levee Features

The levee crest elevation input for each plan is the levee crest elevation at the index station for the economic damage reach. The model is based upon the assumption that the levee crest profile is a line parallel to the water surface profile. A levee is actually built so that in the rare event that it is overtopped water will first enter the protected area from the most downstream location. To insure this occurs a levee is designed with superiority. Generally, the levee crest is about 1 foot higher than the overtopping profile at the most upstream location while it is equal to the overtopping profile at the most downstream location. However, for Alternative 4 the most downstream portion is along a commercial facility. The overflow section should be upstream of this facility so as not to be damaged by water velocity in the unlikely event of a flood that exceeds the capacity of the levee.

Without-Project

The city reported low level levees on the right descending bank between HEC-RAS cross-sections 47,445 through 50,037 (about 2,600 linear feet) and on the left descending bank between cross-sections 48339 through 50037 (about 2,400 linear feet). Refer to Plate A-21 for the HEC-RAS cross-section map in this vicinity. There are also existing levees farther upstream on the right descending bank between HEC-RAS cross-sections 56909 through 60212 (about 3,300 linear feet) and on the left descending bank between cross-sections 55549 through 57813 (about 2,200 linear feet). Refer to Plate A-25 for an HEC-RAS cross-section map along the river. These levees are not certified as they will be overtopped or flanked by the .04 exceedance probability event. There are no flap gates or gatewells in existing levee outflows. Reverse flow is limited by placing sandbags in manholes if time permits city workers to perform this operation.

The examination and evaluation of any existing levees is a geotechnical function. The Rock Island District Geotechnical Engineering Branch sent a memo to the Hydrology and Hydraulics Branch that "concluded that all levees in Cedar Rapids that exist do not meet the minimum standards set by the U.S. Army Corps of Engineers. For the purposes of the Cedar Rapids feasibility, no measurable level of flood protection shall be taken into account." Thus the without-project HEC-FDA model contained no levees. For the discussion of existing levees refer to the Geotechnical Appendix.

With-Project

The "Levee Features" module was used to evaluate an array of five levee crest elevations for each alternative. The elevations are in NAVD 88 datum. The alternatives 1, 1A, 5, 7 and 10 used the same array of crest elevations for the relevant damage reaches and index stations shown in table A-37. These elevations are identified throughout the feasibility study as Z, A, B, C, and D. For the most downstream Economic Damage Reach (5C) they correspond to levees or floodwalls of approximately 9, 10, 12, 15, and 17 feet in height. The index stations of the economic damage reaches referenced in table A-37 are defined in Table A-33. Levee Crest elevations are also referenced to the USGS gage in downtown Cedar Rapids. The crest elevations from damage reach to damage reach follow the slope of the water surface profile based upon the Alternative 1 profile. This was the first alternative evaluated and also used to compute levee costs. The same array of crest elevations was used to evaluate the ring levees (Alternatives 5, 7 and 10) since the distances along the river were short and since the levee cost data already existed.

The one exception was Alternative 4 where the crest elevations of upstream of economic damage reach 5C follows the slope of the water surface profile based upon the Alternative 4 profile. The levee crest elevation for the downstream most economic damage reach (5C) was identical to the other alternatives but since alternative 4 has a levee only on the east side the upstream crest elevations are not as high as shown in the second part of Table A-37.

Table A-37 Levee Crest Elevations used for Various Alternatives

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)
Alt 1	west bank					
61371.18	2A	731.76	733.26	737.11	740.59	744.15
56909.09	2B	730.60	732.10	736.17	739.66	743.18
53297.19	2C	727.00	728.50	730.92	734.18	738.27
50037.51	2D	725.65	727.15	729.37	732.50	736.30
Alt 1	east bank					
59539.50	4A	730.83	732.33	736.16	739.17	742.39
56177.15	4B	730.13	731.63	735.52	738.55	741.72
53297.19	5A	726.85	728.35	731.04	734.54	738.62
50219.63	5B	725.99	727.49	729.77	732.97	736.90
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.3	727.6	730.33	733.69	737.82
Alt 1A	west bank					
61371.18	2A	731.76	733.26	737.11	740.59	744.15
56909.09	2B	730.60	732.10	736.17	739.66	743.18
53297.19	2C	727.00	728.50	730.92	734.18	738.27
50037.51	2D	725.65	727.15	729.37	732.50	736.30
Alt 1A	east bank					
56177.15	4B	730.13	731.63	735.52	738.55	741.72
53297.19	5A	726.85	728.35	731.04	734.54	738.62
50219.63	5B	725.99	727.49	729.77	732.97	736.90
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.3	727.6	730.33	733.69	737.82
Alt 5	east bank only					
56177.15	4B	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.08	727.58	729.78	732.13	732.
Alt 7	east bank only					
56177.15	4B	730.13	731.63	735.52	738.55	741.72
52270.6	USGS gage	725.98	727.48	729.50	731.78	731.5
Alt 10	east bank only					
56177.15	4B	730.13	731.63	735.52	738.55	741.72
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.08	727.58	729.78	732.13	732.
Alt 4	east bank only					
56177.15	4B	730.07	731.57	733.77	736.06	738.23
53297.19	5A	726.81	728.31	730.84	733.77	736.47
50219.63	5B	725.99	727.49	729.63	732.25	735.14
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.25	727.75	730.11	732.89	735.68

The last alternative, 10E, was a combination of Alternative 7B with Alternative 5A. No new HEC-RAS runs were made. Alternative 10E was evaluated using existing analyses. Performance would be found in Table A-44 with Alternative 10A used for Reach 5C and Alternative 10B used for Reach 4B.

HEC-FDA Results for Hydrologic and Hydraulic Performance of Alternatives

Corps of Engineer guidance directs that flood risk for levees be described using expected annual stage exceedance probability, long-term risk, and conditional probability of non-exceedance instead of freeboard (References 13 and 14). The performance numbers for the existing case (without-project) appear in Table A-38. Performance numbers for Alternatives 1, 1A, 4, 5, 7 and 10 appear in Table A-39 through Table A-44. Alternatives discussed in this section are also evaluated in the Economic Appendix.

The definitions for the performance terms used in the output tables are described below. The performance values for the without-project case are summarized by damage reach. The performance values for the alternatives are summarized for each levee only once. Thus if a levee alternative extends through several economic reaches the levee performance at the index station of the reach with the worst performance is summarized in the table. Data for the remaining economic reaches that make up the levee alternative are not included. For reaches without levees the target stage is the stage typically associated with the start of significant damage for the without-project condition. For reaches with levees that do not use the geotechnical failure (as is the case in Cedar Rapids) the data is related to the proposed crest of the levee.

The median and expected annual exceedance probabilities are values associated with the target stage. The median exceedance probability is the middle value in an ordered list (thus there is a 0.5 probability that the actual value is less than the median). The expected exceedance probability is the mean or average value. For normal probability density functions, the expected and median are the same.

> "Because probabilities must be inferred from random sample data, they are uncertain and mathematical expectation cannot be computed exactly as errors due to uncertainty do not necessarily compensate. For example, if the estimate based on sample data is that a certain flood magnitude will be exceeded on the average once in 100 years, it is possible that the true exceedance could be three times per hundred years, but it can never go less than zero times per hundred years. The impact of errors in one direction due to uncertainty can be quite different from the impact of errors in the other direction. Thus, it is not adequate to simply be too high half the time and too low the other half." (Reference 2, page 11-1).

The expected probability correction is computed and applied to address this irregularity.

The long-term risk lists the probability of the target stage being exceeded in a 10-year, 30-year, and 50-year period.

The conditional non-exceedance probability by events lists the chance of containing the specific 0.10, 0.04, 0.02, 0.01, 0.004 and 0.002 exceedance probability within the target stage, should that exceedance probability event occur. Since the alternatives involve levees, this number gives the probability of the proposed levees containing the specific exceedance probability event given the uncertainty estimated for discharge and stage. The exceedance probability is the probability that a specific event will occur in any given year. For example, the 0.01 exceedance probability event has one chance in a hundred (a one percent chance) of occurring in any given year.

The present guidance (in draft form) for certifying levees (Reference 17 page 12) states that to be certified a levee must have at least a 90% assurance of providing protection from overtopping by the 0.01 exceedance probability family of floods. This minimum assurance is required for all reaches of the levee system. If top of levee elevation is less than three feet above the expected (50%) base flood stage, then the levee can only be certified if the assurance is 95% or greater. Top of levee elevation shall not be less than two feet above the expected base flood elevation, even if the assurance is 95% or greater.

This guidance means that levee crest Z for Alternatives 1, 1A, 4, 5, 7 and 10 are not certifiable for the National Flood Insurance Program. To a lesser degree Alternatives 1 and 1A with levee crest A cannot be certified. Economic Reach 4B would require the addition of 0.7 feet to the levee crest while Economic Reaches 2A and 2B would require about 0.3 feet. Adding superiority to both east and west levee crests to insure overtopping at the downstream end would supply the needed increase in crest elevation. Thus Alternatives 1-A and 1A-A could easily meet certification requirements. It also appears that these small increases would not be significant enough to increase the estimate of the cost to build the levee. All the remaining economic reaches making up these two alternatives already meet certification requirements. The remaining levee crest arrays for all the remaining alternatives meet certification requirements.

Table A-38 Performance for Without-Project

Economic Reaches from Downstream to Upstream Left & Right	Target Stage	Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
		Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
Left Reach 7	711.72	0.0166	0.0195	0.1789	0.3891	0.6267	0.9999	0.9264	0.6046	0.2484	0.0512	0.0131
Left Reach 6	716.31	0.0303	0.0332	0.2866	0.5701	0.8152	0.9994	0.7230	0.1710	0.0134	0.0001	0.0000
Left Reach 5C	716.47	0.0574	0.0612	0.4681	0.7936	0.9574	0.9490	0.1600	0.0060	0.0000	0.0000	0.0000
Left Reach 5B	717.99	0.0719	0.0759	0.5458	0.8609	0.9807	0.8383	0.0515	0.0007	0.0000	0.0000	0.0000
Left Reach 9 (Mays Is.)	722.78	0.0205	0.0227	0.2049	0.4362	0.6822	1.0000	0.9372	0.4546	0.0718	0.0012	0.0000
Left Reach 5A	720.74	0.0383	0.0413	0.3438	0.6511	0.8783	0.9977	0.5185	0.0624	0.0018	0.0000	0.0000
Left Reach 4B	722.20	0.0458	0.0490	0.3950	0.7153	0.9189	0.9914	0.3338	0.0209	0.0002	0.0000	0.0000
Left Reach 4A	726.02	0.0200	0.0222	0.2013	0.4299	0.6750	1.0000	0.9478	0.4654	0.0672	0.0008	0.0000
Right Reach 3	717.18	0.0155	0.0181	0.1665	0.3657	0.5977	1.0000	0.9446	0.6444	0.2768	0.0594	0.0138
Right Reach 2D	719.63	0.0416	0.0446	0.3664	0.6804	0.8979	0.9952	0.4373	0.0433	0.0010	0.0000	0.0000
Right Reach 2C	721.08	0.0344	0.0373	0.3162	0.6133	0.8505	0.9991	0.6219	0.0990	0.0041	0.0000	0.0000
Right Reach 2B	722.69	0.0452	0.0484	0.3912	0.7108	0.9163	0.9920	0.3471	0.0231	0.0003	0.0000	0.0000
Right Reach 2A	724.53	0.0432	0.0468	0.3811	0.6987	0.9092	0.9919	0.3900	0.0329	0.0006	0.0000	0.0000
Right Reach 1	725.71	0.1058	0.1125	0.6970	0.9495	0.9974	0.4080	0.0055	0.0000	0.0000	0.0000	0.0000

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table A-39 Performance for Alternative 1 (Levees West & East Banks)

Array	Levee crest at (Left & Right)	Target Stage	Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
			Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
1-Z	Left Levee crest 4B	Levee	0.0076	0.0088	0.0844	0.1978	0.3565	1.0000	0.9998	0.9724	0.6759	0.1224	0.0135
1-A	Left Levee crest 4B	Levee	0.0058	0.0065	0.0631	0.1504	0.2782	1.0000	1.0000	0.9915	0.8332	0.3031	0.0942
1-B	Left Levee crest 5A	Levee	0.0022	0.0028	0.0278	0.0680	0.1313	1.0000	1.0000	0.9999	0.9903	0.7831	0.4073
1-C	Left Levee crest 5A	Levee	0.0009	0.0009	0.0092	0.0230	0.0454	1.0000	1.0000	1.0000	0.9998	0.9765	0.8386
1-D	Left Levee crest 5C	Levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9961
1-Z	Right Levee crest 2B	Levee	0.0074	0.0085	0.0821	0.1927	0.3483	1.0000	0.9998	0.9753	0.6955	0.1361	0.0163
1-A	Right Levee crest 2B	Levee	0.0055	0.0059	0.0574	0.1374	0.2558	1.0000	1.0000	0.9937	0.8634	0.3742	0.1332
1-B	Right Levee crest 2C	Levee	0.0023	0.0029	0.0286	0.0700	0.1351	1.0000	1.0000	0.9999	0.9893	0.7707	0.3906
1-C	Right Levee crest 2C	Levee	0.0010	0.0011	0.0107	0.0266	0.0525	1.0000	1.0000	1.0000	0.9996	0.9699	0.8095
1-D	Right Levee crest 2C	Levee	0.0001	0.0000	0.0000	0.0001	0.0002	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table A-40 Performance for Alternative 1A (Levees West Bank & shorter East Bank)

Array	Levee crest at (Left & Right)	Target Stage	Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
			Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
1A-Z	Left Levee crest 4B	levee	0.0076	0.0088	0.0844	0.1978	0.3565	1.0000	0.9998	0.9724	0.6759	0.1224	0.0135
1A-A	Left Levee crest 4B	levee	0.0058	0.0065	0.0631	0.1504	0.2782	1.0000	1.0000	0.9915	0.8332	0.3031	0.0942
1A-B	Left Levee crest 5A	levee	0.0022	0.0028	0.0278	0.0680	0.1313	1.0000	1.0000	0.9999	0.9903	0.7831	0.4073
1A-C	Left Levee crest 5A	levee	0.0009	0.0009	0.0092	0.0230	0.0454	1.0000	1.0000	1.0000	0.9998	0.9765	0.8386
1A-D	Left Levee crest 5C	levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9961
1A-Z	Right Levee crest 2B	levee	0.0074	0.0085	0.0821	0.1927	0.3483	1.0000	0.9998	0.9753	0.6955	0.1361	0.0163
1A-A	Right Levee crest 2B	levee	0.0055	0.0059	0.0574	0.1374	0.2558	1.0000	1.0000	0.9937	0.8634	0.3742	0.1332
1A-B	Right Levee crest 2C	levee	0.0023	0.0029	0.0286	0.0700	0.1351	1.0000	1.0000	0.9999	0.9893	0.7707	0.3906
1A-C	Right Levee crest 2C	levee	0.0010	0.0011	0.0107	0.0266	0.0525	1.0000	1.0000	1.0000	0.9996	0.9699	0.8095
1A-D	Right Levee crest 2C	levee	0.0001	0.0000	0.0000	0.0001	0.0002	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table A-41 Performance for Alternative 4 (only East Bank Levee-No West Bank Levee)

			Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
Array	Levee crest at index station	Target Stage	Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
4-Z	Left Levee crest 5A	levee	0.0067	0.0079	0.0762	0.1797	0.3270	1.0000	0.9999	0.9797	0.7432	0.1866	0.0303
4-A	Left Levee crest 5A	levee	0.0039	0.0047	0.0464	0.1120	0.2115	1.0000	1.0000	0.9977	0.9310	0.5030	0.1764
4-B	Left Levee crest 5A	levee	0.0018	0.0022	0.0222	0.0546	0.1062	1.0000	1.0000	0.9999	0.9948	0.8561	0.5304
4-C	Left Levee crest 5B	levee	0.0006	0.0006	0.0060	0.0148	0.0295	1.0000	1.0000	1.0000	0.9999	0.9897	0.9124
4-D	Left Levee crest 5C	levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9961

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table A-42 Performance for Alternative 5 (Ring Levee Reach 5C)

			Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
Array	Levee crest at index station	Target Stage	Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
5-Z	Left Levee crest 5C	Levee	0.0055	0.0066	0.0644	0.1532	0.2830	1.0000	0.9999	0.9885	0.8272	0.2935	0.0660
5-A	Left Levee crest 5C	Levee	0.0030	0.0038	0.0371	0.0901	0.1722	1.0000	1.0000	0.9993	0.9677	0.6379	0.2678
5-B	Left Levee crest 5C	Levee	0.0015	0.0019	0.0186	0.0458	0.0896	1.0000	1.0000	1.0000	0.9970	0.8990	0.6183
5-C	Left Levee crest 5C	Levee	0.0005	0.0005	0.0050	0.0124	0.0247	1.0000	1.0000	1.0000	0.9999	0.9929	0.9320
5-D	Left Levee crest 5C	Levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9962

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table A-43 Performance for Alternative 7 (Ring Levee Reach 4B)

			Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
Array	Levee crest at index station	Target Stage	Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
7-Z	Left Levee crest 4B	Levee	0.0057	0.0067	0.0650	0.1546	0.2853	1.0000	0.9999	0.9897	0.8260	0.2802	0.0606
7-A	Left Levee crest 4B	Levee	0.0030	0.0037	0.0368	0.0895	0.1710	1.0000	1.0000	0.9992	0.9654	0.6421	0.2821
7-B	Left Levee crest 4B	Levee	0.0004	0.0003	0.0033	0.0082	0.0164	1.0000	1.0000	1.0000	1.0000	0.9964	0.9602
7-C	Left Levee crest 4B	Levee	0.0001	0.0000	0.0001	0.0002	0.0003	1.0000	1.0000	1.0000	1.0000	1.0000	0.9996
7-D	Left Levee crest 4B	Levee	0.0001	0.0000	0.0003	0.0008	0.0016	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table A-44 Performance for Alternative 10 (Ring Levees Reach 4B & 5C)

			Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
Array	Levee crest at index station	Target Stage	Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
10-Z	Left Levee crest 5C	Levee	0.0055	0.0066	0.0644	0.1532	0.2830	1.0000	0.9999	0.9885	0.8272	0.2935	0.0660
	Left Levee crest 4B	Levee	0.0058	0.0069	0.0665	0.1581	0.2912	1.0000	0.9999	0.9886	0.8141	0.2659	0.0555
10-A	Left Levee crest 5C	Levee	0.0030	0.0038	0.0371	0.0901	0.1722	1.0000	1.0000	0.9993	0.9677	0.6379	0.2678
	Left Levee crest 4B	Levee	0.0030	0.0039	0.0380	0.0922	0.1759	1.0000	1.0000	0.9991	0.9619	0.6255	0.2673
10-B	Left Levee crest 5C	Levee	0.0015	0.0019	0.0186	0.0458	0.0896	1.0000	1.0000	1.0000	0.9970	0.8990	0.6183
	Left Levee crest 4B	Levee	0.0005	0.0004	0.0043	0.0108	0.0214	1.0000	1.0000	1.0000	0.9999	0.9947	0.9472
10-C	Left Levee crest 5C	Levee	0.0005	0.0005	0.0050	0.0124	0.0247	1.0000	1.0000	1.0000	0.9999	0.9929	0.9320
	Left Levee crest 4B	Levee	0.0001	0.0000	0.0003	0.0006	0.0013	1.0000	1.0000	1.0000	1.0000	0.9999	0.9978
10-D	Left Levee crest 5C	Levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9962
	Left Levee crest 4B	Levee	0.0001	0.0000	0.0003	0.0008	0.0016	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Examination of Pump Stations on East Side of Cedar River

To evaluate the feasibility of pumping facilities, it was necessary to compare the interior conditions for Alternative 4 without-pumping and Alternative 4 with-pumping. These facilities are proposed for downtown Cedar Rapids on the east side of the Cedar River. Quaker Oats facility at the upstream end of the proposed levee already operates its own pumps and was not examined. HEC-FDA was used to compute elevation-damage curves for the remaining proposed pump sites. The HEC-FDA model used earlier to evaluate all alternatives was modified to create a sensitivity model that approximated the subbasins of each proposed pump facility. This modification increased the number of reaches on the east side of the Cedar River as shown in Table A-42.

Table A-45 Pump FDA and HEC-RAS Cross References for East Pump Facilities

Economic Reach	Description	Downstream X-section	Index X-section	Upstream X-section
4A	Long Bluff Rd. to Southern edge of Cedar Lake	57,813.87	59,539.50	66,550.02
4B	Southern edge Cedar Lake to I-380	55,278.83	56177.15	57,813.87
35E part 5A	I-380 to downstream 3rd Ave SE	53,799.27	45,332.53	55,278.83
45E part 5A	downstream 3rd Ave SE to 7th Ave SE	52,270.60	52,442.23	53,799.27
55E 5A&5B	7th Ave SE to 14th Ave SE	49,457.12	50,862.79	52,270.60
65E Part 5B	14th Ave SE to 9th St SE	48339.74	49,199.70	49,457.12
75E old 5C	9th St S to Van Vechten Park	43,800.70	45,228.10	48,339.74
6	Otis Road to Otis Avenue	34,185.03	37,573.16	41,572.89
7	Bertram Rd. Water Pollution Control Facility	12,161.44	13,835.67	15,530.17
9	Mays Island similar to 5A	51,667.35	53,297.19	55,278.83

The elevation-damage tables for each pump facility or reach was then computed and extracted using HEC-FDA. This data was combined with the results of the interior pond elevation analysis using a spread sheet to compute expected annual damage for both the without-pumps and with-pumps cases. The results when subtracted produced expected annual benefits. An example of this computation appears on Plate A-37. These computations are summarized in Table A-43.

Table A-46 Expected Annual Damage and Benefits

Pump Facility	Total Capacity GPM	Annual Damage ($) No-Pump	Annual Damage ($) With-Pump	Annual Benefits ($)
35E	5,000	5,548	1,743	3,805
45E	1,500	5,049	3,997	1,052
55E	15,000	41,394	14,817	26,576
65E	500	132,197	130,547	1,650
75E	1,500	82,062	74,645	7,418

Table A-44 provides the estimates of the total annual costs of pumps for these same facilities. The pump cost as obtained from the contractor appeared to include the cost of the pump with motor, the cost of the concrete pad, and the cost of the all piping. The *General Principles of Pumping Station Design and Layout* (Reference 18 paragraph 5-1-a.) recommends a minimum of two pumps but this is not mandatory. Only pump station 55E contains two pumps; the other stations have one pump. The costs for engineering and design, supervision during construction, and contingency were assigned a

value of 50% of pump costs; these costs appear in the table as "other costs." Annual operation and maintenance was estimated at about 5% or about $4,000 per pump. Since these pumps are located on pads exposed to the elements of nature and to vandalism a replacement life of 25 years was assigned. This is less than the 35 years used for pumps operated within pump houses. All of this data will be refined during the next phase of the study process. Dollars shown are in actual dollars not in thousands of dollars.

Table A-47 Estimate of Total Annual Pump Costs for East Side Cedar River

Pump Facility	Pump Cost ($)	Other Costs	Total 1st Cost ($)	Annualized 1st Cost ($)	Annual O&M ($)	Annual Re-placement ($)	Total Annual Costs ($)
35E	60,040	30,000	90,040	4,460	4,500	1,500	10,460
45E	54,190	27,100	81,290	4,030	4,060	1,400	9,490
55E	162,200	81,100	243,300	12,060	12,170	4,100	28,330
65E	54,190	27,100	81,290	4,030	4,060	1,400	9,490
75E	54,190	27,100	81,290	4,030	4,060	1,400	9,490

Discussion of Pump Facility Results

The analysis confirmed that the pump facilities would not be incrementally justified based upon economic guidance. In reviewing the results presented in Table A-45 it appears that a good starting point for the next phase of the study process would be to combine pump facilities 35E, 45E, and 55E into one station located at the site of the proposed 55E station. At pump station 75E much of the runoff comes from the slope of a hill above the top of the levee. It may be possible to use a pressure storm sewer for storm runoff coming from the hillside which would reduce the need for the pump or the capacity of the pump.

Table A-48 Pump Station Net Benefits

Pump Facility	Total Capacity GPM	Annual Costs ($)	Annual Benefits ($)	Benefit to cost Ratio	Net Benefits ($)
35E	5,000	10,460	3,805	0.36	-6,655
45E	1,500	9,490	1,052	0.11	-8,438
55E	15,000	28,330	26,576	0.94	-1,754
65E	500	9,490	1,650	0.17	-7,840
75E	1,500	9,490	7,418	0.78	-2,072

The *Planning Guidance Notebook* (Reference 18, page E-18[c]3f) states that safety and social concerns can be valid reasons for selecting an interior pump capacity. It is also known that water (with a depth greater than 3 feet or with a velocity above 3 feet per second) can cause the death of a person. Without pumping these conditions could occur during blocked gravity conditions along several streets within the protected area. Residents may feel that the proposed levees have reduced all danger from flooding and may be lured into driving into these situations. For facility 55E flooding at a depth of 3 feet without pumping occurs at the 0.004 exceedance probability on 1st Ave SE, 3rd St SE, 4th St SE, and possibly 12th Ave SE. Pumping reduces the exceedance probability to .0005. The analysis did not determine the water velocity at these areas during the synthetic storm. Water quality issues were not evaluated but could provide additional reasons for interior pumps.

APPENDIX CONCLUSIONS

Floodplain Mapping

A comparison of the FEMA Flood Insurance Rate Map effective April 5, 2010 and the feasibility study HEC-RAS inundation mapping is shown on Plate A-27. Due to updated hydrology and more detailed hydraulic modeling and mapping; the USACE Flood Risk Management study's results show larger areas inundated at greater depths than the effective FEMA Flood Insurance Rate Maps. The City of Cedar Rapids may want to more accurately define the flood risk by submitting a Letter of Map Revision package requesting the incorporation of the updated modeling and mapping into the FEMA Flood Insurance Rate Map effective April 5, 2010. In the meantime, while the LOMR is being processed by FEMA, the City of Cedar Rapids may want to consider the use of the USACE Flood Risk Management study's updated inundation mapping for floodplain regulatory purposes.

Levee Alignment Alternatives

All the Z array options for all the alternatives do not meet levee certification requirements. Alternatives 1-A and 1A-A contain some Economic Reaches that do not meet levee certification requirements but can be easily made to meet requirements. All the remaining arrays of all the remaining alternatives do meet levee certification requirements.

Flood Warning System

The City of Cedar Rapids' flood warning preparedness has been examined especially the updated Flood Response Manual and the National Weather Service real-time products available on-line. The design of a flood warning system other than what is already in-place is not required.

Interior Drainage Facilities

The minimum interior drainage facilities for both east and west sides of the Cedar River are the same as the existing gravity outlets. A small pump capacity for each outlet was investigated. The size was based upon the 24-hour duration of a storm likely to occur 4 times per year. The goal was to limit flooding to about 1 acre. While pumping is not economically justified it should be installed for safety reasons. More time will be spent in the next phase to combine runoff from several subbasins and to optimize pump capacity to insure safety of residents and meet economic and social concerns during rare blocked gravity events.

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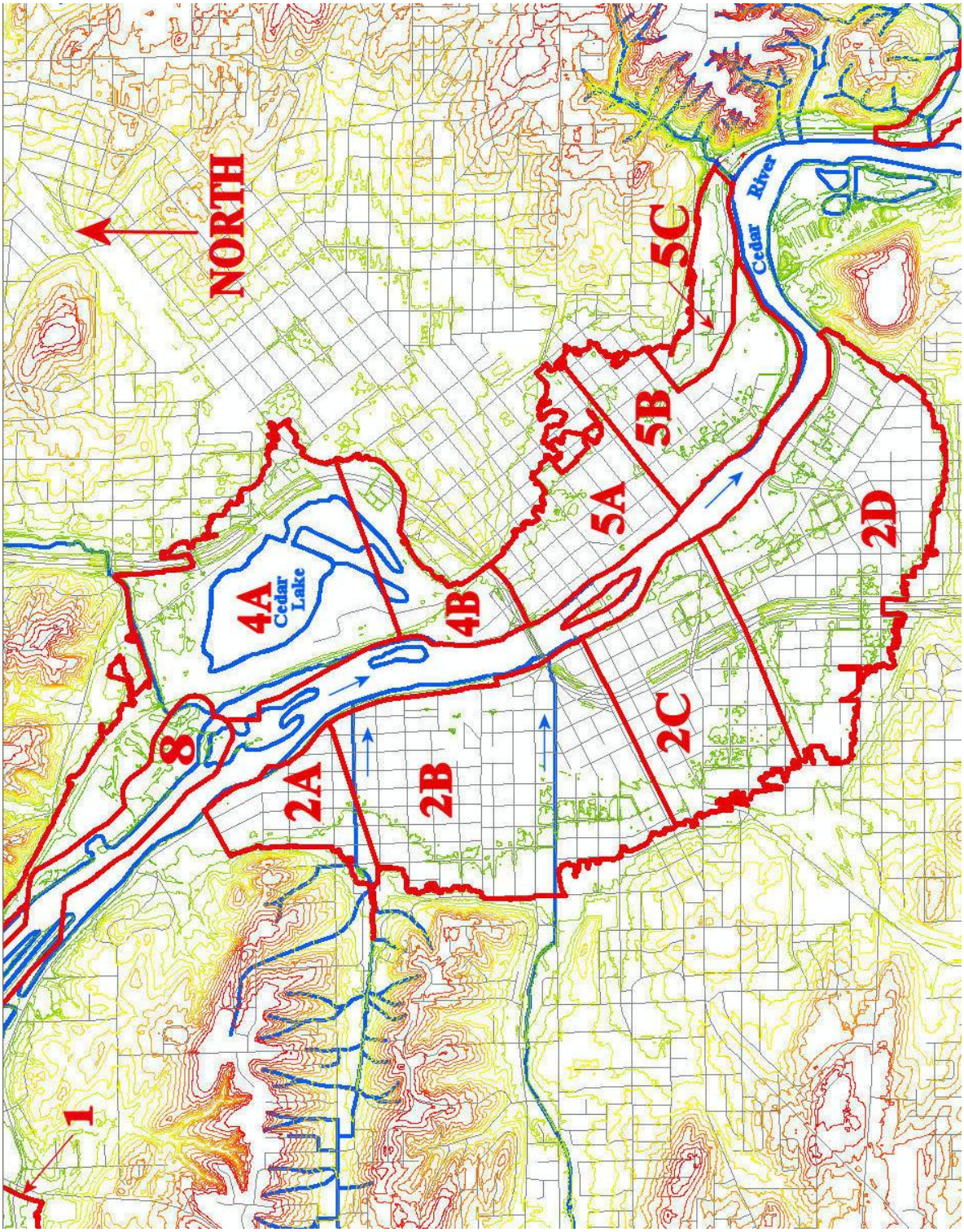


Plate A-1 Cedar Rapids Downtown Map and Economic Reaches

PLATE A-1

Events Analyzed			Ordered Events			
Day	Mon	Year	FLOW CFS	Rank	Water Year	FLOW CFS	Weibull Plot Pos
31	May	1903	53,600	1	2008	140,000	0.93
26	Mar	1904	11,800	2	1961	73,000	1.87
23	Mar	1905	23,000	3	1993	71,000	2.80
30	Mar	1906	55,700	4	1965	66,800	3.74
20	Jul	1907	19,800	5	1929	64,000	4.67
30	May	1908	21,000	6	2004	62,500	5.61
30	Mar	1909	22,100	7	1999	62,300	6.54
14	Mar	1910	24,100	8	1933	58,400	7.48
16	Feb	1911	14,300	9	1947	56,200	8.41
01	Apr	1912	54,000	10	1906	55,700	9.35
18	Mar	1913	22,500	11	1960	55,100	10.28
19	Jun	1914	17,000	12	1917	54,900	11.21
28	Mar	1915	33,600	13	1969	54,500	12.15
30	Mar	1916	25,700	14	1951	54,100	13.08
26	Mar	1917	54,900	15	1912	54,000	14.02
07	Jun	1918	28,200	16	1903	53,600	14.95
20	Mar	1919	29,700	17	1945	52,300	15.89
30	Mar	1920	14,800	18	1962	50,000	16.82
01	Jun	1921	17,900	19	1990	46,300	17.76
27	Feb	1922	21,000	20	1991	46,100	18.69
04	Apr	1923	16,000	21	1973	45,500	19.63
22	Aug	1924	26,300	22	2001	42,000	20.56
18	Jun	1925	12,800	23	1954	41,400	21.50
21	Sep	1926	11,500	24	1937	40,700	22.43
25	May	1927	11,800	25	1986	39,600	23.36
29	Aug	1928	29,200	26	1974	38,200	24.30
18	Mar	1929	64,000	27	1979	37,600	25.23
24	Feb	1930	12,200	28	1984	35,000	26.17
26	Sep	1931	3,270	29	1948	34,500	27.10
02	Apr	1932	19,100	30	1942	33,900	28.04
04	Apr	1933	58,400	31	1915	33,600	28.97
09	Apr	1934	8,620	32	1950	33,000	29.91
08	Mar	1935	26,900	33	1975	32,800	30.84
15	Mar	1936	22,700	34	1982	32,200	31.78
09	Mar	1937	40,700	35	1992	32,100	32.71
21	Sep	1938	12,900	36	1983	31,700	33.64
18	Mar	1939	19,700	37	1949	30,800	34.58
04	Apr	1940	5,540	38	1919	29,700	35.51
21	Mar	1941	17,100	39	1966	29,200	36.45
03	Aug	1942	33,900	40	1928	29,200	37.38
31	Mar	1943	15,800	41	1944	29,100	38.32
18	Jun	1944	29,100	42	2007	28,800	39.25
19	Mar	1945	52,300	43	1998	28,400	40.19
09	Jan	1946	27,100	44	1918	28,200	41.12
16	Jun	1947	56,200	45	2000	27,700	42.06
03	Mar	1948	34,500	46	1971	27,400	42.99
07	Mar	1949	30,800	47	1946	27,100	43.93
11	Mar	1950	33,000	48	1952	27,000	44.86
11	Apr	1951	54,100	49	1935	26,900	45.79
05	Apr	1952	27,000	50	1924	26,300	46.73
10	Aug	1953	15,200	51	2005	26,200	47.66
26	Jun	1954	41,400	52	1959	25,800	48.60
05	Mar	1955	8,100	53	1916	25,700	49.53
06	Apr	1956	5,400	54	1997	24,100	50.47
20	Jun	1957	9,900	55	1910	24,100	51.40
13	Jun	1958	5,240	56	1905	23,000	52.34
30	Mar	1959	25,800	57	1987	22,700	53.27
02	Apr	1960	55,100	58	1936	22,700	54.21
31	Mar	1961	73,000	59	1994	22,500	55.14
02	Apr	1962	50,000	60	1913	22,500	56.07
19	Mar	1963	15,600	61	1968	22,200	57.01
08	May	1964	4,270	62	1909	22,100	57.94
10	Apr	1965	66,800	63	1980	21,800	58.88
05	Oct	1965	29,200	64	1922	21,000	59.81
16	Jun	1967	16,000	65	1908	21,000	60.75
07	Aug	1968	22,200	66	1907	19,800	61.68
12	Jul	1969	54,500	67	2003	19,700	62.62
04	Mar	1970	14,300	68	1978	19,700	63.55
05	Apr	1971	27,400	69	1939	19,700	64.49
08	May	1972	12,400	70	1932	19,100	65.42

Plate A-2 Cedar Rapids Flow Frequency Data

PLATE A-2

21 Apr 1973	45,500	71	1985	18,000	66.36
14 Jun 1974	38,200	72	1921	17,900	67.29
24 Mar 1975	32,800	73	1941	17,100	68.22
22 Apr 1976	16,100	74	2006	17,000	69.16
18 Sep 1977	14,600	75	1914	17,000	70.09
23 Mar 1978	19,700	76	1995	16,400	71.03
20 Mar 1979	37,600	77	1976	16,100	71.96
16 Aug 1980	21,800	78	1967	16,000	72.90
29 Jun 1981	15,400	79	1923	16,000	73.83
23 Mar 1982	32,200	80	1943	15,800	74.77
19 Apr 1983	31,700	81	1963	15,600	75.70
21 Feb 1984	35,000	82	1981	15,400	76.64
22 Feb 1985	18,000	83	1953	15,200	77.57
23 Mar 1986	39,600	84	1920	14,800	78.50
18 Oct 1986	22,700	85	1977	14,600	79.44
08 Mar 1988	9,760	86	1970	14,300	80.37
16 Mar 1989	8,130	87	1911	14,300	81.31
02 Aug 1990	46,300	88	1996	13,700	82.24
23 May 1991	46,100	89	2002	13,000	83.18
13 Dec 1991	32,100	90	1938	12,900	84.11
04 Apr 1993	71,000	91	1925	12,800	85.05
08 Mar 1994	22,500	92	1972	12,400	85.98
27 Apr 1995	16,400	93	1930	12,200	86.92
06 Jun 1996	13,700	94	1927	11,800	87.85
16 Mar 1997	24,100	95	1904	11,800	88.79
26 Jun 1998	28,400	96	1926	11,500	89.72
25 Jul 1999	62,300	97	1957	9,900	90.65
15 Jul 2000	27,700	98	1988	9,760	91.59
17 Apr 2001	42,000	99	1934	8,620	92.52
05 Jun 2002	13,000	100	1989	8,130	93.46
16 May 2003	19,700	101	1955	8,100	94.39
27 May 2004	62,500	102	1940	5,540	95.33
03 Jul 2005	26,200	103	1956	5,400	96.26
08 Apr 2006	17,000	104	1958	5,240	97.20
27 Aug 2007	28,800	105	1964	4,270	98.13
13 Jun 2008	140,000	106	1931	3,270	99.07

Based on 106 events, mean-square error of station skew = 0.068
Mean-square error of regional skew = 0.145

Low Outlier Test

Based on 106 events, 10 percent outlier test value K(N) = 3.037
0 low outlier(s) identified below test value of 3,149.53

High Outlier Test

Based on 106 events, 10 percent outlier test value K(N) = 3.037
0 high outlier(s) identified above test value of 180,922.51

Frequency Curve Cedar Rapids

Computed Curve FLOW, CFS	Expected Probability	Percent Chance Exceedance	Confidence Limits 0.05 FLOW, CFS	0.95
121,751	126,050	0.2	154,333	100,220
106,007	108,959	0.5	132,313	88,301
94,109	96,251	1.0	115,943	79,171
82,214	83,678	2.0	99,841	69,921
66,458	67,256	5.0	78,980	57,436
54,444	54,870	10.0	63,503	47,694
42,198	42,380	20.0	48,206	37,493
24,852	24,852	50.0	27,682	22,334
13,824	13,747	80.0	15,542	12,121
9,938	9,828	90.0	11,382	8,480
7,474	7,340	95.0	8,736	6,203
4,246	4,075	99.0	5,202	3,313

Systematic Statistics Cedar Rapids

Log Transform: FLOW, CFS		Number of Events	
Mean	4.3779	Historic Events	0
Standard Dev	0.2896	High Outliers	0
Station Skew	-0.3697	Low Outliers	0
Regional Skew	-0.3630	Zero Events	0
Weighted Skew	-0.3676	Missing Events	0
Adopted Skew	-0.3630	Systematic Events	106

Plate A-3 Cedar Rapids Flow Frequency Data (continued) and Results

PLATE A-3

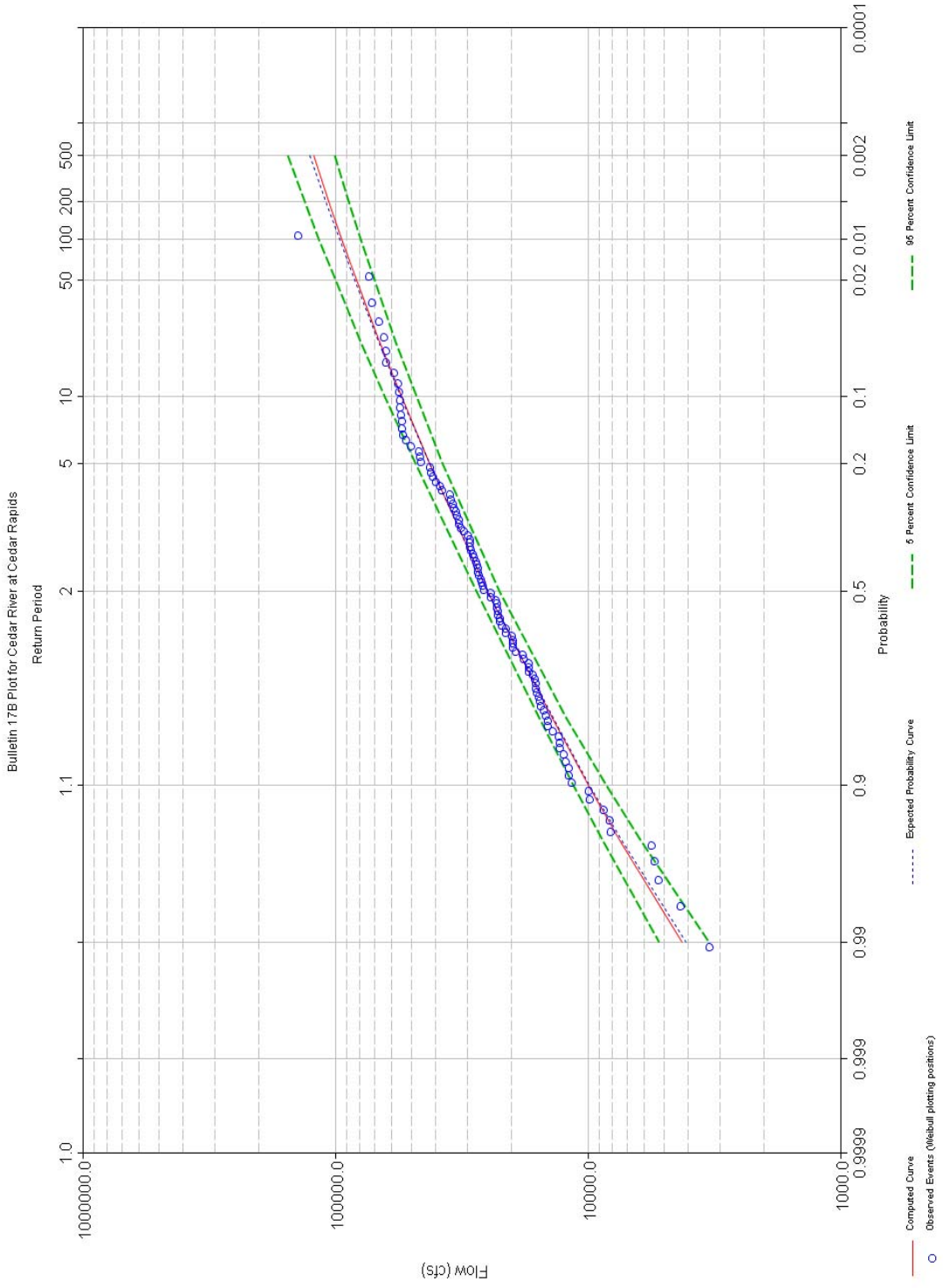


Plate A-4 Cedar Rapids Flow Frequency Curve

PLATE A-4

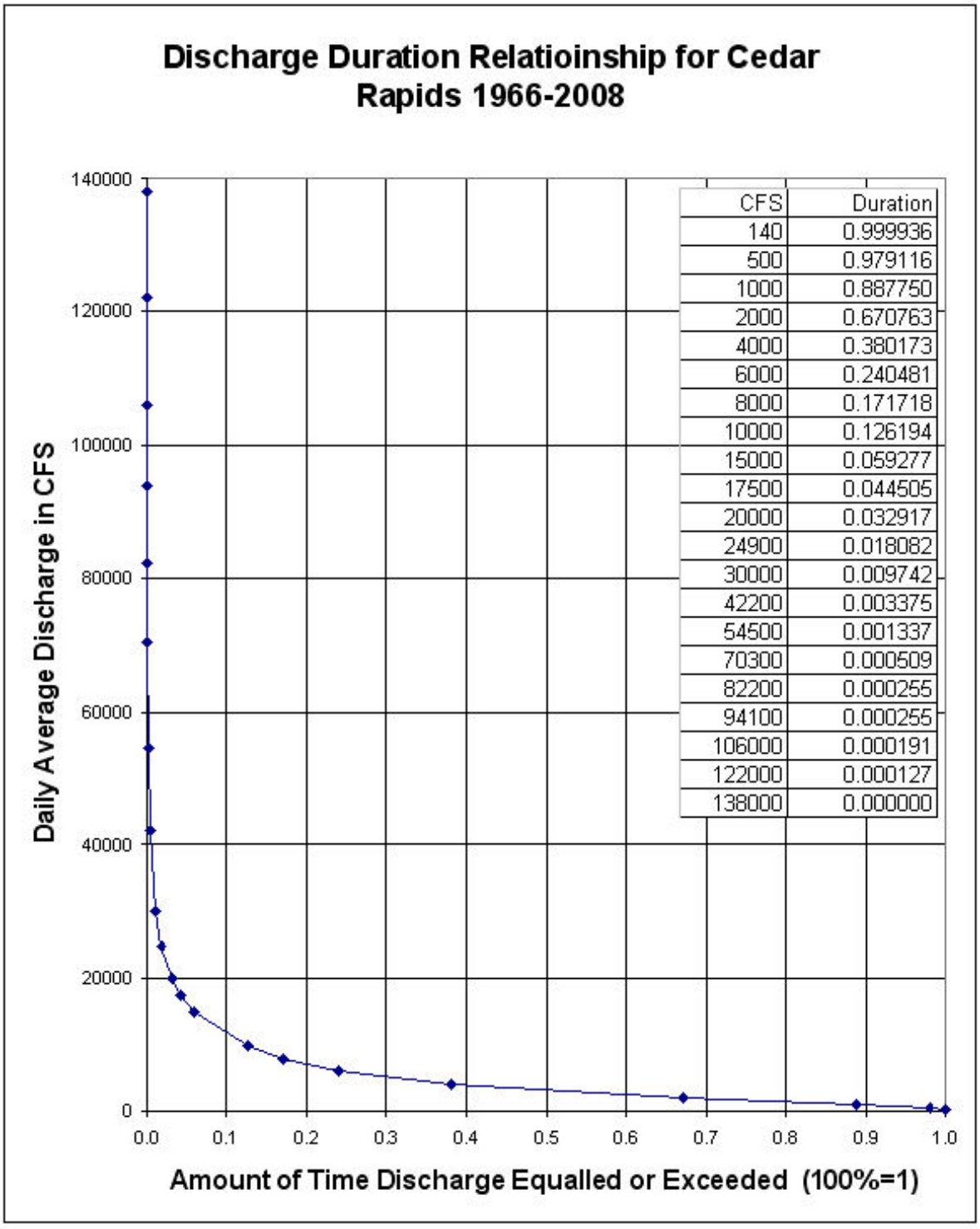
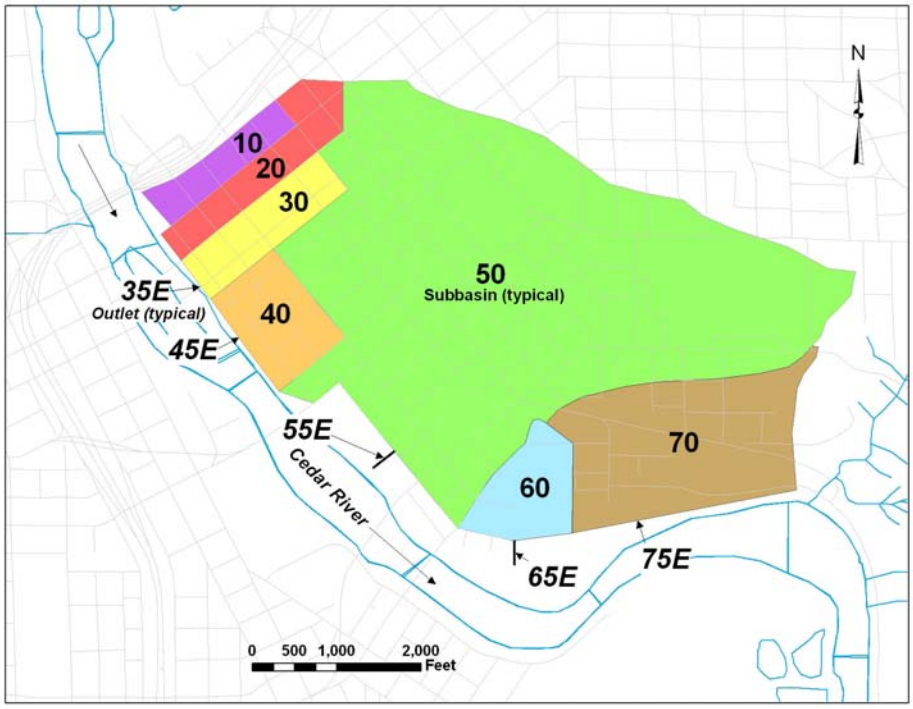


Plate A-5 Cedar River Discharge Duration Curve at Cedar Rapids Gage

PLATE A-5



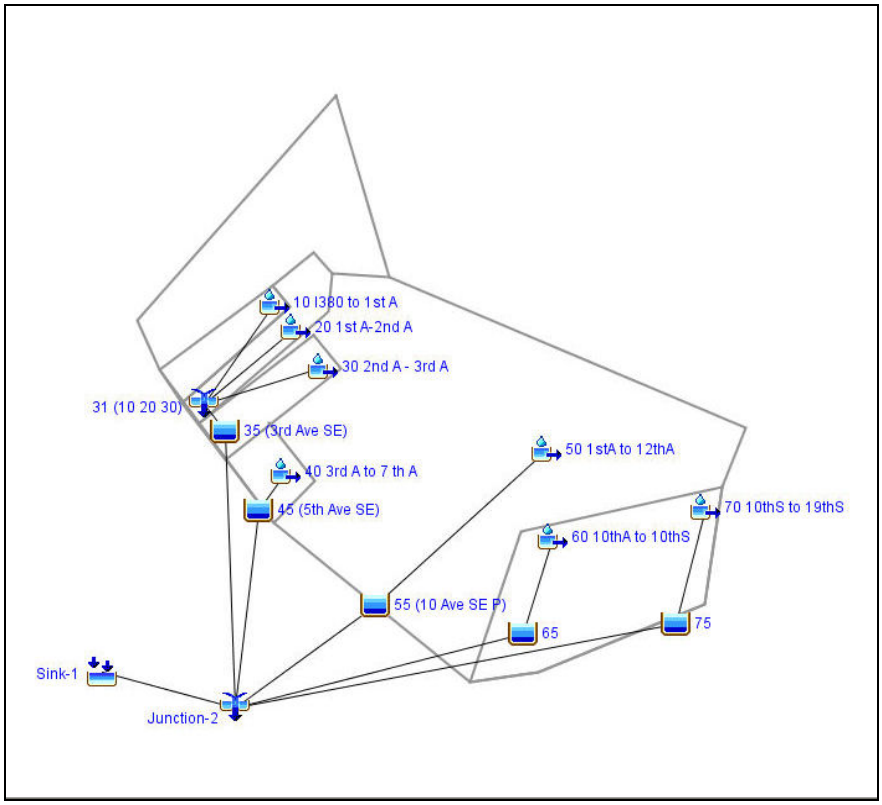


Plate A-6 East Cedar Rapids HEC-HMS Subbasin and Schematic Maps

PLATE A-6

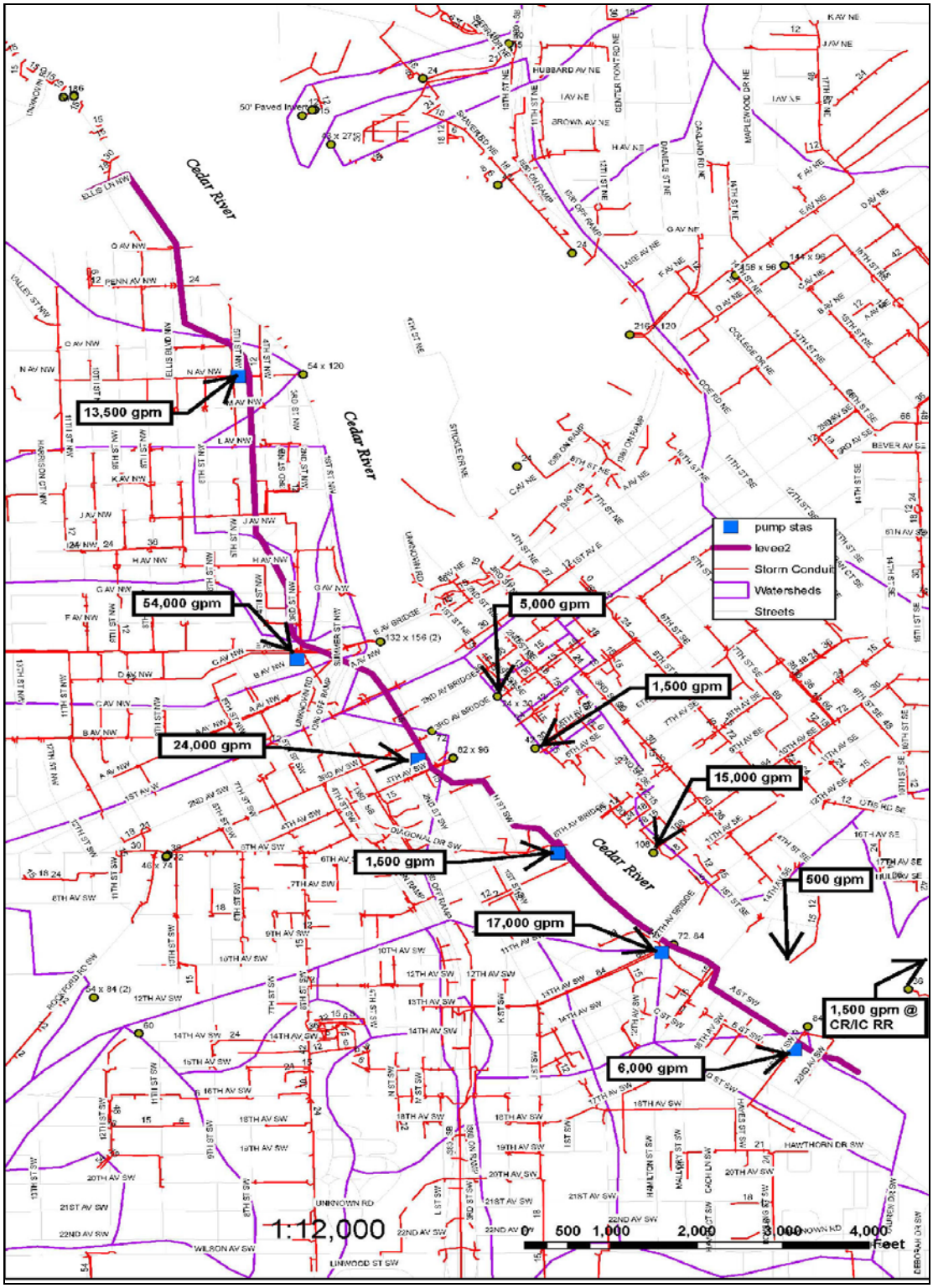


Plate A-7 Approximate Pump Station Location Map

PLATE A-7

East Bank Node 35E

HMS 35E Exceedance Probability	B5 TW 709.5	B4 TW 712.7	B3 TW 714.7	B2 TW 717	B1n Blocked no pump	B1p Blocked w/pump
0.002	719.3	719.8	720.6	721.6	728.2	727.0
0.01	717.9	718.5	719.3	720.3	727.8	726.6
0.02	717.2	717.8	718.5	719.5	727.4	726.3
0.04	716.7	717.2	717.8	718.9	727.1	726.0
0.1	715.8	716.5	717.2	718.2	726.7	725.3
0.2	714.7	716.0	716.8	717.9	726.5	724.8
0.5	713.1	715.0	716.3	717.6	726.2	724.4
0.999	712.0	714.1	715.9	717.3	725.8	724.1

East Bank Node 45E

HMS 45E Exceedance Probability	B5 TW 708	B4 TW 711.7	B3 TW 713.5	B2 TW 715.7	B1n Blocked no pump	B1p Blocked w/pump
0.002	711.6	712.7	714.5	716.7	724.1	723.4
0.01	711.2	712.4	714.2	716.4	723.8	723.1
0.02	711.0	712.2	714.0	716.2	723.6	722.9
0.04	710.7	712.1	713.9	716.1	723.4	722.7
0.1	710.4	712.0	713.8	716.0	723.1	722.4
0.2	710.2	711.9	713.7	715.9	722.9	722.3
0.5	709.9	711.8	713.6	715.8	722.7	722.2
0.999	709.7	711.8	713.6	715.8	722.5	722.1

East Bank Node 55E

HMS 55E Exceedance Probability	B5 TW 708	B4 TW 710.5	B3 TW 711.5	B2 TW 712.5	B1n Blocked no pump	B1p Blocked w/pump
0.002	715.4	715.4	715.4	715.7	724.0	722.9
0.01	714.2	714.2	714.3	714.7	723.4	722.3
0.02	713.4	713.4	713.6	714.2	722.9	721.8
0.04	712.6	712.7	713.1	713.7	722.5	721.2
0.1	711.6	711.9	712.5	713.2	722.0	720.5
0.2	711.0	711.5	712.2	713.0	721.6	720.2
0.5	710.0	711.0	711.8	712.8	721.0	719.2
0.999	709.1	710.7	711.7	712.6	720.6	718.5

Plate A-8 East Bank HEC-HMS Peak Interior Stage Results 35E, 45E and 55E

PLATE A-8

East Bank Node 65E

HMS 65E Exceedance Probability	B5 TW 712	B4 TW 712.5	B3 TW 713.5	B2 TW 714.5	B1n Blocked no pump	B1p Blocked w/pump
0.002	716.2	716.2	716.2	716.3	718.8	718.6
0.01	716.0	716.0	716.0	716.0	718.6	718.4
0.02	715.7	715.7	715.7	715.8	718.4	718.2
0.04	715.4	715.4	715.4	715.5	718.3	718.1
0.1	714.8	714.8	714.8	715.1	718.1	717.6
0.2	714.5	714.5	714.5	714.9	718.0	717.2
0.5	714.0	714.0	714.0	714.7	717.4	716.7
0.999	713.5	713.5	713.7	714.6	717.1	716.4

East Bank Node 75E

HMS 75E Exceedance Probability	B5 TW 710	B4 TW 712.5	B3 TW 713.5	B2 TW 714.5	B1n Blocked no pump	B1p Blocked w/pump
0.002	716.9	716.9	717.3	717.9	721.1	720.8
0.01	716.3	716.3	716.6	717.2	720.7	720.3
0.02	715.8	715.8	716.2	716.7	720.4	720.1
0.04	714.9	714.9	715.6	716.3	720.1	719.5
0.1	714.0	714.0	714.8	715.8	719.5	718.7
0.2	713.4	713.5	714.3	715.3	719.0	718.3
0.5	712.5	712.9	713.8	714.8	718.5	717.4
0.999	711.6	712.6	713.6	714.6	718.1	716.6

Plate A-9 East Bank HEC-HMS Peak Interior Stage Results 65E and 75E

PLATE A-9

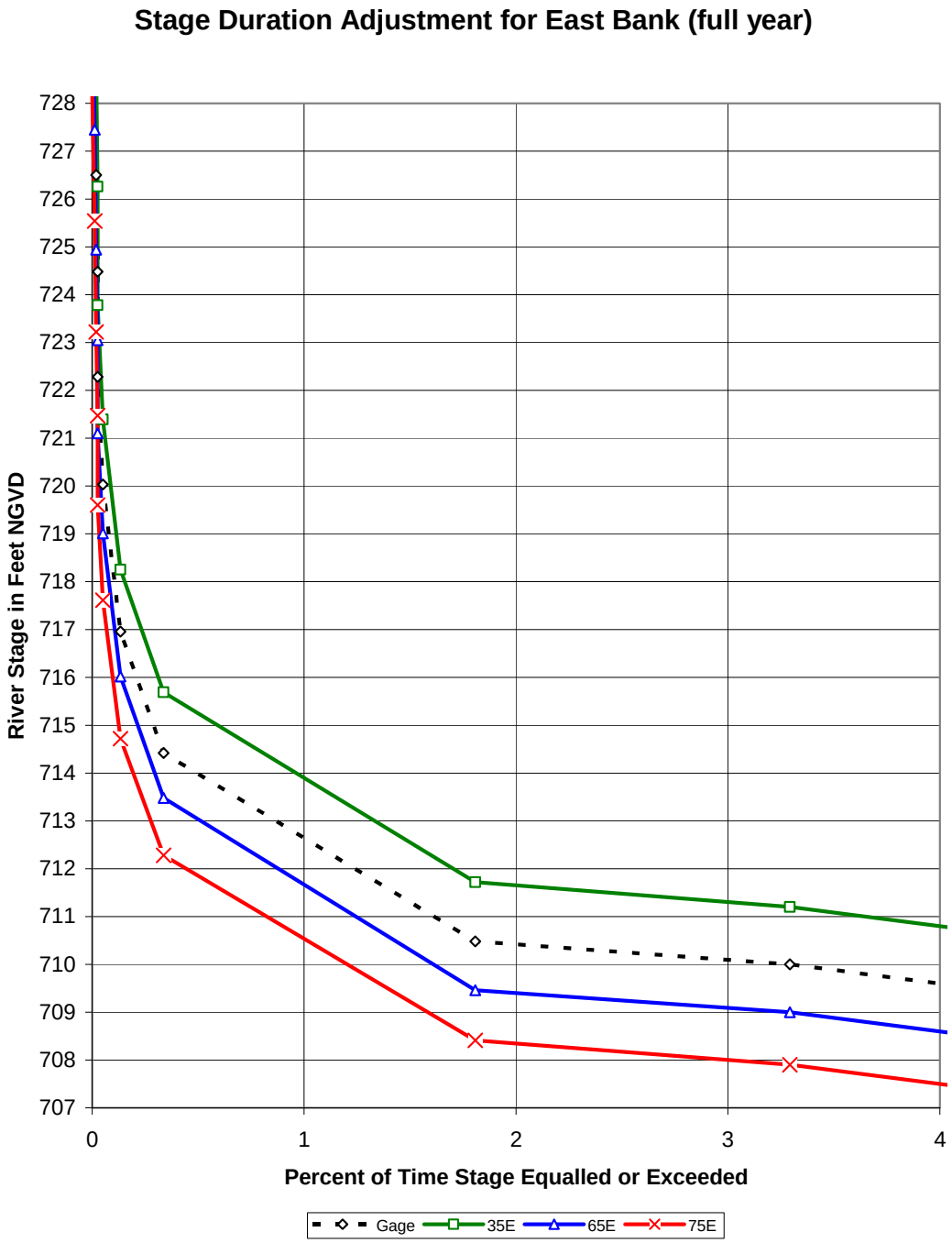


Plate A-10 Enlarged Detail of Stage Duration Curve for East Bank

PLATE A-10

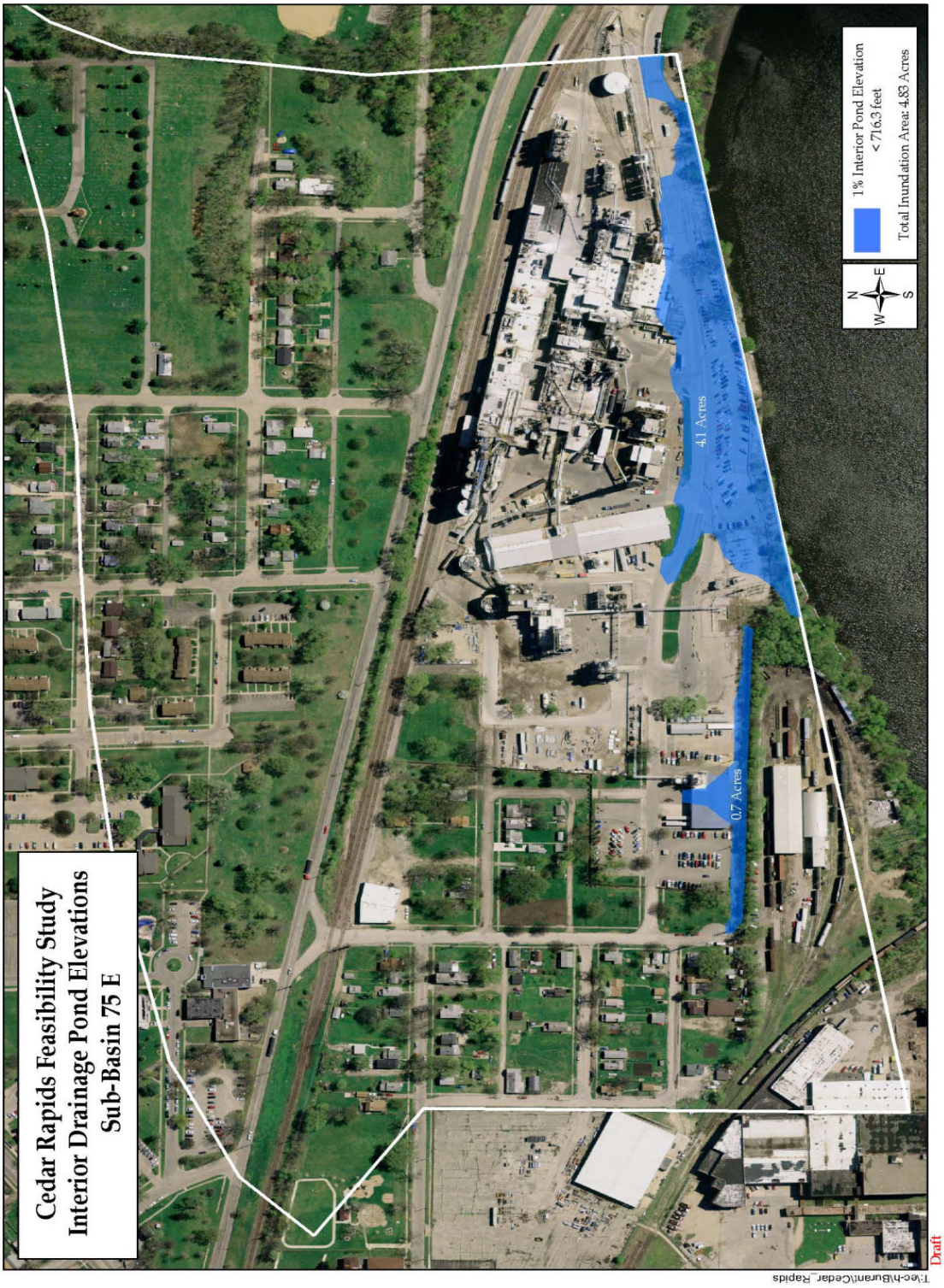


Plate A-11 Location and Area of Interior Flooding 75E

PLATE A-11

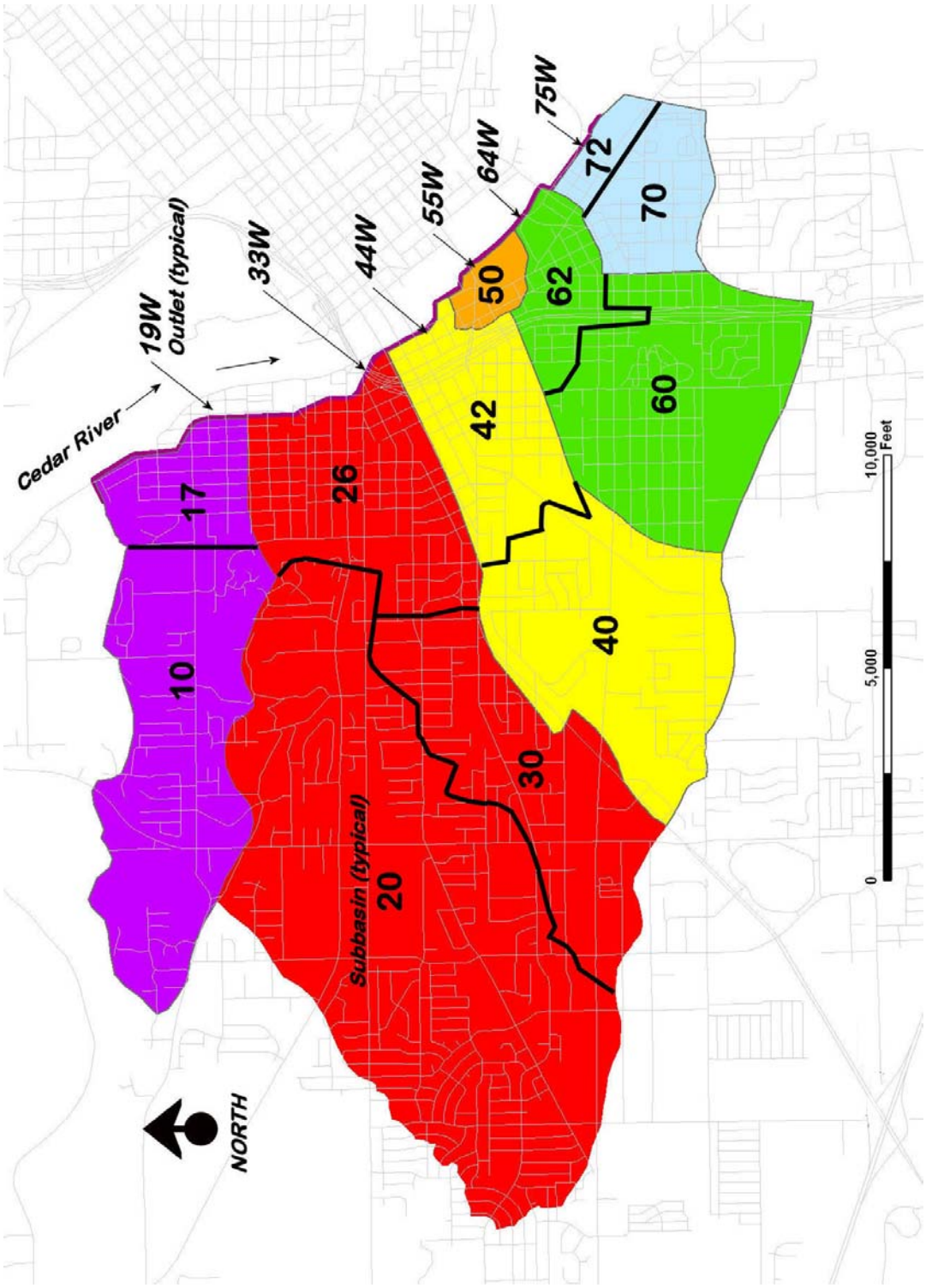


Plate A-12 West Cedar Rapids HEC-HMS Map

PLATE A-12

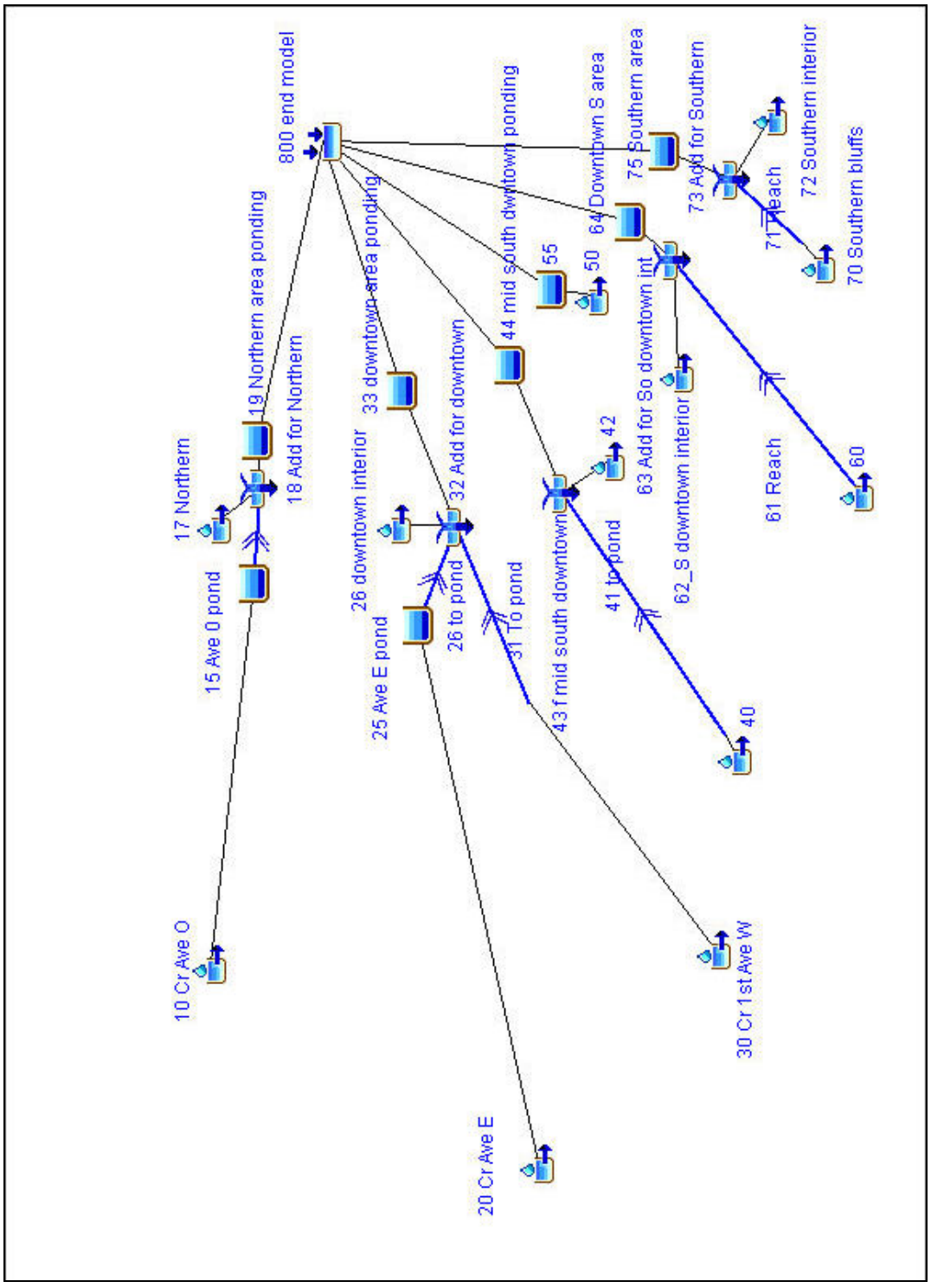


Plate A-13 West Cedar Rapids HEC-HMS Schematic

PLATE A-13

Existing Condition West Bank Node 19W

HMS 19W Exceedance Probability	B1 TW 718	B2 TW 720.6	B3 TW 722.2	B4 TW 723.2	B5 Blocked no pump	B5p Blocked w/pump
0.002	727.3	727.4	727.8	728.2	730.8	730.2
0.01	726.5	726.6	727.0	727.4	730.0	729.2
0.02	726.0	726.1	726.4	726.9	729.3	728.5
0.04	724.9	725.1	725.9	726.4	728.7	727.9
0.1	723.8	724.1	724.8	725.8	728.0	726.9
0.2	722.1	723.1	724.2	725.2	727.4	726.4
0.5	720.5	721.7	723.2	724.4	726.7	725.5
0.999	719.1	720.9	722.5	724.0	726.3	724.5

Minimum Facility West Bank Node 19W (increase number of culverts)

HMS 19W Exceedance Probability	B1 TW 718	B2 TW 720.6	B3 TW 722.2	B4 TW 723.2	B5 Blocked no pump	B5p Blocked w/pump
0.002	725.4	725.6	726.3	726.6	730.8	730.2
0.01	724.3	724.6	725.5	726.1	730.0	729.2
0.02	723.5	724.0	724.7	725.4	729.3	728.5
0.04	722.0	723.0	724.2	724.8	728.7	727.9
0.1	720.4	721.6	723.2	724.1	728.0	726.9
0.2	719.8	721.2	722.8	723.8	727.4	726.4
0.5	719.0	720.9	722.5	723.5	726.7	725.5
0.999	718.4	720.7	722.3	723.3	726.3	724.5

West Bank Node 33W

HMS 33W Exceedance Probability	B1 TW 714	B2 TW 717	B3 TW 718.5	B4 TW 719.5	B5 Blocked no pump	B5p Blocked w/pump
0.002	716.6	719.8	721.3	722.2	732.3	731.3
0.01	715.7	718.9	720.4	721.4	731.4	730.2
0.02	715.2	718.4	719.9	720.9	730.5	729.3
0.04	714.8	717.9	719.4	720.4	729.8	728.5
0.1	714.5	717.5	719.0	720.0	728.8	727.3
0.2	714.3	717.3	718.8	719.8	728.2	726.6
0.5	714.1	717.1	718.6	719.6	727.3	725.4
0.999	714.1	717.1	718.6	719.6	726.6	724.3

West Bank Node 44W

HMS 44W Exceedance Probability	B1 TW 713.5	B2 TW 716.8	B3 TW 719	B4 TW 720.6	B5 Blocked no pump	B5p Blocked w/pump
0.002	721.0	722.7	724.1	724.7	729.6	728.8
0.01	718.3	721.4	722.9	724.1	728.9	728.1
0.02	717.0	720.2	722.2	723.4	728.5	727.5
0.04	715.9	719.2	721.3	722.6	728.0	726.9
0.1	714.9	718.2	720.4	722.0	727.3	726.2
0.2	714.4	717.7	719.9	721.5	726.9	725.5
0.5	713.9	717.2	719.4	721.0	726.3	724.6
0.999	713.7	717.0	719.2	720.8	725.8	724.0

Plate A-14 West Bank HEC-HMS Peak Interior Stage Results 19W, 33W, and 44W

PLATE A-14

West Bank Node 55W

HMS 55W Exceedance Probability	B1 TW 710	B2 TW 711.75	B3 TW 713.5	B4 TW 714.5	B5 Blocked no pump	B5p Blocked w/pump
0.002	713.3	714.4	715.5	716.3	719.0	718.5
0.01	712.5	714.0	715.0	716.0	718.5	718.0
0.02	712.0	713.5	714.7	715.7	718.1	717.5
0.04	711.5	713.1	714.5	715.4	717.7	717.0
0.1	711.0	712.6	714.2	715.1	717.1	716.5
0.2	710.7	712.4	714.1	715.0	716.7	716.2
0.5	710.4	712.1	713.9	714.8	716.3	715.5
0.999	710.2	712.0	713.7	714.7	715.8	714.9

West Bank Node 64W

HMS 64W Exceedance Probability	B1 TW 710	B2 TW 711.75	B3 TW 713.5	B4 TW 714.5	B5 Blocked no pump	B5p Blocked w/pump
0.002	717.1	717.9	718.8	719.5	728.4	727.1
0.01	715.4	716.3	717.7	718.4	727.2	726.2
0.02	714.0	715.2	716.7	717.6	726.6	725.4
0.04	712.9	714.2	715.9	716.7	726.0	724.5
0.1	711.7	713.2	714.9	715.9	724.9	723.0
0.2	711.1	712.7	714.4	715.4	724.3	722.1
0.5	710.5	712.2	713.9	714.9	723.2	720.4
0.999	710.2	711.9	713.7	714.7	722.2	718.8

West Bank Node 75W

HMS 75W Exceedance Probability	B1 TW 710	B2 TW 712.5	B3 TW 713.5	B4 TW 714.5	B5 Blocked no pump	B5p Blocked w/pump
0.002	713.5	716.2	717.2	718.0	722.8	722.1
0.01	712.4	715.4	716.5	717.4	722.1	721.2
0.02	711.7	714.7	716.1	716.9	721.5	720.6
0.04	711.2	714.2	715.7	716.5	721.0	720.1
0.1	710.7	713.7	715.2	716.1	720.3	719.2
0.2	710.4	713.4	714.9	715.9	719.9	718.6
0.5	710.2	713.2	714.7	715.7	719.2	718.0
0.999	710.1	713.1	714.6	715.6	718.7	717.1

Plate A-15 West Bank HEC-HMS Peak Interior Stage Results 55W, 64W, and 75W

PLATE A-15

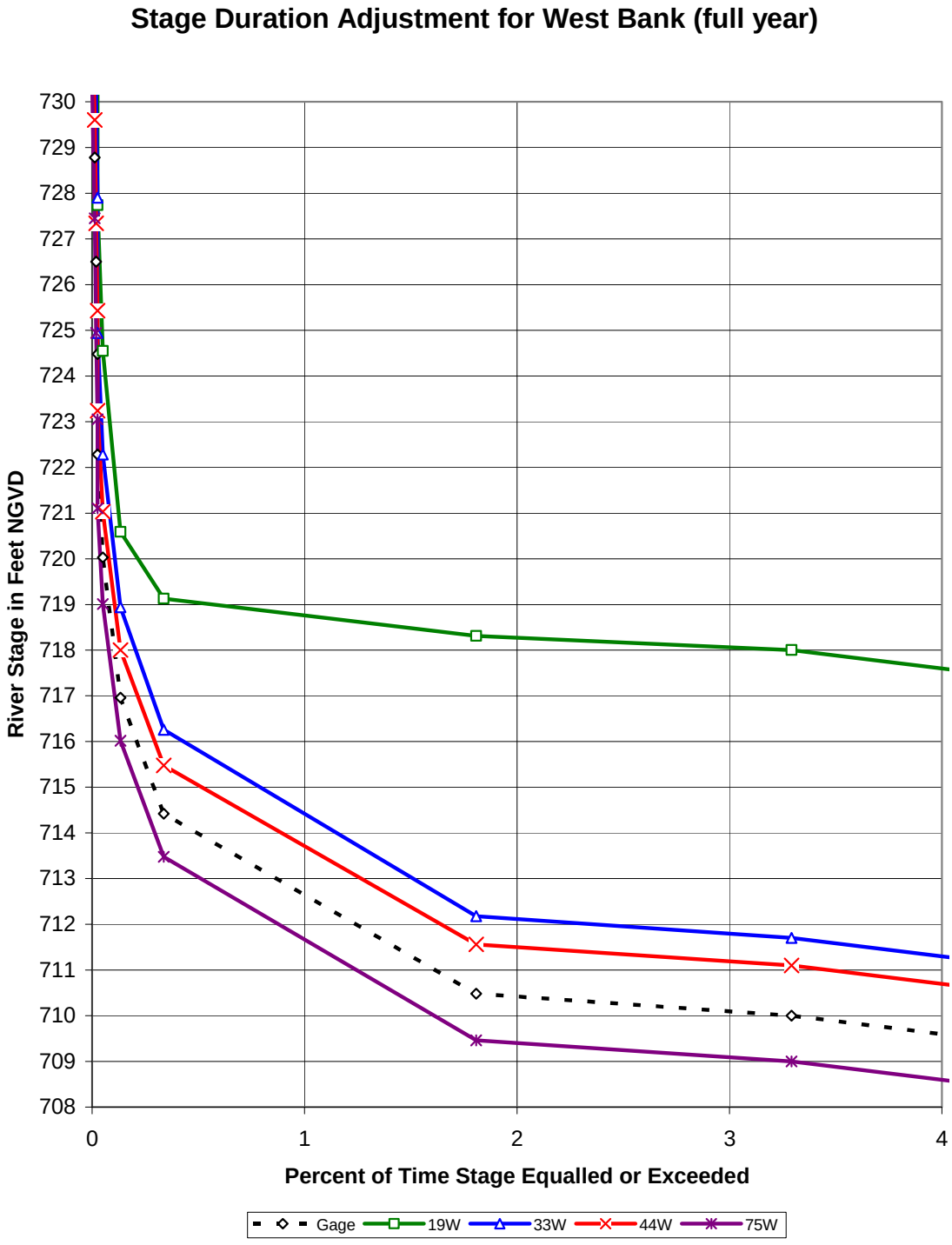


Plate A-16 Enlarged Detail of Stage Duration Curve for West Bank

PLATE A-16



Plate A-17 Location and Area of Interior Pond 64W

PLATE A-17



Plate A-18 Cedar Rapids Inundation Mapping (X-section 79.385 – 9,644.8)

PLATE A-18

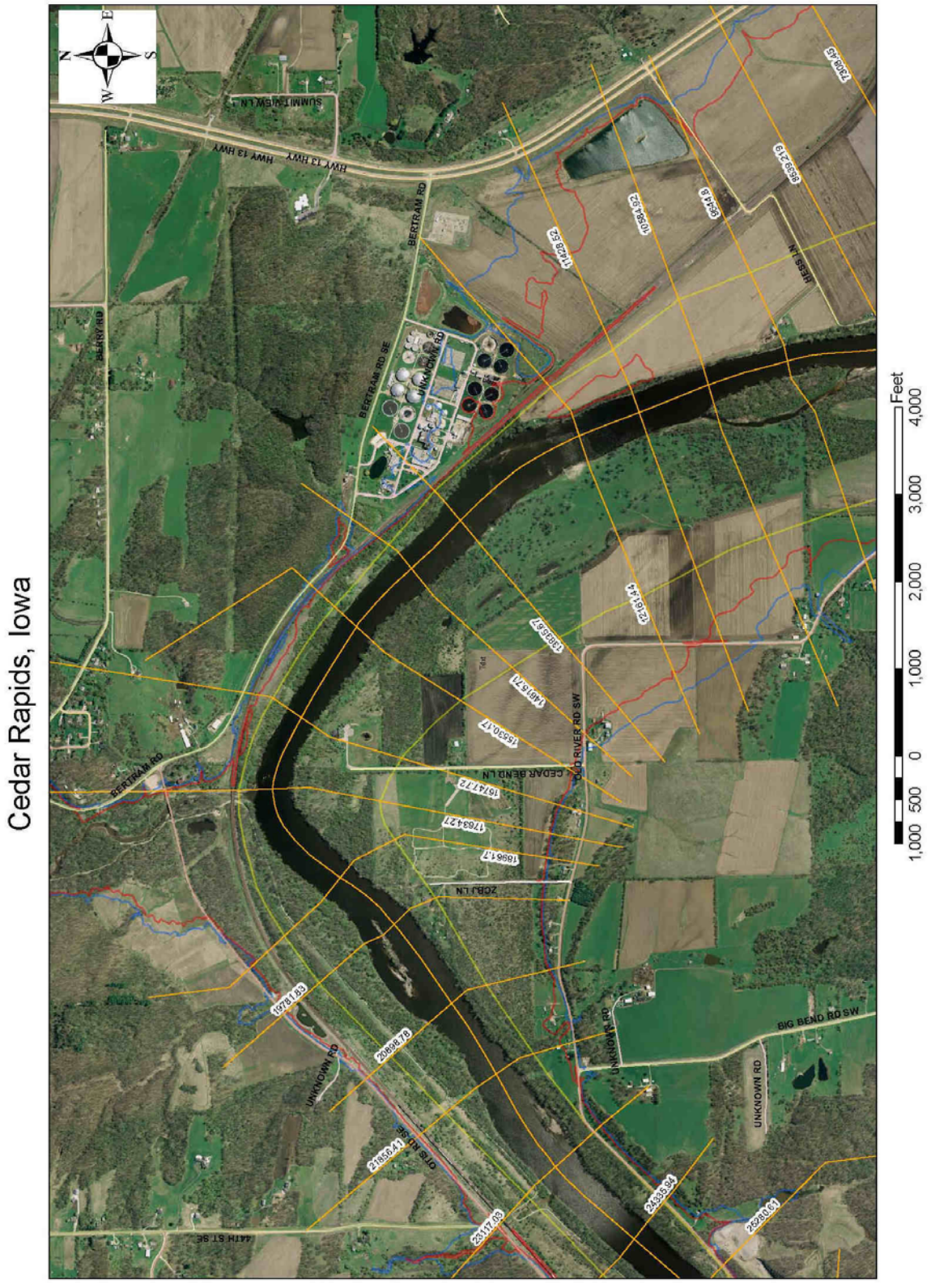


Plate A-19 Cedar Rapids Inundation Mapping (X-section 9,644.8 – 23,117.03)

PLATE A-19

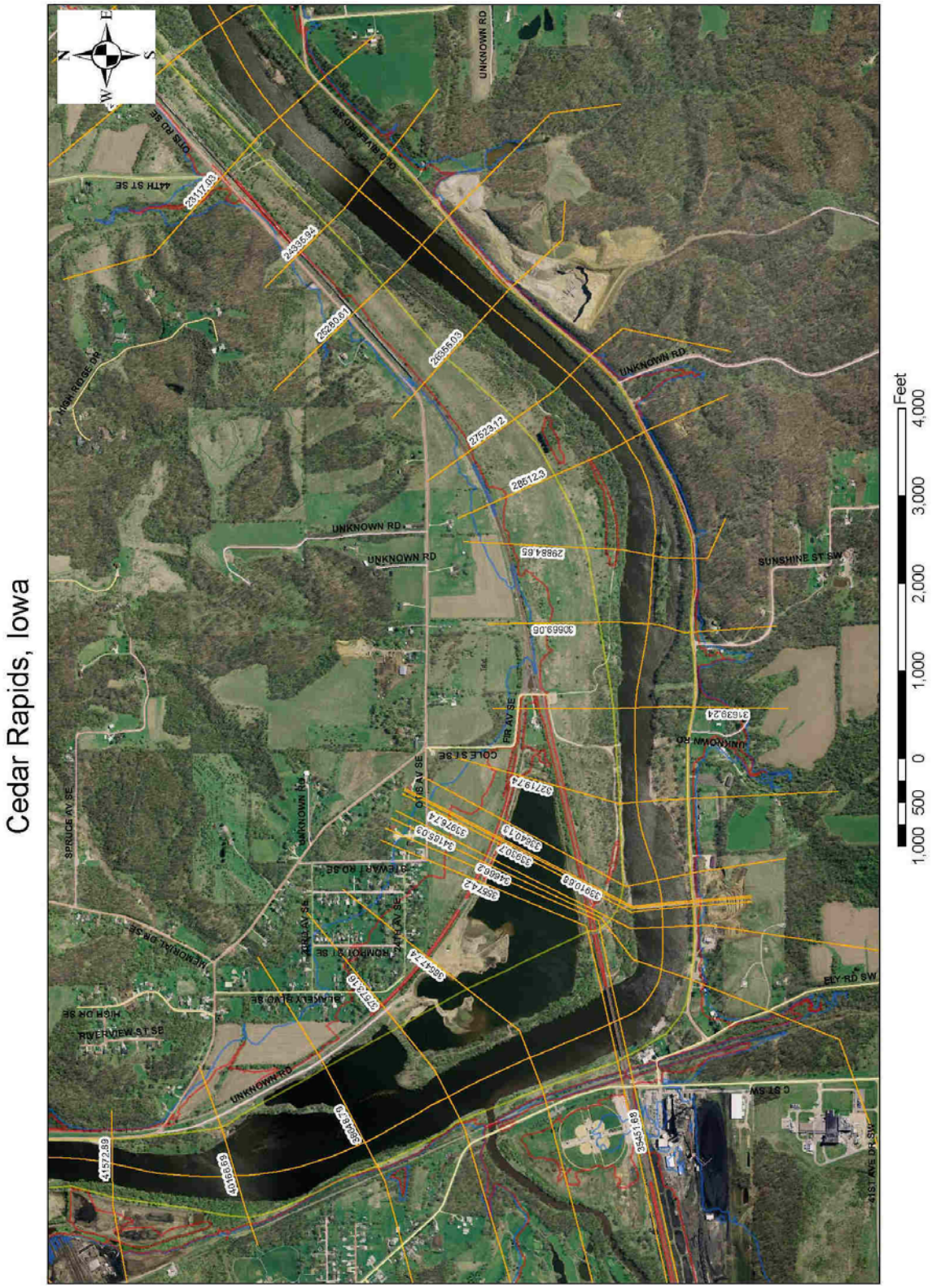


Plate A-20 Cedar Rapids Inundation Mapping (X-section 23,117.03 – 41,572.89)

PLATE A-20



Plate A-21 Cedar Rapids Inundation Mapping (X-section 40,166.69 – 55,549.12)

PLATE A-21



Plate A-22 Cedar Rapids Inundation Mapping (Downtown 1, X-section 46,268.91 – 52,442.23)

PLATE A-22



Plate A-23 Cedar Rapids Inundation Mapping
(Downtown 2, X-section 52,270.6 – 56,909.09)

PLATE A-23

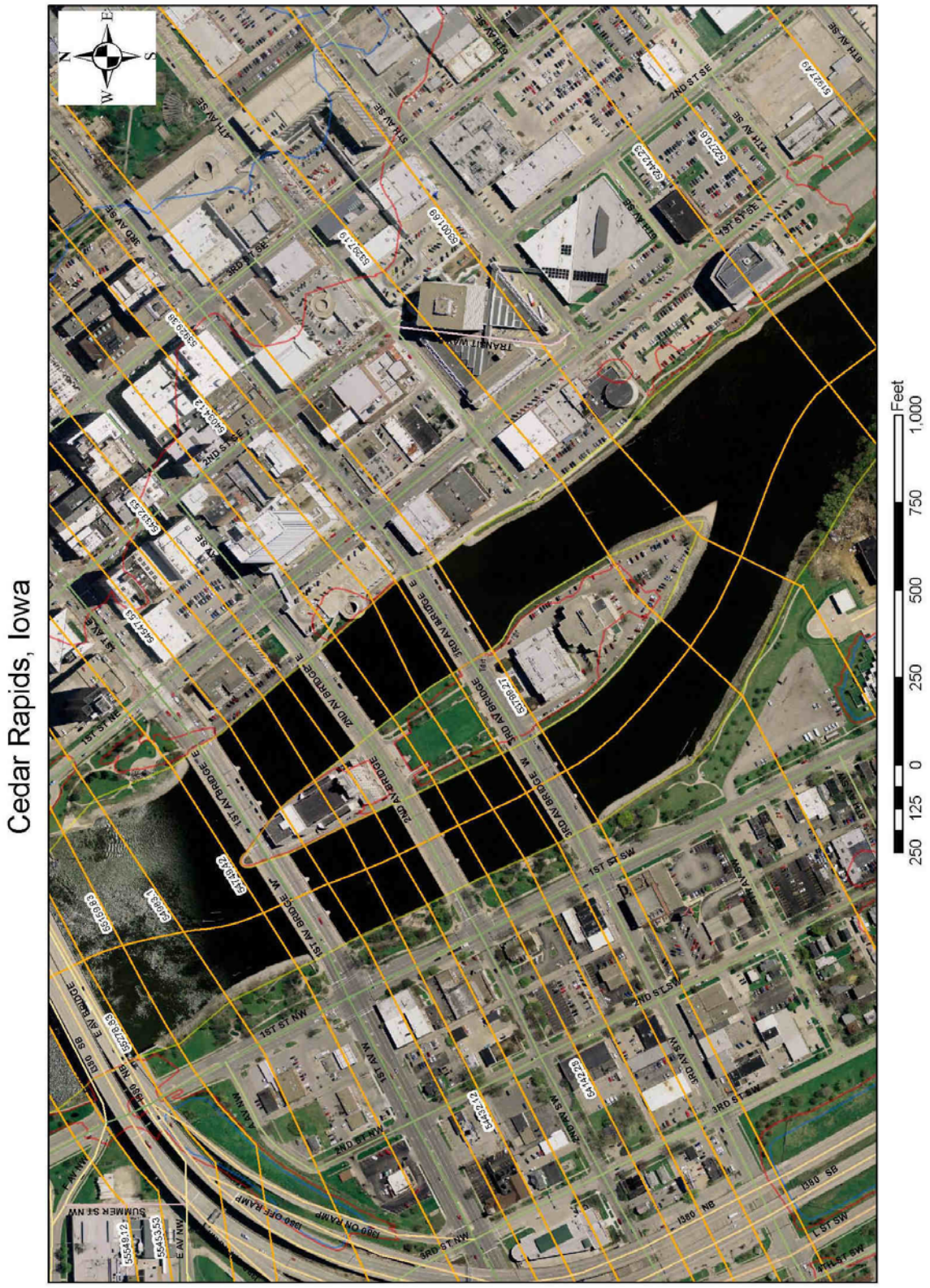


Plate A-24 Cedar Rapids Inundation Mapping (Mays Island, X-section 53,001.69 – 54,983.1)

PLATE A-24



Plate A-25 Cedar Rapids Inundation Mapping (X-section 55,549.12 – 63,708.75)

PLATE A-25

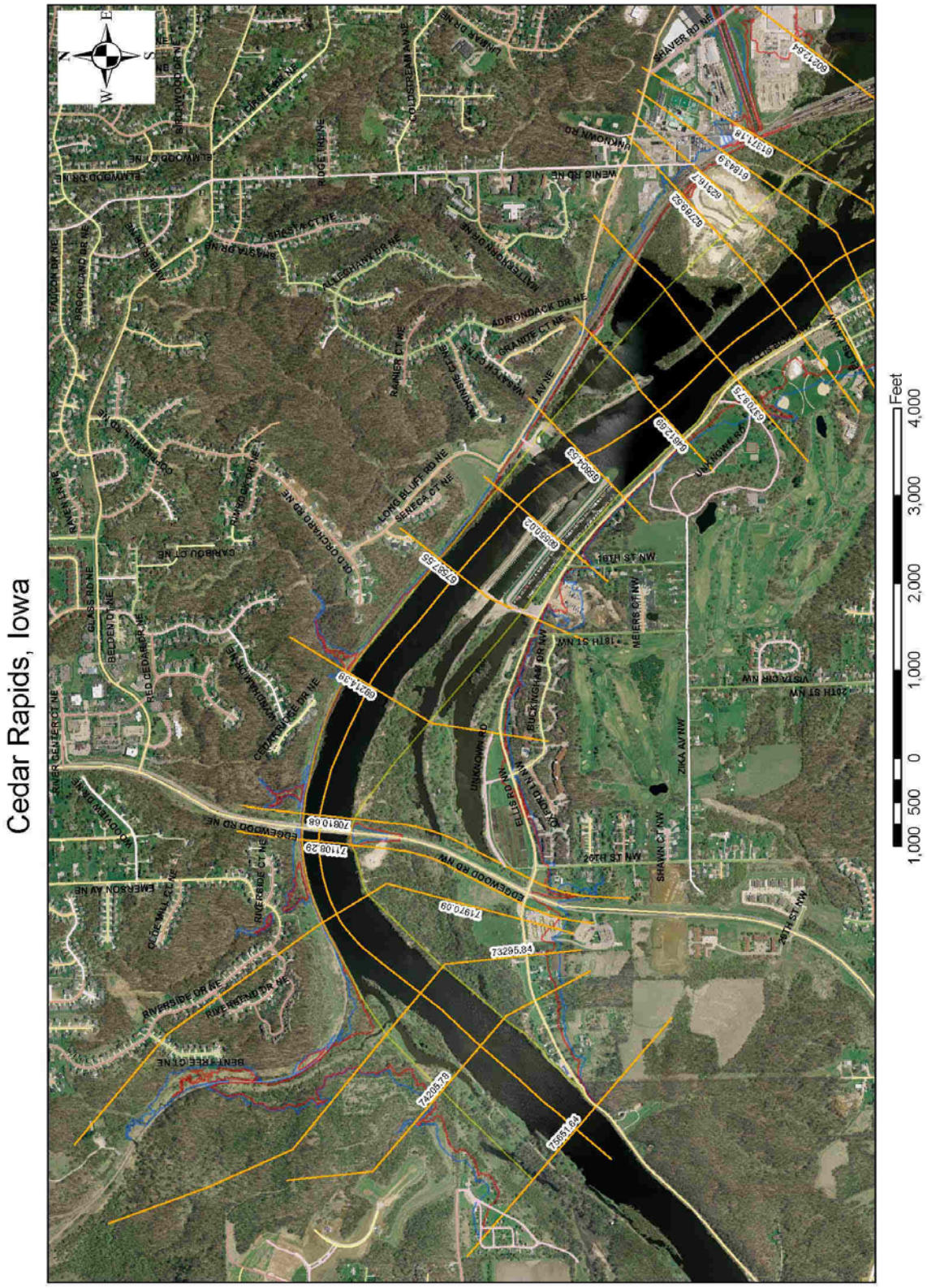


Plate A-26 Cedar Rapids Inundation Mapping (X-section 62,316.7 – 75,651.64)

PLATE A-26

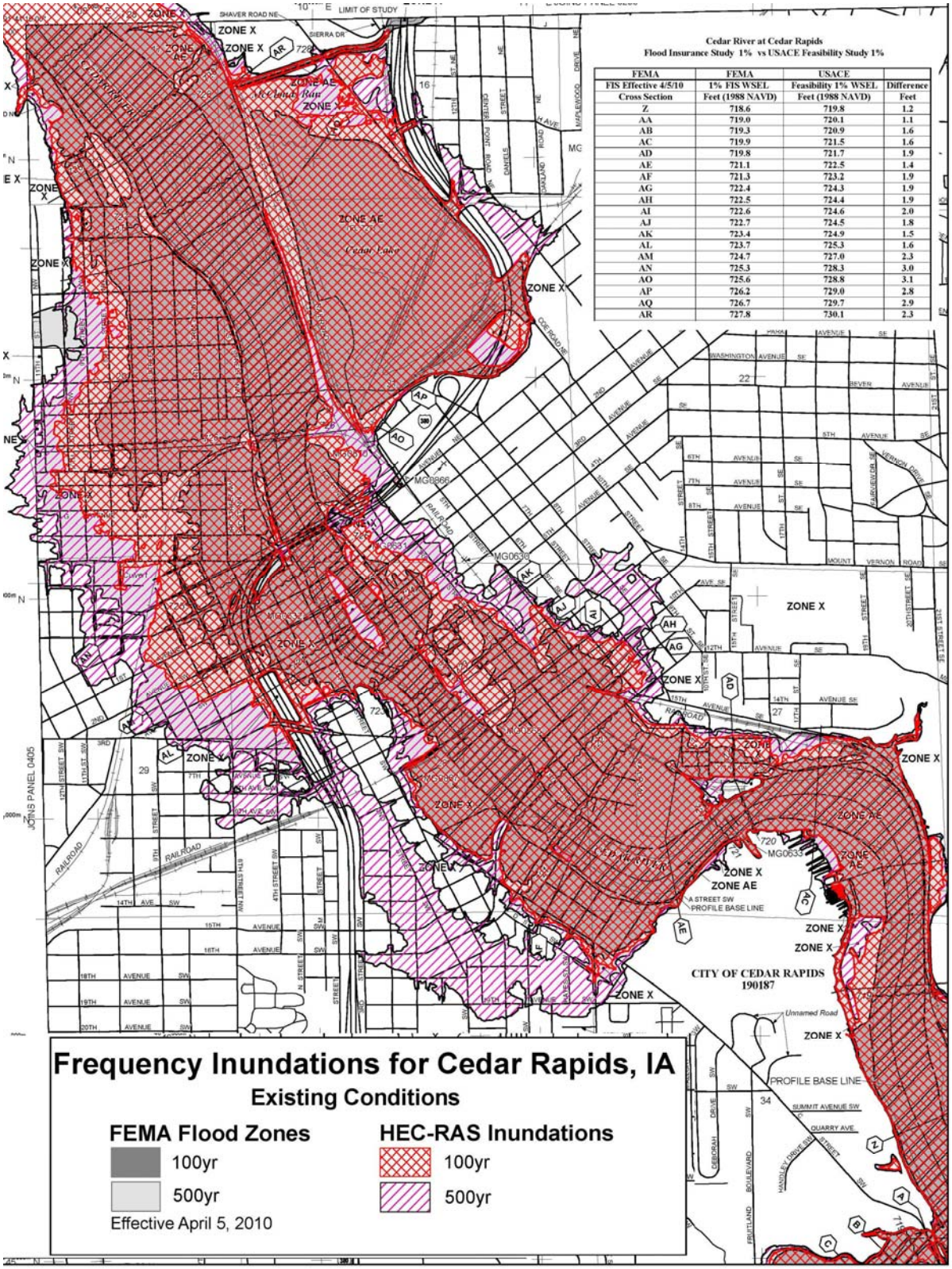


Plate A-27 Comparison of HEC-RAS and FEMA Flood Inundation Limits for Cedar Rapids

PLATE A-27

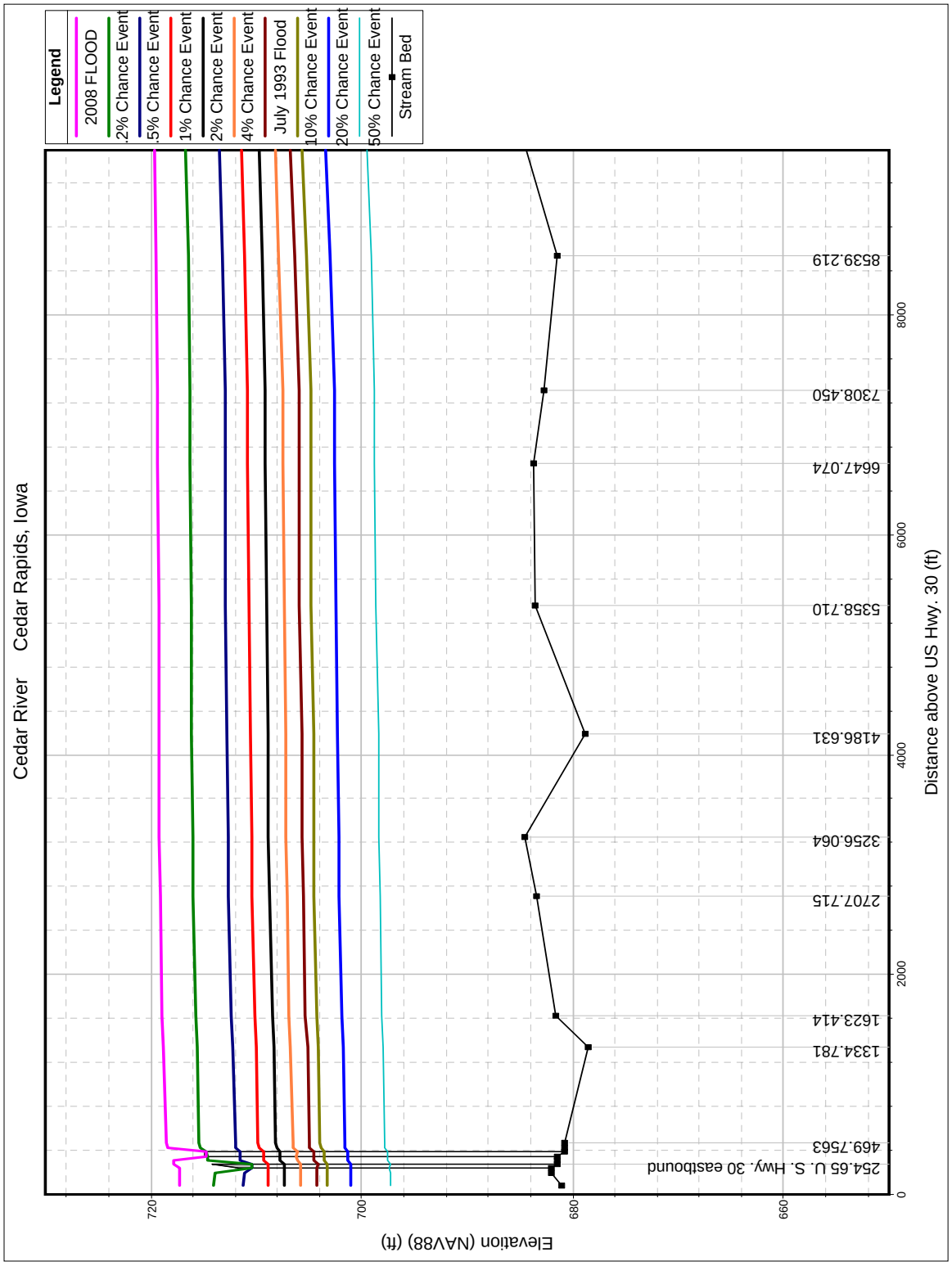


Plate A-28 Existing Condition Water Surface Profiles (Cedar River, X-section 79.38 – 8,539.219)

PLATE A-28

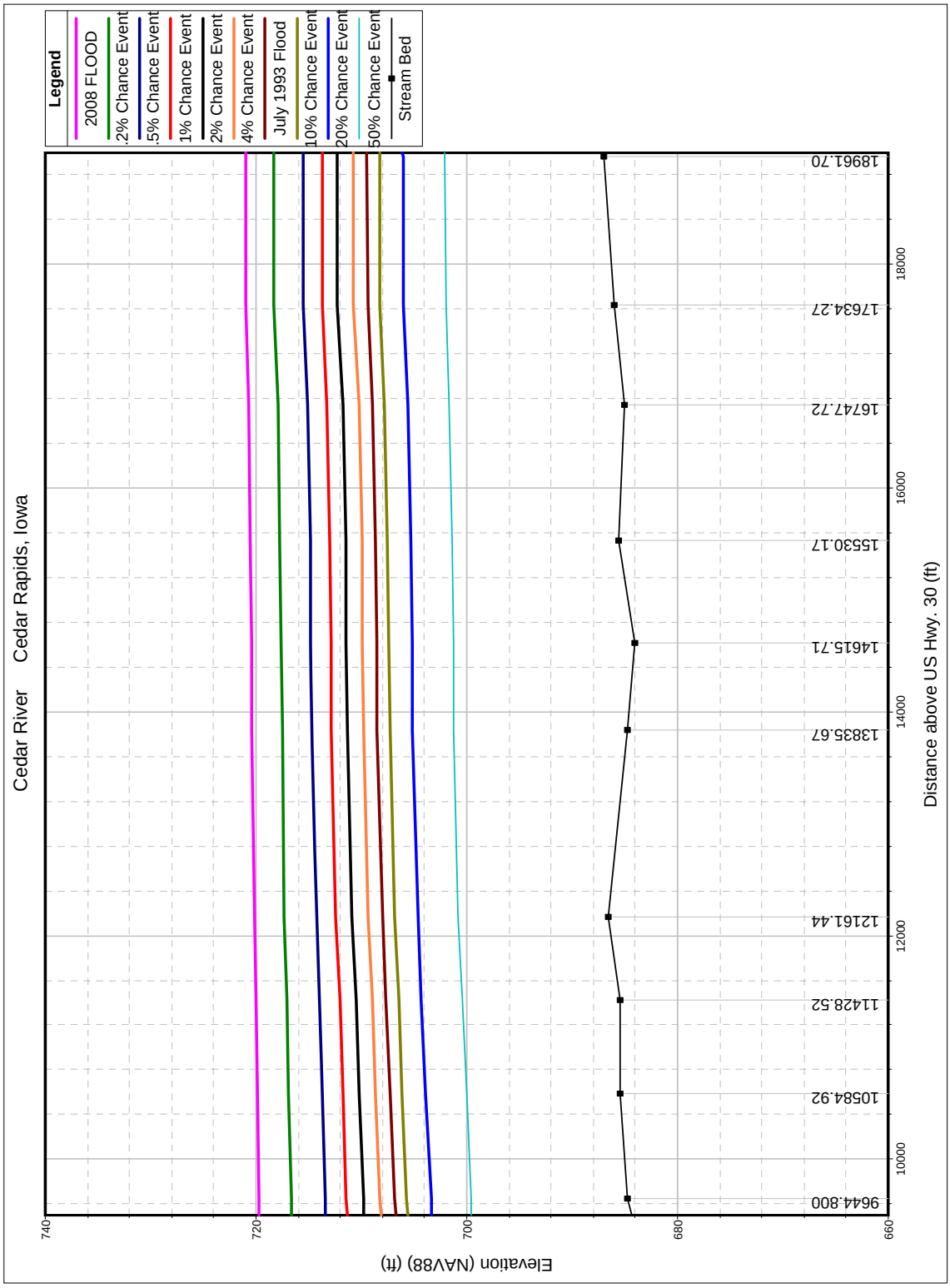


Plate A-29 Existing Condition Water Surface Profiles (Cedar River, X-section 9,644.800–18,961.70)

PLATE A-29

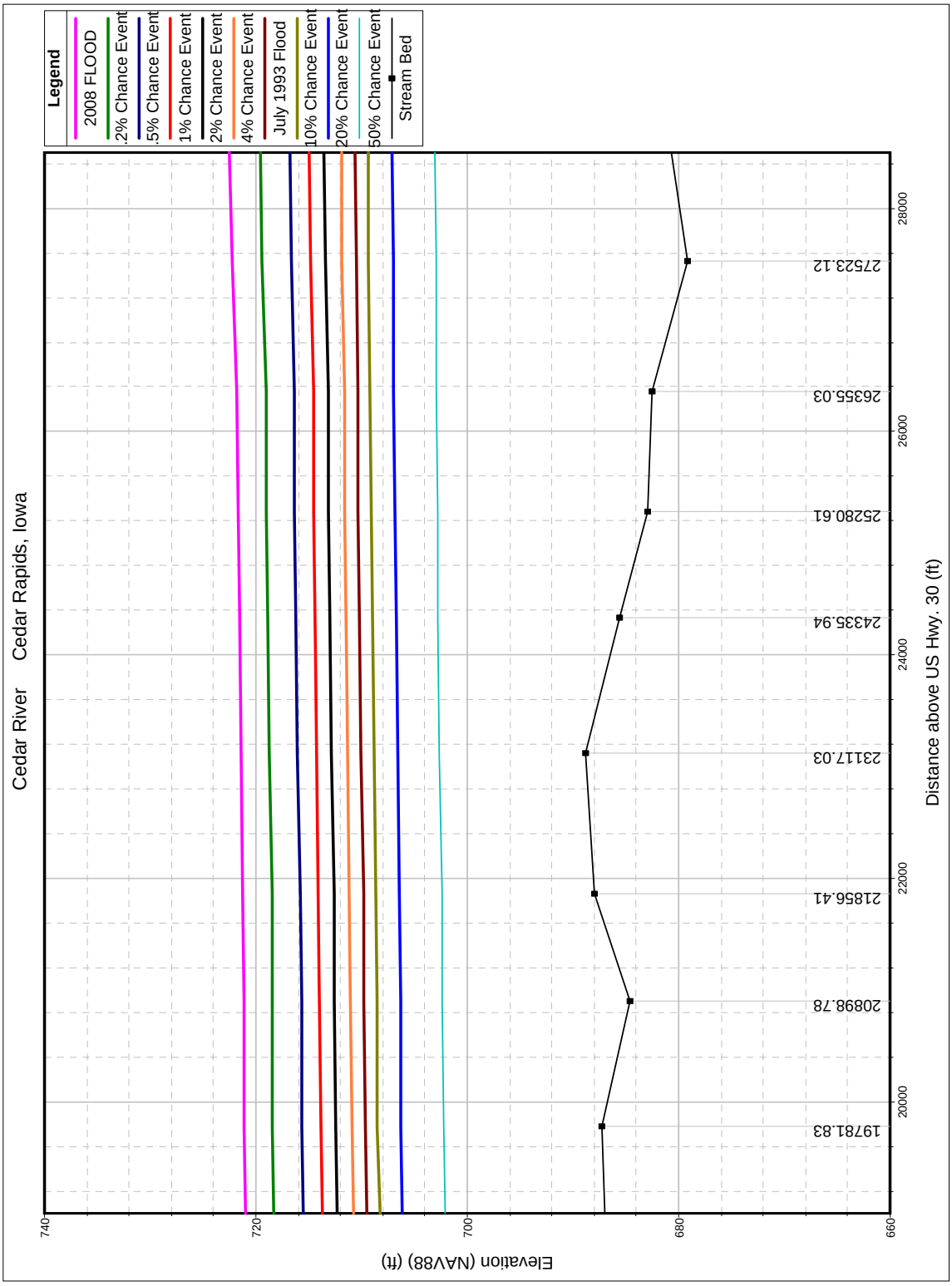


Plate A-30 Existing Condition Water Surface Profiles
(Cedar River, X-section 19,781.83–27,523.12)

PLATE A-30

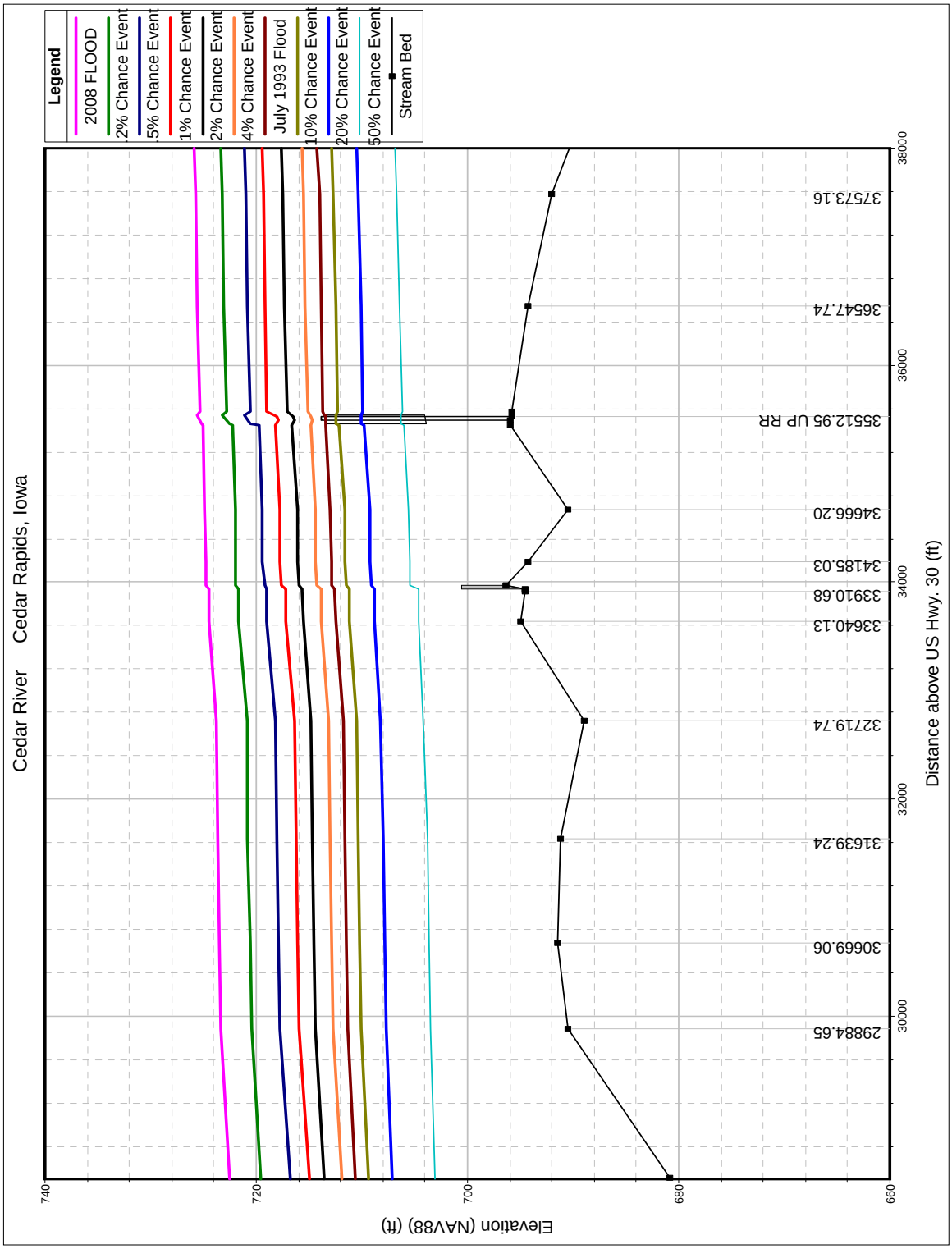


Plate A-31 Existing Condition Water Surface Profiles (Cedar River, X-section 29,884.65–37,573.16)

PLATE A-31

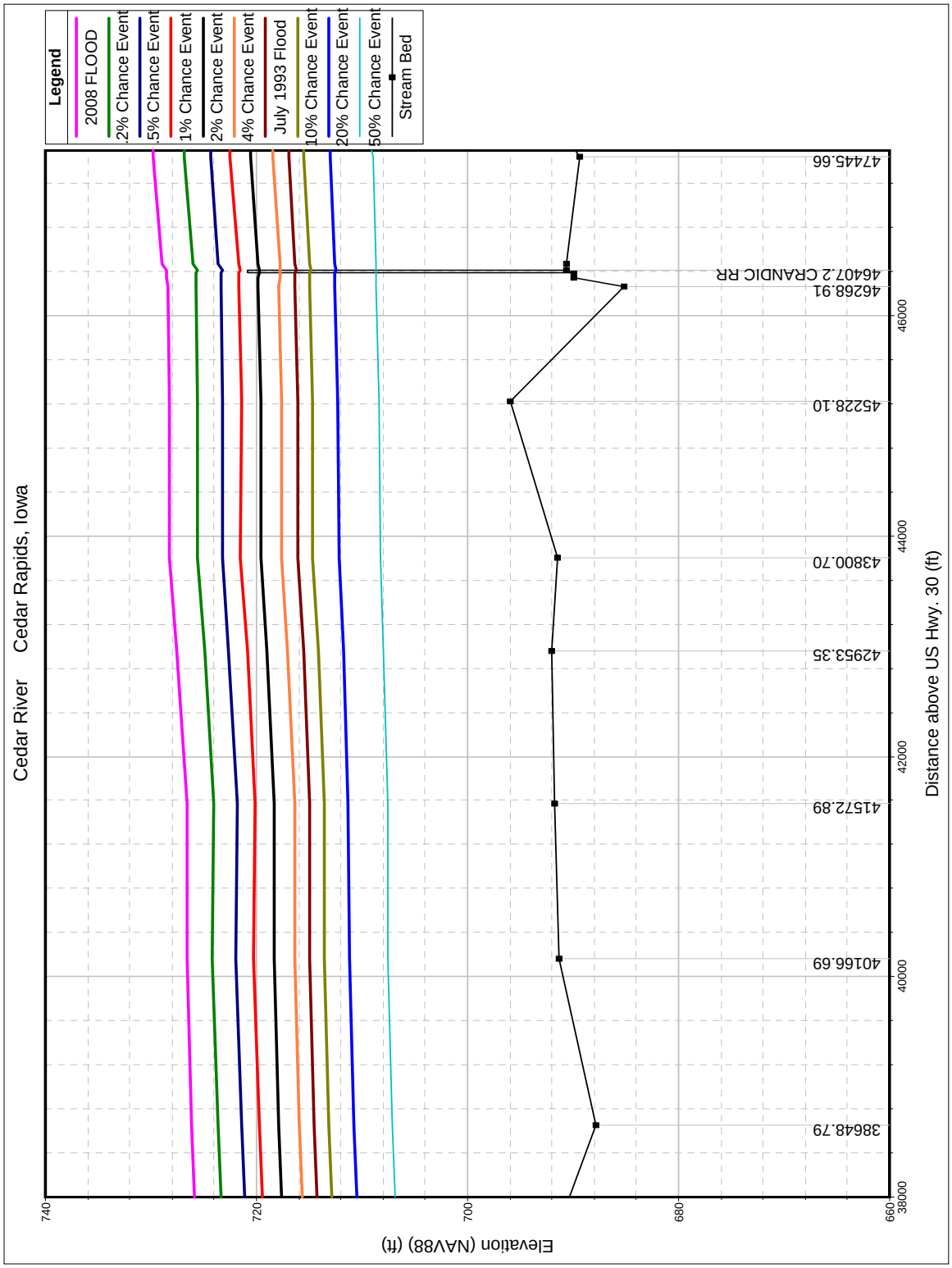


Plate A-32 Existing Condition Water Surface Profiles (Cedar River, X-section 38,648.79–47,445.66)

PLATE A-32

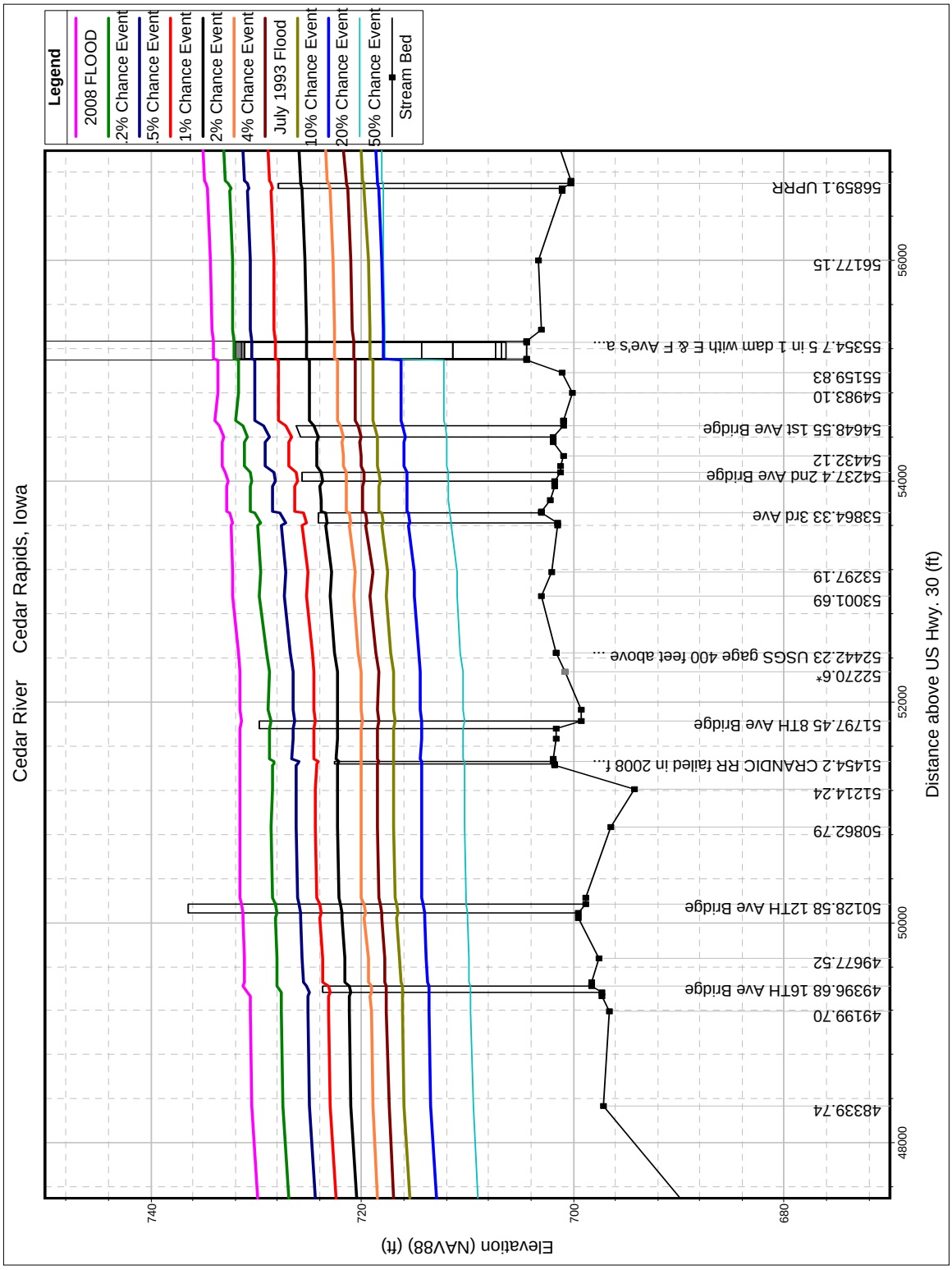


Plate A-33 Existing Condition Water Surface Profiles (Cedar River, X-section 48,339.74–56,859.1)

PLATE A-33

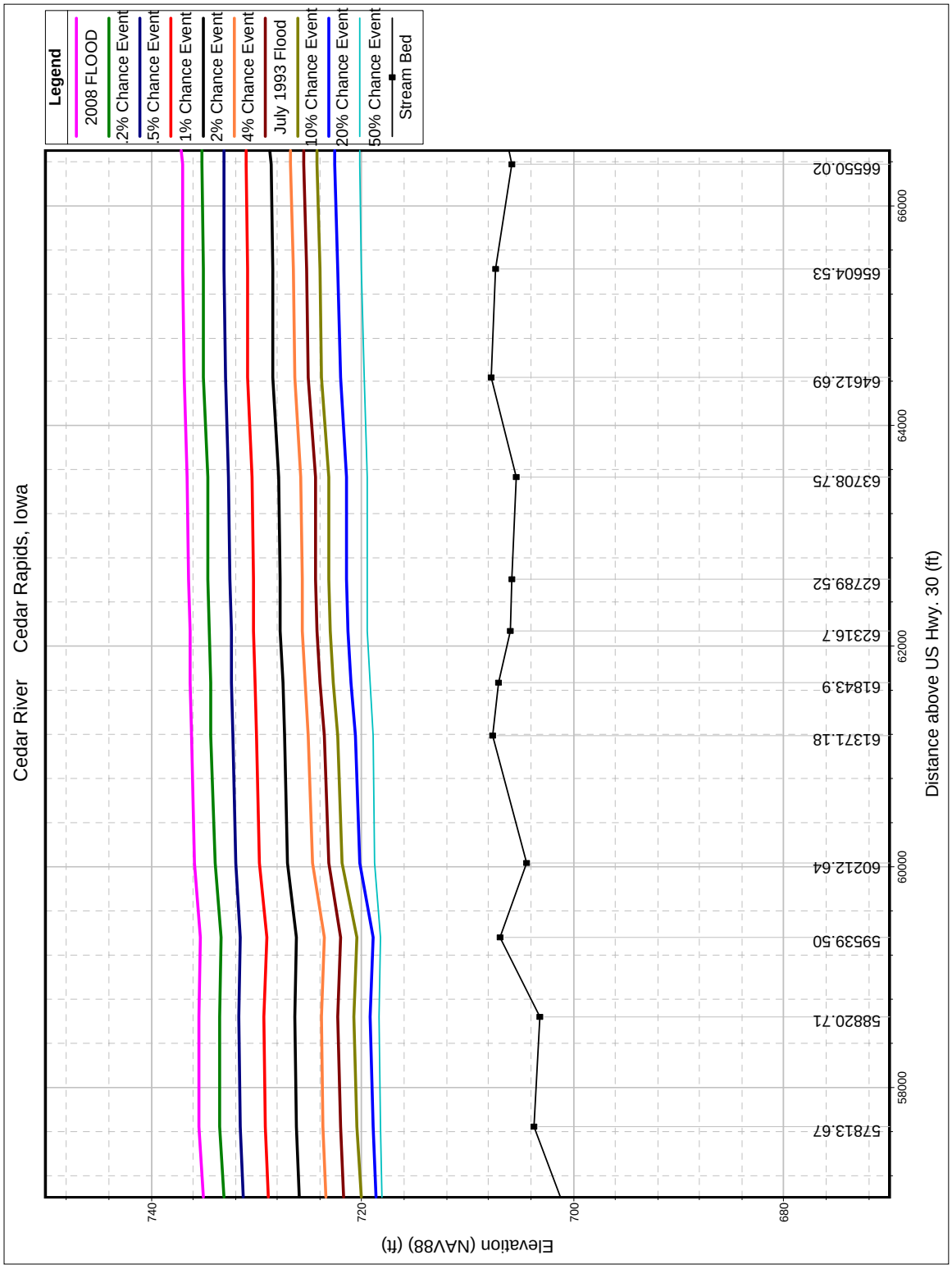


Plate A-34 Existing Condition Water Surface Profiles (Cedar River, X-section 57,813.67–66,550.02)

PLATE A-34

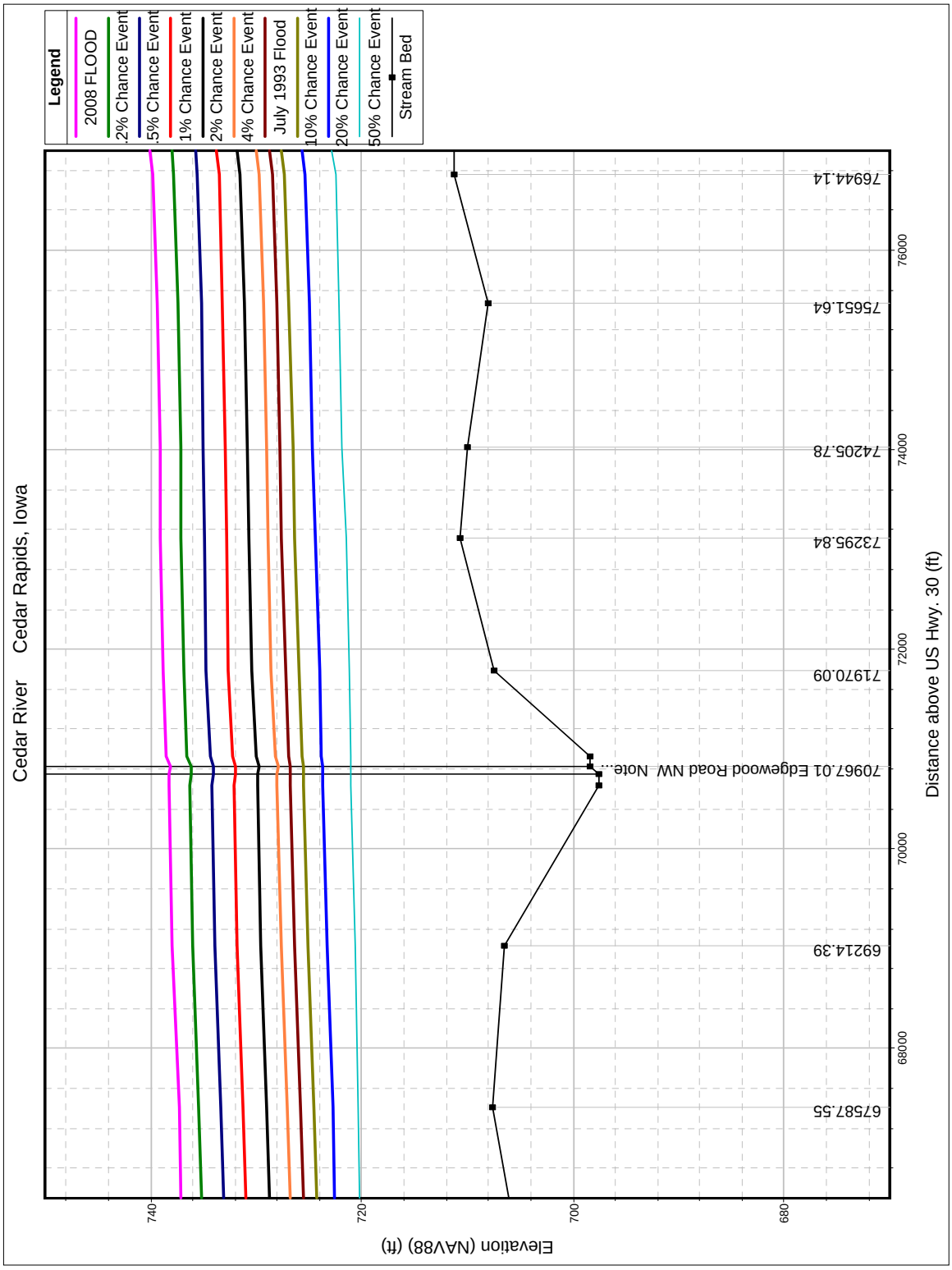


Plate A-35 Existing Condition Water Surface Profiles (Cedar River, X-section 67,587.55–76,944.14)

PLATE A-35

Approx. HEC-RAS X-section	2008 Cedar River Flood Profile Location / Description	High Water COE	High Water FEMA		HEC-RAS WSEL
168892.9	Lewis Access Rd over Cedar River Southwest of Center Point, IA High Water Mark Right D/S debris by trees	763.11			761.57
136210.7	Duane Arnold Energy Center NW of Cedar Rapids, IA HWM trash line in road ditch at intersection to power pole	749.95			750.00
116233	Chain Lakes Public Use Area NW of Cedar Rapids, IA HWM Right bank 1ST farm house U/S of abandon bridge	747.30			748.19
94711.22	Iowa Northern Railroad Bridge Northwest of Cedar Rapids, IA High Water Mark Left Bank at edge of ballast	746.64			746.74
71108	upstream of Edgewood Road NW 334-UIA-05-002		738.4		738.81
66550	334-UIA-04-001		736.9		736.79
65604	334-UIA-04-018		736.7		736.64
64612	334-UIA-04-003		736.4		736.55
62789	334-UIA-04-019		736		736.02
62316	Ellis Blvd. at Ellis Lane in Cedar Rapids, IA HWM water line on Jack Henry Salon & Spa Building	737.57			735.85
56909	UPRR at Quaker Oats in Cedar Rapids HWM water line on North side of Quaker Oats silos 334-UIA-05-020	735.41	735.2		734.86
54749	1 Ave Bridge over Cedar River in Cedar Rapids, IA HWM Right U/S of 1 Ave at Mautz Points 334-UIA-04-013	733.66	733.8		733.67
54547	334-UIA-04-014		733.7		733.14
54332	2 Avenue Bridge over Cedar River in Cedar Rapids, IA HWM Right Bank dirt stain on window	732.42			733.16
53799	3 Avenue Bridge over Cedar River in Cedar Rapids, IA HWM Left D/S 1/2 block East of River	732.33			732.09
52270	7 Avenue USGS Gage in Cedar Rapids, IA HWM disc on power pole South side of 7 Street set by USGS	731.89			731.52
51667	8 Avenue Bridge over Cedar River in Cedar Rapids, IA HWM Right D/S side water stain line on building	731.54			731.47
50219	12 Avenue Bridge over Cedar River in Cedar Rapids, IA HWM Right U/S debris and trash line on bank	731.19			731.51
49677	16 Ave Bridge over Cedar River in Cedar Rapids, IA HWM on decorative stone next to Czech Museum	731.2			731.19
47445	334-UIA-04-018 Cedar Rapids Solid Waste Agency HWM Right Bank on top step of Waste Agency	730.52	729.9		729.79
35574	UPRR Bridge over Cedar River in Cedar Rapids HWM water stain on railroad sign	725.66			725.3
17634	334-UIA-04-028 UPRR Bridge near Indian Creek Nature Center HWM water stain on deck post of Nature Center	721.10	720.7		720.99
12161	334-UIA-04-029		720.2		720.14
7308	334-UIA-04-024		719.3		719.36
4186	334-UIA-04-023		719.1		719.21

Note: Elevations in NAVD88

Plate A-36 Observed High Water Marks from 2008
(140,000 cfs)

PLATE A-36

Pump Facility 45E Without Pumping Condition (in $ 1,000's)

Interior Pond 45E Elev. (ft)	Exceedance Probability	Total Damage ($)	Compute incremental Damages ($)
709.7	1	0.640	
711.0	0.03281	0.890	0.740
711.7	0.01955	0.970	0.012
711.8	0.01502	0.970	0.004
712.8	0.01001	1.110	0.005
713.6	0.00669	1.190	0.004
715.0	0.00338	1.310	0.004
715.6	0.00236	1.351	0.001
716.6	0.00134	1.416	0.001
722.5	0.00134	4480.389	0.014
722.7	0.00064	5012.716	3.300
722.8	0.00045	5278.880	0.963
723.0	0.00020	6040.409	1.438
		Total without=	**5.049**

Pump Facility 45E With Pumping Condition (in $ 1,000's)

Interior Pond 45E Elev. (ft)	Exceedance Probability	Total Damage $	Compute incremental damages
709.7	1	0.640	
711.0	0.03281	0.890	0.740
711.7	0.01955	0.970	0.012
711.8	0.01502	0.970	0.004
712.8	0.01001	1.110	0.005
713.6	0.00669	1.190	0.004
715.0	0.00338	1.310	0.004
715.6	0.00236	1.351	0.001
716.6	0.00134	1.416	0.001
722.1	0.00134	3545.011	0.011
722.2	0.00064	3681.899	2.512
722.25	0.00045	3814.981	0.702
722.3	0.00020	3948.063	0.986
		Total with=	**3.997**

Benefit = $5,049-$3,997 = $1,052

Note: For this preliminary analysis the expected annual damages were calculated as shown above instead of using HEC-FDA. The exceedance interval was multiplied by the average damage over the interval to produce incremental damages which were totaled to give the answer.

Plate A-37 Example of EAD and Benefit Calculation Pump Facility 45E

PLATE A-37

CEDAR RIVER
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ACRONYMS AND ABBREVIATIONS

BCR	Benefit-to-Cost Ratio
CSVR	Content to Structure Value Ratio
DDF	Depth Damage Function
EAD	Expected Annual Damage
ERP	Emergency Response and Planning
FEMA	Federal Emergency Management Agency
FFE	First Floor Elevation
FIA	Flood Insurance Administration
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
HEC-FDA	Hydraulic Engineering Center – Flood Damage Analysis
HEC-RAS	Hydraulic Engineering Center – River Analysis System
IWR	Institute for Water Resources
LCA	Local Cooperation Agreement
M&S	Marshall & Swift
MSA	Metropolitan Statistical Area
NED	National Economic Development
NFIP	National Flood Insurance Program
O&M	Operation and Maintenance
OMB	U.S. Office of Management and Budget
PDT	Project Delivery Team
PED	Preconstruction, Engineering, and Design
WSE	Water Surface Elevation

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APPENDIX B ECONOMIC ANALYSIS

I. INTRODUCTION

The Economic Analysis Appendix provides information on the methodologies and details of the economic analysis conducted for the *Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study* (Study). Additional information regarding the Study can be found in the main report and appendices of the Study.

A. Purpose of the Study. This appendix describes the economic analysis of project alternatives for providing flood risk management measures for the City of Cedar Rapids, Iowa (City). The purpose is to provide a comprehensive review of the methodology applied and results of the economic analysis performed on the flood risk management (FRM) alternatives for the Study. The array of FRM alternatives are described in detail, in addition to how the optimal level of protection was identified for each one. This appendix also presents detailed results of the economic analysis for each alternative and a comparative evaluation.

B. Study Area. The Cedar Rapids Study area is located in Linn County, Iowa. The Cedar River Watershed is in Northeastern Iowa, approximately 70 miles west of Dubuque, Iowa; 30 miles north of Iowa City, IA; and 130 miles northeast of Des Moines, IA. The Cedar River Watershed is 6,997 square miles and stretches from southeastern Minnesota to just southwest of Muscatine, Iowa, where it combines with the Iowa River. The Iowa River enters the Mississippi River south of Muscatine, Iowa. Cedar Rapids is the second largest city in the State of Iowa, and is situated on the Cedar River, which flows through the City. The area is served by major state and Federal highways, the Interstate Highway system, railways, and a regional airport.

The Study area includes both banks of the Cedar River within the City limits (figure B-1). The Study area includes the downtown business district, residential neighborhoods, commercial and industrial area, and critical infrastructure including potable water supply, wastewater treatment, power generation, and public health and safety facilities. For analysis purposes, the Study area was delineated into "reaches," all of which exhibit fairly dense urban land use. Figure B-1 illustrates the delineation of the reaches and table B-1 lists the reaches by title and street boundaries.

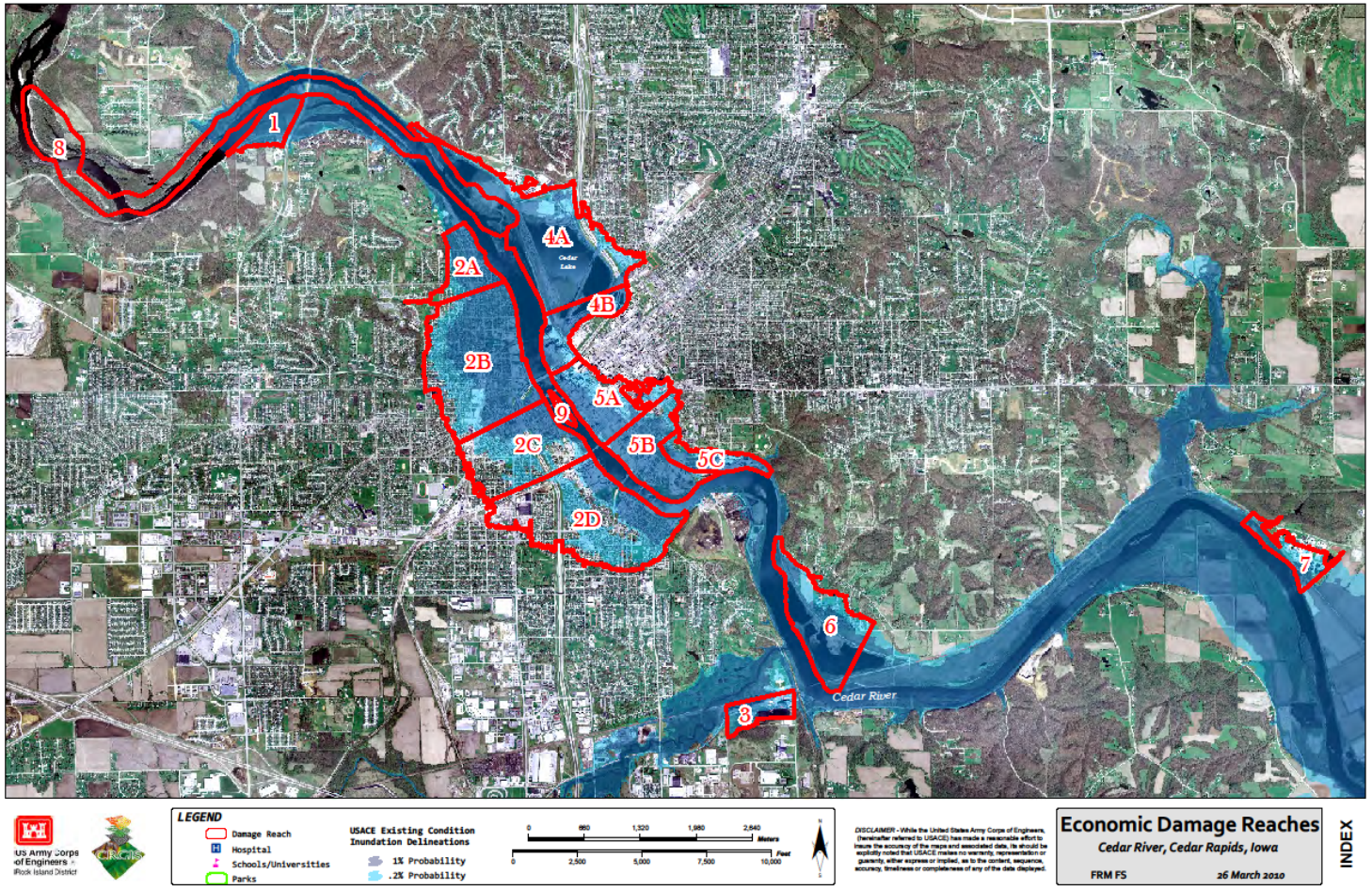

Figure B-1. Cedar Rapids Damage Reach Extents

Table B-1. Cedar Rapids Damage Reach Information [1]

						Existing Condition Elevation by Selected Flood Event			
Damage Reach	**Descending River Bank**	**Description**	**Downstream X-Section**	**Index Station X-section**	**Upstream X-Section**	**50-yr**	**100-yr**	**500-yr**	**2008 flood**
1	Right	Manhattan Robbins Lake Park	71,108.29	73,295.84	75,651.64	730.5	732.9	736.9	739.2
2A	Right	Ellis Lane to O Avenue	59,539.50	61,371.18	62,789.52	727.2	730.0	733.7	735.7
2B	Right	O Avenue to 1st Avenue	54,547.42	56,909.09	59,539.50	725.8	728.8	732.9	734.9
2C	Right	1st Avenue to 8th Avenue	51,667.35	53,297.19	54,547.42	722.9	725.1	729.6	732.2
2D	Right	8th Avenue to Skejskal Park	47,445.66	50,037.51	51,667.35	721.9	724.0	728.2	731.3
3	Right	Power Plant	34,185.03	35,451.68	35,451.68	716.6	718.2	722.2	725.0
4A	Left	Long Bluff Road to I-380	57,813.87	59,539.50	66,550.02	726.0	729.1	733.3	735.3
4B	Left	Industrial Area South of Cedar Lake	55,278.83	56,177.15	57,813.87	725.4	728.4	732.5	734.3
5A	Left	I-380 to 8th Avenue	51,667.35	53,297.19	55,278.83	722.9	725.1	729.6	732.2
5B	Left	8th Avenue to VanVechten Park	48,339.74	50,219.63	51,667.35	722.2	724.3	728.5	731.5
5C	Left	Industrial Area Downtown South	43,800.70	45,228.10	48,339.74	719.6	721.5	725.5	728.2
6	Left	Otis Road to Otis Avenue	34,185.03	37,573.16	41,572.89	717.5	719.3	723.2	725.7
7	Left	Bertram Road to East Gate	12,161.44	13,835.67	15,530.17	711.3	712.8	717.6	720.4
8	Left	Various upstream water wells							
9	Left	Mays Island	51,667.35	53,297.19	55,278.83	722.3	724.5	728.7	731.5

[1] All damage reaches extend from the Cedar River to the city estimated edge of the 2008 inundation area. Cedar River Cross Sections begin at cross section 79.38 located about 200 feet downstream of the twin bridges of Highway 30.

C. Alternative Descriptions. Brief descriptions of each alternative are provided in this section. The main report of the Study and the engineering appendices provide more detailed descriptions for each alternative.

1. Initial Screening of Alternatives. Several potential FRM alternatives were considered throughout the course of this Study. These alternatives were initially screened based on the four evaluation criteria (completeness, effectiveness, efficiency, and acceptability) and other considerations (refer to plan formulation appendix). Based on the evaluation and preliminary analysis, many of the alternatives were removed from further consideration. The main report provides a list of all of the alternatives considered under this Study.

2. Alternatives Carried Forward. Alternative plans were identified by numbers. Letters were used to designate levee or floodwall height for each alternative plan. The levee crest elevation input for each plan is the levee crest elevation at the index station for the economic damage reach. The model is based upon the assumption that the levee crest profile is a line parallel to the water surface profile. A levee is actually built so that in the rare event that it is overtopped water will first enter the protected area from the most downstream location. To insure this occurs a levee is designed with superiority. Generally, the levee crest is about 1 foot higher than the overtopping profile at the most upstream location while it is equal to the overtopping profile at the most downstream location.

The “Levee Features” module of HEC-FDA was used to evaluate an array of five levee crest elevations for each alternative. The elevations are in NAVD 88 datum. The alternatives 1, 1A, 4, 5, 7 and 10 used the same array of crest elevations for the relevant damage reaches and index stations shown in table B-2. These elevations are identified throughout the feasibility study as Z, A, B, C, and D. For the most downstream Economic Damage Reach (5C) they correspond to levees or floodwalls of approximately 9, 10, 12, 15, and 17 feet in height. The index stations of the economic damage reaches referenced in table B-2 are defined in table B-1. Levee Crest elevations are also referenced to the USGS gage in downtown Cedar Rapids. The top of levee crest elevations for each alternative were provided by the Structural Engineering Branch and entered into HEC-FDA by the Hydrology and Hydraulics branch. Table B-2 lists the levee crest elevations for each protected damage reach. Refer to Appendix A, *Hydrology and Hydraulics*, for list of profiles used in HEC-FDA)

Table B-2. Levee Crest Elevations Used for Alternatives

Alternative 1

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)	Significant Damage Elev.
	West Bank						
61371.18	2A	731.76	733.26	737.11	740.59	744.15	724.53
56909.09	2B	730.60	732.10	736.17	739.66	743.18	722.69
53297.19	2C	727.00	728.50	730.92	734.18	738.27	721.08
50037.51	2D	725.65	727.15	729.37	732.50	736.30	719.63
	East Bank						
59539.50	4A	730.83	732.33	736.16	739.17	742.39	726.02
56177.15	4B	730.13	731.63	735.52	738.55	741.72	722.20
53297.19	5A	726.85	728.35	731.04	734.54	738.62	720.74
50219.63	5B	725.99	727.49	729.77	732.97	736.90	717.99
45228.10	5C	722.95	724.45	726.19	728.61	731.18	716.47
52270.6	USGS gage	726.3	727.6	730.33	733.69	737.82	none

Alternative 1A

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)
	West Bank					
61371.18	2A	731.76	733.26	737.11	740.59	744.15
56909.09	2B	730.60	732.10	736.17	739.66	743.18
53297.19	2C	727.00	728.50	730.92	734.18	738.27
50037.51	2D	725.65	727.15	729.37	732.50	736.30
	East Bank					
56177.15	4B	730.13	731.63	735.52	738.55	741.72
53297.19	5A	726.85	728.35	731.04	734.54	738.62
50219.63	5B	725.99	727.49	729.77	732.97	736.90
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.3	727.6	730.33	733.69	737.82

Alternative 4 – East Bank Only

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)
56177.15	4B	730.07	731.57	733.77	736.06	738.23
53297.19	5A	726.81	728.31	730.84	733.77	736.47
50219.63	5B	725.99	727.49	729.63	732.25	735.14
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.25	727.75	730.11	732.89	735.68

Alternative 5 – East Bank Only

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)
45228.10	5C	722.95	724.45	726.19	728.61	731.18
52270.6	USGS gage	726.08	727.58	729.78	732.13	

Alternative 7 – East Bank Only

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)
56177.15	4B	730.13	731.63	735.52	738.55	741.72
52270.6	USGS gage	725.98	727.48	729.50	731.78	

Alternative 10 – East Bank Only

Index Section	Economic Damage Reach	Height Z Elev. (ft)	Height A Elev. (ft)	Height B Elev. (ft)	Height C Elev. (ft)	Height D Elev. (ft)	Height E Elev. (ft)
56177.15	4B	730.13	731.63	735.52	738.55	741.72	735.52
45228.10	5C	722.95	724.45	726.19	728.61	731.18	724.45
52270.6	USGS gage	726.08	727.58	729.78	732.13		n/a

The following alternatives were carried forward for detailed economic analysis:

a. No Action Alternative. The Without-Project alternative is the baseline alternative; it provides a common base of comparison for all other alternatives. This alternative includes features and other conditions that would likely occur in the Study area without further Federal involvement or funding of the With-Project Alternatives considered in this report.

b. Alternative 1. Alternative 1 includes a levee or floodwall on the east and west sides of the Cedar River corridor of Cedar Rapids. The neighborhoods included on the east side are, from north to south: the Cedar Lake Area, Cedar Rapids Downtown-East, the Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. The west side alignment includes, from north to south: the Time Check/Northwest neighborhood, the Cedar Rapids Downtown-West/Taylor neighborhood, and the Czech neighborhood. This alternative provides flood damage reduction for damage reaches 2A, 2B, 2C, 2D, 4A, 4B, 5A, 5B, and 5C.

The east side levee and floodwall alignment starts in the north with a tie-back levee along McCloud Run and proceeds to the Cedar River, then turns south and runs parallel between the railroad tracks and the river. The alignment runs parallel along the riverside of the downtown buildings. The alignment then turns east at 8th Street, where it creates greenway between the alignment and the river through City-owned properties to 12th Street. From 12th Street, the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

The west side levee and floodwall alignment starts with a tie-back north of Ellis Lane and runs south between Ellis Boulevard NW and the Cedar River and then turns just north of O Avenue NW. At O Avenue NW and 4th Street NW, the alignment turns south and follows just west of 4th Street NW until K Avenue NW, where it turns east to the railroad bridge. At the railroad bridge, the alignment turns south and follows 1st Street NW until 4th Avenue SW, where it turns southeast in front of the Police Station. The alignment then proceeds south following the Cedar River aligning with A Street SW and tying into high ground at the terminus of A Street SW.

c. Alternative 1A. Alternative 1A includes a levee or floodwall on the east and west sides of the Cedar River corridor of Cedar Rapids. The neighborhoods included on the east side are, from north to south: southern Cedar Lake Area (Alliant Energy, Cargill, and Quaker Oats facilities), Cedar Rapids Downtown-East, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. The west side alignment includes, from north to south: the Time Check/Northwest neighborhood, the Cedar Rapids Downtown-West/Taylor neighborhood, and the Czech Village neighborhood. This alternative provides flood damage reduction to reaches 2A, 2B, 2C, 2D, 4B, 5A, 5B, and 5C.

The east side levee and floodwall alignment starts in the north with a tie-back levee protecting the southern Cedar Lake area. The alignment then turns south and runs parallel along the riverside of the downtown buildings. The alignment then turns east at 8th Street, where it creates greenway between the alignment and the river through City-owned properties to 12th Street. From 12th Street the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

The west side levee and floodwall alignment is the same as that in Alternative 1.

d. Alternative 4. Alternative 4 includes a levee or floodwall on only the east side of the Cedar River corridor of Cedar Rapids. The neighborhoods included are, north to south: southern Cedar Lake Area (Alliant Energy, Cargill, and Quaker Oats facilities), Cedar Rapids Downtown-East, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. This alternative provides flood damage reduction to reaches 4B, 5A, 5B, and 5C.

The east side levee and floodwall alignment starts in the north with a tie-back levee in the southern Cedar Lake area. The alignment then turns south and runs parallel along the riverside of the downtown buildings. It then turns landward at 8th Street. From 12th Street, the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

e. Alternative 5. Alternative 5 includes a levee or floodwall on a small portion of the east side of the Cedar River corridor of Cedar Rapids. Included are portions of the Oakhill-Jackson and Sinclair-Cargill neighborhoods. This alternative provides flood damage reduction to reach 5C.

The levee and floodwall alignment starts in the north with a tie-back levee starting at the intersection of 8th Street SE and 12th Avenue SE. The levee alignment runs parallel to 12th Avenue SE then turns south along 5th Street SE and continues in a general southeast direction. The alignment then proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

f. Alternative 7. Alternative 7 includes a levee or floodwall on a small portion of the east side of the Cedar River corridor of Cedar Rapids. The neighborhood included is the southern Cedar Lake Area (Alliant Energy, Cargill, and Quaker Oats facilities). This alternative provides flood damage reduction to reach 4B.

The levee and floodwall alignment starts in the northeast with the levee alignment around the backside of the three facilities from Cedar Lake. The alignment then generally runs east to west, turning south along the Cedar River. The final tie-back portion of the levee to the south is under Interstate 380.

g. Alternative 10. Alternative 10 is a combination of Alternatives 5 and 7.

h. Nonstructural Alternatives. See Appendix P, *Nonstructural Measures*, for information regarding the nonstructural alternatives evaluated under this Study.

II. CHARACTERISTICS OF THE STUDY AREA

The following is a summary of the Study area's demographic characteristics. Additional information pertaining to the socioeconomic setting of the Study area can be found in the main report.

A. Demographic Data. Population is one of the parameters of community change. The changes in community population over time are one of several indicators of past and current trends in the community that influence its potential for growth. This growth will continue to reshape and determine future resource uses and needs. Future housing, employment, markets, transportation and services are all based on the size and composition of the population, as are the medical, educational and recreational facilities.

The most recent census data available is from the 2008 *American Community Survey 3-Year Estimates*. This data estimates there are 125,850 people, 54,538 households, and 31,433 families residing in Cedar Rapids. The racial makeup of the City is 89.2 percent white, 4.9 percent African American, 3.0 percent Hispanic or Latino, 0.2 percent Native American, and 2.6 percent Asian. Table B-3 depicts historical population trends for Cedar Rapids, Linn County and the State of Iowa. Both the City and the County have exhibited steady population growth over the past two decades.

Table B-3. Historical Population Trends

	1980	1990	2000	2008(est)
City of Cedar Rapids	110,243	108,780	120,758	125,850
Linn County	169,775	168,796	191,701	208,574
State of Iowa	2,913,808	2,776,755	2,926,381	3,002,555

A city's ability to provide for its residents can be gleaned from taking a look at the population spread. Working age residents raise revenue for the city which can influence the level of community services that can be offered for more "dependent" residents like the elderly and children. Having a number of younger residents that would soon be entering the workforce may hint at the city's prospects for

continued vitality into the future. Residents ages 25 to 54 represent 43 percent of total population (table B-4).

Table B-4. Population Age Spread-2008

Age Range	Population	% of Total
0-14 years	25,306	20.1
15-19 years	8,557	6.8
20-24 years	8,989	7.1
25-34 years	18,197	14.5
35-44 years	18,132	14.4
45-54 years	18,071	14.4
55-59 years	6,980	5.5
60-64 years	5,168	4.1
65-85+ years	16,450	13.0

B. Housing and Families. According to the 2008 American Community Survey there are 58,443 housing units in Cedar Rapids:

- 93.3 percent (54,538) of the units are occupied; 6.7 percent (3,905) vacant
- 69 percent of occupied housing are owner-occupied and 31 percent are renter-occupied
- 67 of total housing units are single-unit structures; 29 percent are multi-unit structures; 4 percent are mobile homes

The number of households reported in the 2008 survey is 54,538. Families made up 58 percent of the households. This figure includes both married couple families (43 percent) and other families (15 percent). Nonfamily households made up 42 percent of all households. Most of the non-family households were people living alone, but some were composed of people living in households in which no one was related to the householder.

- 28.5 percent of families have children under the age of 18 living with them
- 43.1 percent are married couple families
- 10.6 percent are a female householder family with no husband present
- 3.9 percent are a male householder family with no wife present
- 42.4 percent are non-families
- 33 percent are householders living alone
- 10.2 percent have someone living alone who is 65 years of age or older
- average household size is 2.24
- average family size is 2.88
- 8.8 percent of families are below the poverty level
- 12.6 percent of the population are below the poverty level, including 17.2 percent of those under age 18 and 8.2 percent of those age 65 and over

C. Employment and Labor Force. Labor force defines the distribution of skills and the level of labor force participation by persons of working age in the community. Cedar Rapids is an important

manufacturing, service and trade area serving an eight county area. The Cedar Rapids economy is serviced by a diverse group of industries. The City's largest employers include Cargill, Alliant Energy, Rockwell Collins, Quaker Oats, AEGONUSA, ImOn Communications, Archer Daniels Midland, and Qwest. Industries employing the largest number of workers center on education, manufacturing, and retail trade. The 2008 labor force estimate is 69,872 and the unemployment rate in September 2009 was 4.7 percent. The median household income is $47,645 and per capita income is $27,280, compared to $48,585 and $25,222, respectively for the State of Iowa. Table B-5 presents labor force data for Cedar Rapids and Linn County.

D. Demographic and Economic Projections. Future housing, employment, markets, transportation and services are all based on the size and composition of the population, as are the medical, educational and recreational facilities. Population projections can help in planning for the future. Regional projections of demographic data (table B-6) and economic data (table B-8) are taken from the "2010 State Profile" for the State of Iowa published by Woods and Poole Economics, Inc. The Cedar Rapids metropolitan statistical area (MSA) used in the projections links the counties of Benton, Jones and Linn to capture regional flows and the potential for growth on surrounding areas that might be impacted by the construction of an FRM project in the City.

Table B-5. Cedar Rapids and Linn County Labor Force [1]

Industry	Cedar Rapids	%	Linn County	%
Agriculture, forestry, fishing, hunting, mining	392	1	1,225	1
Construction	3,540	5	6,085	6
Manufacturing	11,292	17	19,062	18
Wholesale trade	1,897	3	3,095	3
Retail trade	7,925	12	12,442	11
Transportation, Communication, Public Utilities	3,506	5	5,597	5
Information	2,442	4	3,886	4
Finance, insurance, real estate	4,989	8	8,392	8
Professional, scientific, mgmt, administrative, waste mgmt	6,155	9	9,593	9
Educational, health and social assistance	14,179	21	23,983	22
Arts, entertainment, recreation, accommodation and food services	5,818	9	8,211	7
Other services (except public administration)	2,868	4	4,885	4
Public administration	1,456	2	2,445	2
Totals	**66,459**	**100**	**108,901**	**100**

[1] Source: 2008 census bureau 3-yr estimates survey

Table B-6. Cedar Rapids MSA Population Projections

Category	2010	2020	2030
Total population	259,620	281,520	304,510
Median age (years)	37.45	38.20	38.70
White population	238,970	252,490	264,980
Black population	9,010	12,440	16,930
Native American population	970	1,140	1,280
Asian/Pacific Islander population	4,850	7,000	9,500
Hispanic population	5,820	8,450	11,820
Population 0-14 years	52,160	57,060	59,730
Population 15-19 years	18,210	18,340	20,120
Population 20-24 years	16,670	16,850	18,540
Population 25-34 years	34,430	37,620	38,870
Population 35-44 years	35,330	35,870	39,670
Population 45-54 years	37,860	35,040	35,930
Population 55-59 years	16,350	18,100	17,070
Population 60-64 years	13,740	17,120	16,130
Population 65 yrs & over	34,870	45,520	58,470
Male population	128,580	139,450	150,530
Female population	131,040	142,070	153,980

Total employment for the area is expected to reach 178,320 by the year 2010, and 193,890 in 2020 (table B-7). This represents an increase of 8.7 percent in the total number of employed in the Cedar Rapids MSA area by 2020. In the following decade, the labor force will grow again by about 8.5 percent. The rate of employment will stay slightly ahead of population growth, resulting in additional jobs for residents of all ages. Job growth will vary among counties in the MSA.

Table B-7. Cedar Rapids MSA Employment Projections

Industry	2010	2020	2030
Total Employment	178,320	193,890	210,310
Agriculture, forestry, fishing, hunting, mining	4,470	4,640	4,800
Construction	11,640	12,910	14,150
Manufacturing	23,400	22130	20,880
Wholesale trade	6,450	6,220	5,950
Retail trade	20,820	22,900	25,010
Transportation, communication, utilities	9,100	10,070	10,920
Information	5,740	5,530	5,230
Fire, insurance, real estate	16,400	18,590	21,030
Professional, scientific, mgmt, administrative, waste mgmt	17,680	19,810	21,930
Educational, health and social assistance	22,700	26,950	31,730
Arts, entertainment, recreation, accommodation and food services	13,030	15,040	17,340
Other services (except public administration)	9,520	10,550	11,610
Public administration	17,370	18,530	19,740

Table B-8. Cedar Rapids MSA Economic Projections

Category	2010	2020	2030
Personal income $	9,050,810	11,297,140	14,204,700
Per capita income $	34,862	40,129	46,647
Persons per household	2.35	2.27	2.23
Mean household income $	82,251	91,529	104,864
Number of households	107,520	120,610	132,120
Households earning <$10,000	5,550	4,850	3,970
Households earning $10,000-$59,999	60,720	56,160	46,310
Households earning $60,000-$99,999	29,960	43,250	57,780
Households earning $100,000-$149,999	7,840	11,340	16,680
Households earning $150,000 +	3,470	5,020	7,380

III. ECONOMIC EVALUATION PROCEDURES, ASSUMPTIONS, AND METHODOLOGIES

The economic analysis for the Study evaluated the alternatives on the basis of flood-related costs and damages avoided. Flood damages and costs considered in the economic analysis include flood damages to residential and nonresidential structures, public damages (infrastructure and emergency response expenditures), and Flood Insurance Administration (FIA) expenditures.

The economic justification of an alternative is determined by comparing the expected annual benefits to the expected annual costs. If the annual benefits for an alternative exceed the annual costs, then the alternative is considered economically justified. In such cases, the benefit-to-cost ratio (BCR) is greater than 1.0. For this analysis, the expected annual cost of an alternative was determined by considering a number of factors, including construction cost, timing of construction period, interest during construction, and operation and maintenance (O&M) costs. The costs were based on a 2010 price level, a period of performance of 50 years, and were annualized to an annual equivalent cost using the 2010 Federal Discount Rate of 4.375 percent. The expected annual cost for an alternative was subtracted from the expected annual benefit to compute the net annual benefit.

Because of the extensive damage in Cedar Rapids from the June 2008 flood event and the continued recovery efforts, several assumptions were made by the project delivery team (PDT) regarding the without project conditions. The following assumptions were made in October 2009 for structures in Cedar Rapids prior to data collection and economic evaluation:

- Residential properties identified in the City tax assessor database as "substantially damaged" within the floodplain for the current effective FIRM mapping 1- percent chance (100-year) flood event were assumed raised 1 foot above the 1 percent chance event. This followed the City and Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) rules that properties with repairs costing 50 percent or greater of the pre-flood market value must be relocated, removed, or raised above the 1 percent chance flood event by 1 foot elevation.

- Remaining residential properties (those not designated as substantially damaged in the floodplain for the 1 percent chance event) were assumed to be repaired to pre-flood values. Pre-flood values were to be obtained from the City's tax assessor's office. Marshall & Swift (M&S) Residential Estimator software was to be used on a sample of residential properties to determine depreciated replacement value vs. assessed value. The resulting adjustment factor was to be applied to the residential inventory to estimate depreciated replacement values.
- All residential properties above the floodplain for the 1 percent chance event were assumed to be repaired to pre-flood values and elevations.
- Vacant non-residential properties were assumed to be repaired to pre-flood value and type of use when information was not available from the property owner or the City.
- Assume the City's "Greenway" property acquisition program is completed. Other current or potential floodplain buyout programs are not considered under the Study assumptions.

The following sections discuss the types of evaluations and methods used in the economic analysis.

A. Hydrologic and Hydraulic Modeling for Economic Evaluations. Refer to Appendix A, *Hydrology and Hydraulics*, for information on the hydrologic and hydraulic input into the HEC-FDA model. Development within the basin over the next 50 years is not expected to alter the discharge-frequency curve at Cedar Rapids. Nor will the proposed levee alternatives alter the discharge-frequency relationship. For these reasons, the discharge-frequency curve for the existing condition is applicable for all levee alternatives and for the future condition (year 2059).

B. Structure and Content Damages Due to Overbank Flooding. Knowledge of existing residential and nonresidential development located in a floodplain is critical to evaluating an FRM project. Potential flood damages to residential and nonresidential structures in the Study area were evaluated through a structure inventory and interviews at selected nonresidential facilities.

1. Structure Inventory. The purpose of the structure inventory was to collect data on residential and nonresidential structures located in the Study area (inundation area from the June 2008 flood event). All information collected in the field was entered in a Microsoft Access field database. Information from a 10 percent sample of residential structures and all non-residential structures was entered into the M&S Residential and Commercial Estimator programs once field work was completed.

All structures located in the Study area were initially identified from tax assessor records. A random sample of residential structures was selected for detailed data gathering. The sampled structures were used to calculate depreciated replacement value adjustment factors to apply to the remaining structures in the Study area inventory.

a. Field Database. The field database was constructed using a tax database from the City. Working with the tax database, a 10 percent random sample of residential structures (classified as residential in the tax database) in the Study area was selected for detailed data gathering. The final field database contained all residential and nonresidential structures (classified as commercial, exempt,

industrial, agricultural land, agricultural dwelling, and other in the tax database) located in the Study area.

Since most of the residential structures within the Study area were still in a flood-damaged status from the 2008 flood event, pre-flood condition assumptions were used for the evaluation. Tax assessor data from 2008 was entered in the field database for the residential structures.

b. Data Collection. The field work for the structure inventory was conducted in June 2009. One two-person survey team collected information on each structure in the field database. The survey team used addresses and aerial maps to locate the selected structures. All the information was collected from outside of each structure and recorded in the database.

Structures that no longer existed were deleted from the database. Data were also collected for any new nonresidential structures not already contained in the field database. An inventory of structures located at large industrial facilities was often infeasible because of limited access. These structures were marked as inaccessible in the database.

While the tax assessor structure data was used in the M&S Residential Estimator Program calculations, each residential structure was visited in the field to ensure it had not been demolished, elevated, or subjected to other types of major renovation that would significantly alter the effects of future flooding on the structure.

i. Residential Structures. The structural characteristics (listed below) are based on fields used by the M&S Estimation Program to calculate depreciated residential structure values. The following information was collected or verified for each residential structure:

- Address
- Photograph of structure
- Characteristics
    - Type of structure (e.g., single family)
    - Type of foundation
    - Finished floor area
    - Effective age
    - Quality of construction
    - Condition of structure
    - Style of structure (e.g., one-story)
    - Type of exterior wall (e.g., siding)
    - Type of roofing
    - Presence of garage
    - Presence of other outbuildings
    - Presence of fireplaces
    - FFE adjustment (height of first floor above adjacent grade)

The finished floor area of each building was estimated utilizing an aerial photograph and tracing tool available on the computer, tax records, and by visual observation. The

effective age of each structure was estimated from a combination of factors: the style in which the structure was built, the appearance, and any improvements done to the original structure. The effective age takes into account structural renovations since the original construction. The construction quality of the structure was judged by considering the workmanship in relation to the materials used. The appearance and condition of the structure in relation to the effective age determined the physical condition of the buildings.

ii. Nonresidential Structures. The following information was collected for each commercial/industrial structure:

- Name of business
- Address
- Photograph of structure
- Characteristics
  - General use of structure (e.g., office, barber shop)
  - Effective age
  - Total floor area
  - Construction class (e.g., masonry bearing walls)
  - Story height
  - Quality of construction
  - Number of stories
  - Perimeter shape (e.g., square, rectangular)
  - FFE adjustment (height of first floor above adjacent grade)

To more accurately evaluate the structures, the surveyor assigned an M&S three-digit occupancy code to each structure based on its use. Use was determined by the activities conducted in the building as observed during the field survey and based on the company name.

Detailed information was collected for a total of 1,169 structures during the 2009 field work (table B-9). Tax assessor's data was input into the field database for the non-sampled residential structures and the FFE adjustment was recorded in the field during the inventory.

Table B-9. Number of Sampled Residential and All Non-Residential Structures Inventoried

Structure Type	Number Inventoried
Residential (Sampled)	
Basement	458
No Basement	37
Total Residential	**495**
Nonresidential	674
Total Structures	**1,169**

c. Depreciated Structure Values. The structure data were entered into the M&S Residential Estimator Program and Commercial Estimator Program. The M&S programs calculated depreciated replacement values for each commercial and sampled residential structure based on the concepts of effective age, quality, condition, and other structural parameters. The depreciated replacement values were based on a 2009 price level.

Because the survey team did not enter any buildings, a number of structural characteristics that are normally entered into the M&S programs—such as the method of heating and cooling, plumbing, and the type of interior floor covering—could not be recorded. Default values provided in M&S were used for undefined characteristics.

d. Residential Value Comparison. Tax assessor data was used to estimate the depreciated replacement value for the residential structures in the Study area. However, different methods are often applied by taxing entities to estimate the depreciated replacement values of a structure. To provide consistency, the depreciated replacement values estimated by M&S for the sampled residential structures were used as a common base. To provide a comparison metric, tax assessor structure values (listed in the tax assessor database as "improvement value") from 2008 (pre-flood) and the depreciated replacement values calculated by the M&S programs for the sampled residential structures were compared.

The depreciated structure values calculated by M&S were an average of 27 percent higher than the tax assessor values for the sampled structures. To provide a consistent depreciated replacement structure value for all structures, the improvement values for the tax assessor database were increased by 27 percent for all of the residential structures in the Study area.

Not all of the residential structures could be matched in the tax assessor database. This typically occurred with low rise multiple residences that are rental properties, structures that are considered commercial properties in the tax assessor database. The structures with fewer than six units are analyzed as residential structures in the M&S programs. Because of potential differences in how commercial and residential properties are valued by the tax assessor, these structures were not included in the adjustment factor analysis. The M&S structure values calculated for each of these structures were used in the economic analysis, and these structures retained their residential field classification.

e. Depth Damage Functions. The standard depth-damage functions (DDFs) used in the economic analysis were provided by the U.S. Army Corps of Engineers (Corps), St. Paul District and are listed in the document *Cedar Rapids Commercial and Residential Structure Inventory and Nonresidential Surveys* prepared for the US Army Corps of Engineers Rock Island District in November 2009. These DDFs are based on damages experienced in Grand Forks, ND, during the 1997 flood event. The DDFs were selected for this analysis because they reflect regional characteristics similar to Cedar Rapids. The DDFs were assigned to residential structures based on the housing type and presence of a basement. Nonresidential DDFs were assigned based on the M&S occupancy code selected during the structure inventory. Structures were identified in the "Public" category if the tax assessor listed the structure's parcel as "Exempt".

The standard DDFs assigned uncertainty values to the variables used in the analysis. The following uncertainty values are provided in the standard DDFs:

- Structure value assigned a normal distribution with a 5 percent standard deviation
- Content to structure value ratio (CSVR) assigned a normal distribution with a 10 percent standard deviation
- Other to structure value ratio assigned a normal distribution with a 5 percent standard deviation

f. First Floor Elevations. The adjacent ground elevation, the elevation of ground bordering a structure, was discernable for structures built on flat ground. There were cases where the ground around the structure was not level, so surveyors estimated the mid-point between the lowest and highest adjacent ground for those structures. The first floor elevation (FFE) adjustment, which is the difference between the FFE of a structure and the adjacent ground elevation, was estimated for all residential structures in the floodplain through field observations. Some structures presented a lower opening for water to enter into the finished area of the home, such as a window to a finished basement near the top of the foundation. In these cases surveyors considered the bottom of this opening as first floor elevation. Information was collected on a total of 3,930 residential structures that had been affected by the 2008 flooding and entered into a spreadsheet. At the time of the inventory, of the 3,930 residential structures in the 2008 tax assessors database, 212 were found to have been demolished, 19 did not exist, and another 19 were inaccessible due to conditions (such as heavy construction) that made approaching the structure unsafe for surveyors.

The FFE of each structure was estimated by adding the FFE adjustment collected in the field and the elevation of the adjacent ground, which was estimated using a GIS program from 2-foot contour data provided by the City. To estimate the uncertainty associated with the FFE, professional land surveyors determined the FFE and adjacent ground elevation of a random sample of 378 structures. The data gathered from this surveyed random sample was used to perform a comparative analysis, using the data estimated in the field and using 2-foot contour data for each structure as the base. The three categories analyzed were:

1) Difference between the estimated and professionally surveyed FFEs
2) Difference between the estimated and professionally surveyed first-floor adjustments
3) Difference between the estimated and professionally surveyed adjacent ground elevations

A statistical analysis was performed on the error value between the estimated FFE and the Professionally surveyed FFE in the sample. Based on this analysis, a 1.1 foot standard deviation was entered into the HEC-FDA program for first floor stage error. The HEC-FDA assumes the normal distribution for first floor stage. The results of the statistical analysis are shown in table B-10. The maximum represents the greatest difference in feet between estimated and surveyed elevations of the properties where estimated elevation was lower than surveyed elevation. The minimum represents the greatest difference in feet between estimated and surveyed elevations of the properties where estimated elevation was higher than surveyed elevation.

Table B-10. Results of the Statistical Analysis

	First Floor Elevation Difference[1]	First Floor Adjustment Difference[1]	Adjacent Ground Elevation Difference[1]
Standard Deviation	1.1 ft	0.5 ft	1.0 ft
Average	0.85 ft	0.47 ft	0.38 ft
Maximum	4.72 ft	2.23 ft	4.27 ft
Minimum	-6.79 ft	-0.89 ft	-7.02 ft

[1] Difference calculated by subtracting the field estimated elevations from the professionally surveyed elevations.

g. Adjusted First Floor Elevations. The FFEs were revised for selected structures prior to performing the economic evaluations to account for associated structures, anticipated property acquisitions, and substantially damaged structures. The FFE of associated structures were assigned a FFE of 999 in the HEC-FDA dataset to remove them from the economic evaluation. The flood damages connected with associated structures are captured through another structure in the HEC-FDA dataset. For example, an interview conducted at a facility may have provided flood damage estimates for the facility as a whole (all damages referenced to one structure), as opposed to each individual structure at the facility. The structures not assigned individual DDFs were effectively removed from the economic evaluation to avoid double counting by assigning the FFE to 999 as opposed to removing them from the dataset.

It is expected that grant money from the FEMA will be used to acquire selected properties along the Cedar River. These properties will form a "green space" along the river. Eight structures on the east bank (river left) and 144 structures on the west bank (river right) were identified in this FEMA acquisition assumption (table B-11). These structures were effectively removed from the economic evaluation by assigning the FFE to 998 in the HEC-FDA dataset.

Table B-11. Expected FEMA Property Acquisitions by Category

Bank of River	Commercial/ Industrial	Public	Residential	Total
East (left)	0	6	2	8
West (right)	8	2	134	144
Total	**8**	**8**	**136**	**152**

Based on the economic assumptions defined at the beginning of the Study, residential structures located within the floodplain for the 1 percent chance (100-year) flood event and identified as being "substantially damaged" during the June 2008 flood event would be required to comply with FEMA floodplain building standards. It was assumed that the structures would be elevated so the FFE was 1 foot above the 1 percent chance flood event. The FFEs were revised in the HEC-FDA dataset for 75 residential structures on the east bank (river left) and 241 structures on the west bank (river right). The following procedures were followed to assign the revised FFEs:

- Substantially damaged residential structures in the effective FEMA FIRM base floodplain (1 percent chance flood event) were identified based on information provided by the City.

- The water surface elevation (WSE) for the 1 percent chance flood event at each cross section [based on the Hydrologic and Hydraulic (H&H)analysis completed for this Study] were incorporated into a GIS environment.
- The WSE for the 1 percent chance flood event were interpolated between cross sections.
- The WSE for the 1 percent chance flood event estimated for each identified structure was based on the location of the structure in the floodplain.
- The identified structure was assigned a FFE equal to the WSE for the 1 percent chance event plus 1 foot.

h. Nonresidential Interviews. The purpose of the nonresidential surveys was to obtain data improving potential flood damage estimates of the contents of unique structures from those estimated by the standard DDFs. Data were collected at selected facilities and used to calculate DDFs for the contents of each structure at the facility. The resulting unique DDFs replaced the standard DDFs originally assigned to the structures. The standard DDFs as described in Section III. B. 1. E. were used for non-residential structures without onsite surveys.

A survey instrument (Exhibit 3) was developed based on surveys that had been conducted previously for other studies, and was approved by the U.S. Office of Management and Budget (OMB) prior to use. The survey instrument steps respondents through the process of identifying the placement and value of contents within each structure at a facility. Respondents were asked to separate the contents into three categories (equipment, furniture, and inventory/products), and indicate the placement and value for each category. Respondents were then asked to estimate the amount of damage that would occur if the structure flooded again. For the amount of damage, respondents were asked to provide a low, most likely, and high value to account for uncertainty. In addition to the contents in the structures, respondents were asked to identify estimated cleanup costs and emergency preparedness costs. Other items of value that may be located on the facility grounds were also noted. The surveys were completed through interviews conducted with representatives of the selected facilities.

Data collection began after acquiring the structure inventory of the Cedar River area of inundation. The inventory was used to determine which nonresidential structures warranted an interview. Forty-five facilities were identified as being unique and potential candidates for an interview (interviews were conducted at 27 of the total 674 nonresidential structures). Table B-12 displays the selected facilities and whether or not the survey team was able to complete a survey for each facility.

Data collected from the nonresidential surveys were analyzed and used in the development of unique DDFs. The estimated damages for the three categories (equipment, furniture, and inventory/products) were aggregated by depth to estimate the total damage at each level of flooding. These calculations were conducted for each of the uncertainty values (low, most likely, and high). Specific data collected during the interviews is not presented in this report to maintain confidentiality.

The structure component of the DDF was based on the standard DDF assigned to all of the nonresidential structures. The structure component of the standard DDFs was viewed as appropriate to apply to the structures at the unique facilities. The depreciated replacement value of the structure

was determined based on structural parameters entered into the M&S Commercial Estimator program. The structure value was divided by the number of floors to find the value of the first floor. The CSVRs were calculated for each unique DDF.

During the interviews process, some respondents had difficulty estimating the damages to their facilities. Business owners and facilities managers were better able to address the questions on the survey. However, office managers were not as familiar with the value of the contents, and often had difficulty answering the questions. In addition, some of the structures are now vacant and are either for sale or their future use is uncertain at this time.

Some respondents gave limited information on the surveys, such as with the Quaker Oats facility. Quaker provided surveyors with only layout and square footages of the buildings. In this situation, content damage was estimated based on a nonresidential survey conducted for a study in North Dakota. The other facility from the North Dakota Study was similar to Quaker, in square footages and functions performed, and the damage function might be a reasonable approximation of Quaker's potential content damages.

Table B-12. Companies Contacted and Interviewed

Company	Survey Status
African-American Museum	Completed
Alliant Energy	Completed
Amerigas	Not viable for interview, no damage from June 2008 event
Armstrong Building	Completed
Bills Bros Salvage Furniture	Declined
Cargill	Completed
Cedar Rapids Museum of Art	Completed
Cedar Rapids Public Library	Not viable for interview, relocated to higher area
Cedar Rapids Symphony	Completed
City Carton Recycling	Not viable for interview, no damage from June 2008 event
City Hall	Not viable for interview, future use of flooded floor not determined
Clemans Canvas Manufacturing	Unresponsive
Climate Engineers	Completed
Court House	Not viable for interview, future use of flooded floor not determined
Czech & Slovak Museum	Completed
Diamond Vogel	Not viable for interview, vacant and for sale
Farner-Bocken (Hubbard Industrial Park)	Not viable for interview, vacant and for sale
Great America Building	Completed
IA-DOT	Responsive, but no survey received to date
IMAX Science Station	Completed
JG Cherry Building	Completed
JRS Pharma	Completed
Kings Material	Declined
Latterner MFG Company	Not viable for interview, no damage from June 2008 event
Linweld	Completed
Mercy Hospital	Unresponsive
Mid-American Energy	Unresponsive
Mother Mosque of America	Unresponsive
Papich-Kuba Funeral Home - 2nd St	Completed
Papich-Kuba Funeral Home - J St	Completed
Paramount Theatre	Completed
Penford	Completed
Pepsi	Unresponsive
Police Station	Completed
Principal Financial Group	Unresponsive
Quaker	Partially complete
Reliable Machine and Manufacturing	Completed
Smulekoff's	Completed
STS - International Paper Company	Completed
Theatre Cedar Rapids	Completed
U.S. Cellular Center	Completed
Walt Senior Center	Not viable for interview, now vacant
Water Pollution Control Plant	Completed
Wells Fargo	Completed
YMCA	Completed

2. Structure and Content Damage Calculations

a. Future Without-Project. USACE planning and assumptions of future Without-Project conditions consider knowable actions, plans and programs that would be implemented in the future to address the problems and opportunities in the study area in the absence of a Corps project.

Changes in land use, economic activity, and physical setting can affect flood damages. Future Without-Project projections have two major purposes: 1) to determine how changes in drainage patterns that occur as a result of physical development, will affect elevation-frequency relationships; and 2) to determine how changes in development and economic activity will affect elevation-damage relationships. These two relationships are combined to estimate damages under future Without-Project conditions. Hydrologic, demographic, and economics forecasts are not expecting major changes in the study area. The floodplain is fully developed and land use is not expected to change in the study area. There is developable land in and adjacent to the City, outside of the floodplain. As a result of full development in the floodplain, no alterations in drainage, particularly surface runoff are expected to lead to changes in hydrologic relationships. Therefore, damage-elevation and elevation-frequency relationships were not altered for the future Without-Project condition.

The flood of record occurred during the initial start of the study. Since the flood of 2008, the City has been in recovery mode and many efforts are underway to recover and rebuild. As of July 2010, the City has received Federal funds to acquire properties within the current FEMA Flood Insurance Rate Map (1991) 100-year (1 percent) floodplain. One hundred and seventeen properties are targeted for FEMA buyouts in accordance with the City's redevelopment planning efforts. These structures were not included in the Corps' structure inventory because deed restrictions precluding re-development in these areas.

Some structures in the floodplain were more than 50 percent damaged by the 2008 flood event. It was assumed that with or without project, these structures would be rebuilt according to FEMA regulations. This follows FEMA National Flood Insurance Program (NFIP) rules that properties with repairs costing 50 percent or greater of the pre-flood market value must be relocated, removed, or raised above the 1 percent (base flood) + 1 foot elevation. For Study purposes the properties with greater than 50 percent damages in the FEMA base floodplain were analyzed using the new USACE (2010) 100-year (1 percent) floodplain elevation for first floor elevation. The Study team has measured structure value based on replacement costs less depreciation to the structure as it existed prior to the 2008 flood. Replacement cost is the cost of physically reconstructing the structure; and the depreciation accounts for deterioration occurring prior to flooding, and variation in remaining useful life of the structure.

Some structures within the flood plain were damaged but not substantially damaged. It was assumed that with or without project, these structures would be rebuilt to their pre-flood condition, value and elevation.

It can be expected that over the next 50 years, flood damage potential expressed as expected annual flood damages would continue to adversely impact the City. Businesses and residences would

continue to be vulnerable to flooding. Recreational needs would continue to increase according to expected City trends and increase in population.

National Flood Insurance Program Administration. The FIA expends significant time and effort administering each flood insurance policy under the National Flood Insurance Program Administration (NFIP). The estimated average annual cost of this time and effort is $192 (per Corps Economic Guidance Memo 06-04). For the economic analysis, aggregate NFIP administrative expenditures were based on this estimate and the number of structures projected to be covered by a flood insurance policy. According to a telephone call with the FEMA Region 7 Kansas City Office, as of 10/31/2009, the FIA currently administers a total of 707 policies for the structures located in the Cedar River base floodplain, and 1,312 policies for structures located outside the base floodplain. It was assumed that of the total number of policies in Cedar Rapids, 90 percent are for structures located in the Study reaches 2A, 2B, 2C, 2D, 4A, 4B, 5A, 5B, and 5C, or 1,817 properties. This represents an average annual administrative cost of $348,864. Table B-13 lists the number of properties with flood insurance policies in the floodplain (1,817) and aggregate average annual FIA expenditures for Without-project condition.

Table B-13. Annual FIA Administrative Expenditures
for Without-Project Condition in the Study Area

Number of Flood Insurance Policies	1,817
Administrative Expenditures per Policy	**$**192
TOTAL	$348,864

b. Damages Calculated in HEC-FDA. The flood-damage reduction benefit of a With-Project Alternative is the reduction in damages when compared to the Without-Project alternative. Therefore, the average annual benefit for each alternative was calculated by taking the difference between the average annual damage for the Without-Project alternative and the average annual damage for the With-Project Alternative. The estimated structure and content damages for the with- and Without-Project alternatives were determined based on the FFEs, depreciated structure values, water surface elevation during flood events, and DDFs.

When estimating the monetary value of damages for a residential or nonresidential structure, the amount of inundation is referenced to the DDF to determine the percent damage to the structure. The percent damage was then multiplied by the depreciated structure value to determine the value of the damages.

The DDFs were incorporated into the HEC-FDA program along with the results of the structure inventory. Additionally, the water surface elevations during specific flood events (obtained from the H&H analysis) were imported into HEC-FDA. Based on these datasets, average annual flood damages were then estimated by damage reach and recurrence interval. Following the initial HEC-FDA runs, structure input data and DDFs were revised to ensure that the results represented flood damages for the Study area. For example, the beginning damage point was adjusted to the adjacent grade elevation to ensure that damages to structures with basements were not overestimated.

The HEC-FDA program incorporates a method for accounting for uncertainties (potential over/under estimation) in estimates of major economic variables, such as structure first-floor elevations, structure values, structure-to-content value ratios, and depth-damage ratios and functions. A length of record of the gage, 106 years on the Cedar River, was used in calculating the uncertainty associated with the Hydrology and hydraulic input variables. When calculating uncertainty associated with the H&H stage discharge functions, the HEC-FDA program used the standard deviation of the error of the stage where the error becomes constant.

i. Warning time. During the 2008 event, the river elevation rose 5.6 feet in 18.5 hours. Several elderly people were removed by boat from their homes and no one drowned. Two key elements to the severity of the consequences of capacity exceedance are the time of year of flooding and the amount of warning time. The distance from the river bank to high ground varies from 1,000 to 3,700 linear feet. These distances could be walked in 4 to 15 minutes during daylight hours and 8 to 30 minutes during the night. For the Without-Project condition the warning time is estimated to be 6 to 12 hours. Two new stream gages on the Cedar River between Waterloo and Cedar Rapids are part of the without project used by the national weather service that allow an increase in warning time measured in hours over what was available in 2008. The amount of warning time was not considered sufficient to make a significant impact on overall content damages.

A table summarizing all data items used in the structure inventory portion of this Study is provided in table B-14.

ii. Without-Project Condition Overbank Flooding Damages. The Without-Project Condition provides a common base of comparison for all alternatives.

Table B-15 provides a listing of expected annual overbank flood damage estimates by reach and damage category from the HEC-FDA output. Table B-16 provides the number of structures by category in the future without project condition. Table B-17 lists total overbank flood damages by reach and flood frequency, and expected annual damage (EAD) by reach. Table B-18 displays the without project performance.

Table B-14. Summary of Structure Inventory Data Items

Data Item	Nonresidential Structures with Completed Surveys	Other Nonresidential Structures in Study Area	Residential Structures
Structure ID	Unique ID used to reference specific structures. Assigned automatically in IWR-GeoFIT and referenced to tax assessor data.	Unique ID used to reference specific structures. Assigned automatically in IWR-GeoFIT and referenced to tax assessor data.	Unique ID referenced to tax assessor data.
Business Name, Address, Phone	Provided on survey form and tax assessor data.	Field observation and tax assessor data.	Field observation and tax assessor data.
Approximate Building Square Footage	Provided on survey form.	Tax assessor data and field observation.	Tax assessor data.
Type of Construction Material, Effective Age, Number of Stories	Provided on survey form and field observation.	Field Observation.	Tax Assessor Data and Field Observation.
Structure Functional Use	Provided on survey form.	Field observation during inventory.	Tax assessor data.
Number of Structures on Site	Provided on survey form and field observation.	Each structure was recorded individually during inventory.	Data based on primary structure on parcel—garages and other outbuildings were not identified separately and are included with the primary structure.
RM (station number, stream name)	Assigned using Geographic Information System (GIS) river station shape file and location of structure (determined from City tax assessor and field observation).	Assigned using GIS river station shape file and location of structure (determined from City tax assessor and field observation).	Assigned using GIS river station shape file and location of structure (determined from City tax assessor and field observation).
Depreciated Replacement Value of Structure	M&S Commercial Estimator.	M&S Commercial Estimator.	Based on tax assessor data which was adjusted to be comparable with results from M&S Residential Estimator.
Content Value (Inventory) and Other Value (Computers, Equipment, Machines, and Misc.)	Provided on survey form.	Based on standard content-to-structure-value ratios associated with DDF.	Based on standard content-to-structure-value ratios associated with DDF.
DDF for Structure	Assigned standard DDF based on function performed in structure as observed during inventory and from tax assessor data.	Assigned standard DDF based on function performed in structure as observed during inventory and from tax assessor data.	Assigned standard DDF based on residence type in tax assessor data.

Data Item	Nonresidential Structures with Completed Surveys	Other Nonresidential Structures in Study Area	Residential Structures
DDF for Content and Other	Developed unique DDF based on function performed in structure as recorded on survey form.	Associated with DDF assigned to structure.	Associated with DDF assigned to structure.
Damage Category (e.g., commercial, public)	Associated with DDF assigned to structure.	Associated with DDF assigned to structure and tax assessor data.	Associated with DDF assigned to structure.
First Floor Elevation	Provided on survey form or estimated from digital elevation maps provided by the City.	Added adjacent grade elevation estimated from digital elevation maps provided by the City and the first floor adjustment as recorded during field observation.	Added adjacent grade elevation estimated from digital elevation maps provided by the City and the first floor adjustment as recorded during field observation.
Begin Damage Elevation for Structure	Provided on survey form.	Adjacent grade elevation estimated from digital elevation maps provided by the City.	Adjacent grade elevation estimated from digital elevation maps provided by City.
Begin Damage Elevation for Contents and Other	Provided on survey form.	Associated with DDF assigned to structure.	Associated with DDF assigned to structure.
Uncertainty			
Depreciated Structure Value	Incorporated into standard DDF.	Incorporated into standard DDF.	Incorporated into standard DDF.
Content Value	Uncertainty not accounted for.	Incorporated into standard DDF.	Incorporated into standard DDF.
Other Value	Uncertainty not accounted for.	Incorporated into standard DDF.	Incorporated into standard DDF.
Structure Elevation or Begin Damage Elevation	Analysis of estimated versus actual elevations.	Analysis of estimated versus actual elevations.	Analysis of estimated versus actual elevations.
Depth Damage Function	Developed from survey form.	Incorporated into standard DDF.	Incorporated into standard DDF.

Table B-15. EAD by Damage Category and Reach for the Without-Project Condition - $000's (Base Year 2016) [1]

West Bank Reach	Commercial/Industrial	Public	Residential	Total
1	10	0	5	15
2A	32	8	222	262
2B	615	152	705	1,472
2C	319	58	102	478
2D	573	99	333	1,005
3	292	0	0	292
West Bank Total	**1,842**	**317**	**1,367**	**3,526**

East Bank Reach	Commercial/Industrial	Public	Residential	Total
4A	213	5	7	226
4B	2,648	0	0	2,648
5A	787	176	81	1,044
5B	935	121	49	1,105
5C	1,623	1	7	1,631
6	0	0	25	25
7	0	30	0	30
9	0	23	0	23
East Bank Total	**6,207**	**356**	**169**	**6,732**
Study Area Total	**8,048**	**674**	**1,535**	**10,257**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars.

Table B-16. Without Project HEC-FDA Structure Inventory Summary (Number of Structures by Category)

Damage Reach	Commercial/Industrial	Public	Residential	Total
1	3	1	8	12
2A	4	2	303	309
2B	84	31	1288	1,403
2C	96	18	622	736
2D	88	23	1073	1,184
3	1	0	0	1
Right Bank Total	**276**	**75**	**3294**	**3,645**
4A	41	7	44	92
4B	9	0	0	9
5A	89	27	7	123
5B	61	14	113	188
5C	2	4	35	41
6	0	1	78	79
7	0	21	0	21
8				
9	0	3	0	3
Left Bank Total	**202**	**77**	**277**	**556**
Entire Study Area	**478**	**152**	**3571**	**4,201**

Table B-17. Damage Analysis by Reach for the Without-Project Condition (Base Year 2016)

REACH 1

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	721.0	0	0	0	0
0.1	726.0	16	1	9	26
0.05	728.1	48	2	26	77
0.04	728.8	61	3	32	96
0.02	730.9	115	6	61	181
0.01	733.3	233	12	125	370
0.005	735.4	342	17	183	542
0.004	735.9	368	18	197	584
0.002	737.5	447	22	239	708
0.001	739.2	532	27	284	843
0.0001	747.2	811	41	434	1,286

REACH 2A

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	718.2	0	0	0	0
0.1	722.2	4	1	29	34
0.05	724.3	40	10	278	328
0.04	725.1	82	21	569	673
0.02	727.6	394	103	2,735	3,232
0.01	730.4	1,138	297	7,906	9,341
0.005	732.5	1,837	479	12,758	15,074
0.004	733.0	1,999	521	13,887	16,408
0.002	734.3	2,453	640	17,039	20,132
0.001	736.1	3,051	796	21,190	25,037
0.0001	743.6	5,006	1,306	34,774	41,086

REACH 2B

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	716.4	0	0	0	0
0.1	720.2	42	10	48	99
0.05	722.6	820	202	939	1,961
0.04	723.4	1,751	432	2,007	4,190
0.02	726.2	8,268	2,041	9,477	19,786
0.01	729.2	21,280	5,252	24,390	50,922
0.005	731.5	34,375	8,485	39,399	82,259
0.004	732.0	37,688	9,302	43,196	90,187
0.002	733.5	47,025	11,607	53,898	112,529
0.001	735.2	57,728	14,249	66,165	138,142
0.0001	742.8	96,279	23,764	110,349	230,392

Table B-17 (continued). Damage Analysis by Reach for the Without-Project Condition (Base Year 2016)

REACH 2C

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	711.0	0	0	0	0
0.1	717.6	2	0	1	4
0.05	720.1	87	16	28	131
0.04	720.9	275	50	87	412
0.02	723.2	3,358	608	1,069	5,035
0.01	725.5	10,249	1,855	3,261	15,364
0.005	727.7	18,726	3,389	5,958	28,073
0.004	728.4	21,582	3,906	6,876	32,354
0.002	730.3	31,145	5,636	9,909	46,689
0.001	732.2	42,506	7,692	13,524	63,722
0.0001	740.2	92,378	16,717	29,391	138,486

REACH 2D

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	710.0	0	0	0	0
0.1	716.8	84	15	49	148
0.05	719.2	603	104	350	1,057
0.04	720.0	1,315	227	764	2,306
0.02	722.3	7,031	1,212	4,083	12,326
0.01	724.4	17,548	3,025	10,189	30,762
0.005	726.3	29,254	5,042	16,986	51,281
0.004	727.0	33,872	5,838	19,505	59,378
0.002	729.0	50,166	8,646	29,128	87,940
0.001	731.2	71,780	12,372	41,678	125,830
0.0001	739.2	151,133	26,049	87,753	264,935

REACH 3

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	706.0	1	0	0	1
0.1	712.2	1	0	0	1
0.05	714.4	1	0	0	1
0.04	715.0	1	0	0	1
0.02	716.9	1	0	0	1
0.01	718.7	1,864	0	0	1,864
0.005	720.5	19,756	0	0	19,756
0.004	721.2	30,636	0	0	30,636
0.002	723.5	58,173	0	0	58,173
0.001	725.8	67,582	0	0	67,582
0.0001	734.4	89,175	0	0	89,175

Table B-17 (continued). Damage Analysis by Reach for the Without-Project Condition (Base Year 2016)

REACH 4A

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	716.9	2	0	0	2
0.1	720.6	4	0	0	4
0.05	722.8	4	0	0	4
0.04	723.7	20	0	1	21
0.02	726.5	495	12	17	523
0.01	729.5	5,694	138	195	6,027
0.005	731.9	18,002	437	616	19,055
0.004	732.4	20,010	510	719	22,239
0.002	733.8	27,718	673	948	29,339
0.001	735.4	32,901	799	1,125	34,825
0.0001	743.2	56,897	1,382	1,946	60,225

REACH 4B

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	716.1	205	0	0	205
0.1	719.8	370	0	0	370
0.05	722.1	4,976	0	0	4,976
0.04	723.0	13,336	0	0	13,336
0.02	725.8	61,020	0	0	61,020
0.01	728.8	90,026	0	0	90,026
0.005	731.0	106,858	0	0	106,858
0.004	731.5	121,277	0	0	121,277
0.002	733.0	162,111	0	0	162,111
0.001	734.5	182,528	0	0	182,528
0.0001	742.0	199,485	0	0	199,485

REACH 5A

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	711.0	0	0	0	0
0.1	717.6	20	5	2	27
0.05	720.1	560	125	57	742
0.04	720.9	1,217	273	125	1,615
0.02	723.2	7,237	1,621	741	9,599
0.01	725.5	24,989	5,596	2,560	33,145
0.005	727.7	49,356	11,054	5,056	65,465
0.004	728.4	56,822	12,726	5,821	75,369
0.002	730.3	78,082	17,487	7,999	103,568
0.001	732.0	100,390	22,484	10,284	133,158
0.0001	740.2	196,819	44,080	20,162	261,061

Table B-17 (continued). Damage Analysis by Reach for the Without-Project Condition (Base Year 2016)

REACH 5B

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	710.1	0	0	0	0
0.1	717.0	615	79	32	727
0.05	719.5	4,246	548	221	5,014
0.04	720.3	6,733	868	350	7,951
0.02	722.5	15,870	2,047	826	18,744
0.01	724.7	25,157	3,245	1,309	29,712
0.005	726.7	33,339	4,300	1,735	39,374
0.004	727.3	35,808	4,619	1,864	42,291
0.002	729.3	43,111	5,561	2,244	50,916
0.001	731.4	50,020	6,452	2,604	59,076
0.0001	739.4	67,569	8,716	3,517	79,802

REACH 5C

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	708.3	0	0	0	0
0.1	714.8	84	0	0	85
0.05	717.1	3,981	3	18	4,002
0.04	717.8	8,033	5	36	8,074
0.02	719.9	27,082	17	121	27,221
0.01	721.9	51,227	32	230	51,489
0.005	723.7	77,513	49	348	77,909
0.004	724.4	85,572	54	384	86,009
0.002	726.3	105,592	67	474	106,132
0.001	728.1	117,590	74	527	118,191
0.0001	735.9	166,042	105	745	166,892

REACH 6

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	706.7	0	0	0	0
0.1	712.9	0	0	0	0
0.05	715.1	0	0	2	2
0.04	715.8	0	0	12	12
0.02	717.8	0	3	155	158
0.01	719.7	0	11	670	681
0.005	721.5	0	25	1,470	1,495
0.004	722.0	0	30	1,774	1,804
0.002	723.8	0	48	2,884	2,932
0.001	725.6	0	70	4,185	4,255
0.0001	733.1	0	158	9,430	9,588

Table B-17 (continued). Damage Analysis by Reach for the Without-Project Condition (Base Year 2016)

REACH 7

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	701.1	0	0	0	0
0.1	707.4	0	0	0	0
0.05	709.4	0	0	0	0
0.04	710.0	0	0	0	0
0.02	711.7	0	0	0	0
0.01	713.4	0	4	0	4
0.005	715.6	0	982	0	982
0.004	716.3	0	1,431	0	1,431
0.002	718.9	0	5,371	0	5,371
0.001	721.0	0	11,266	0	11,266
0.0001	729.6	0	21,185	0	21,185

REACH 8 **No economic analysis conducted for this damage reach.**

REACH 9

		Damage by Category ($000)			
Exceedance Probability	**Elevation**	**Commercial/ Industrial**	**Public**	**Residential**	**Total Damage**
0.5	711.0	0	2	0	2
0.1	717.7	0	3	0	3
0.05	720.1	0	3	0	3
0.04	720.9	0	3	0	3
0.02	723.2	0	29	0	29
0.01	725.5	0	583	0	583
0.005	727.7	0	1,767	0	1,767
0.004	728.4	0	2,078	0	2,078
0.002	730.3	0	2,849	0	2,849
0.001	732.0	0	3,674	0	3,674
0.0001	740.2	0	12,851	0	12,851

Table B-18. Performance for Without-Project

		Target Stage Annual Exceedance Prob.		Long Term Risk			Conditional Non-Exceedance Probability by Events					
Economic Reaches from Downstream to Upstream Left & Right	**Target Stage**	**Median**	**Expected**	**10-yr**	**30-yr**	**50-yr**	**0.10**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
Left Reach 7	711.72	0.0166	0.0195	0.1789	0.3891	0.6267	0.9999	0.9264	0.6046	0.2484	0.0512	0.0131
Left Reach 6	716.31	0.0303	0.0332	0.2866	0.5701	0.8152	0.9994	0.7230	0.1710	0.0134	0.0001	0.0000
Left Reach 5C	716.47	0.0574	0.0612	0.4681	0.7936	0.9574	0.9490	0.1600	0.0060	0.0000	0.0000	0.0000
Left Reach 5B	717.99	0.0719	0.0759	0.5458	0.8609	0.9807	0.8383	0.0515	0.0007	0.0000	0.0000	0.0000
Left Reach 9 (Mays Is.)	722.78	0.0205	0.0227	0.2049	0.4362	0.6822	1.0000	0.9372	0.4546	0.0718	0.0012	0.0000
Left Reach 5A	720.74	0.0383	0.0413	0.3438	0.6511	0.8783	0.9977	0.5185	0.0624	0.0018	0.0000	0.0000
Left Reach 4B	722.20	0.0458	0.0490	0.3950	0.7153	0.9189	0.9914	0.3338	0.0209	0.0002	0.0000	0.0000
Left Reach 4A	726.02	0.0200	0.0222	0.2013	0.4299	0.6750	1.0000	0.9478	0.4654	0.0672	0.0008	0.0000
Right Reach 3	717.18	0.0155	0.0181	0.1665	0.3657	0.5977	1.0000	0.9446	0.6444	0.2768	0.0594	0.0138
Right Reach 2D	719.63	0.0416	0.0446	0.3664	0.6804	0.8979	0.9952	0.4373	0.0433	0.0010	0.0000	0.0000
Right Reach 2C	721.08	0.0344	0.0373	0.3162	0.6133	0.8505	0.9991	0.6219	0.0990	0.0041	0.0000	0.0000
Right Reach 2B	722.69	0.0452	0.0484	0.3912	0.7108	0.9163	0.9920	0.3471	0.0231	0.0003	0.0000	0.0000
Right Reach 2A	724.53	0.0432	0.0468	0.3811	0.6987	0.9092	0.9919	0.3900	0.0329	0.0006	0.0000	0.0000
Right Reach 1	725.71	0.1058	0.1125	0.6970	0.9495	0.9974	0.4080	0.0055	0.0000	0.0000	0.0000	0.0000

3. Public Damages. The 2008 flood event was a rare and locally disastrous occurrence. Public facilities in several categories were severely damaged. Linn County was included in a Federal disaster declaration, allowing for FEMA financial assistance in the cleanup, repair and reimbursement of flood-related public damages and costs. The FEMA Project Worksheets (PWs) were used to identify direct flood-related costs incurred by public entities located in the Study area. This is an objective and verifiable source of post-flood data, which was employed to help estimate public damages for the full range of potential flood events. The following paragraphs describe the methods used for quantifying damages for public categories including debris removal, emergency protection measures, roads and bridges, water control facilities, buildings and content, utilities, and parks and recreation. Table B-19 reports the 2008 event public damages by category and jurisdiction. This table is based upon the City's accounting for damage categories and repair costs under the FEMA post-disaster declaration public assistance program.

a. Debris Removal. The 2008 flood event caused $7,654,000 in costs for removal of more than 80,000 tons of debris within the City. The bulk of this cost was for truck pick up and hauling of the debris, and for landfill tipping fees. A minor percentage of the cost was for barge-based riverbank debris removal. To estimate stage-damage relationships for debris removal, District Planning personnel consulted directly with very knowledgeable City Public Works employees. Distributive estimates for the documented debris removal costs for the 2008 event were estimated by City quadrant/riverbank. Debris costs which would not occur with repeat flooding (such as debris from houses/buildings which are removed from the floodplain) were estimated and reduced from event damage totals. Debris costs for the 50-year and 100-year (2 percent and 1 percent) flood events were estimated. Also, start-of-damage flood frequency/elevations were estimated. From the above information, four points on a "stage-damage curve" were established and stage-damage relationships for the full range of possible flood events were constructed. Table B-20 reports existing condition debris removal costs by flood frequency and riverbank.

b. Emergency Protection Measures. The 2008 flood event caused more than $85,700,000 in costs for Emergency Protection Measures in the City. This category included costs for emergency waste sludge disposal, emergency demolition and removal of houses and buildings, stabilization of public buildings (police station, public works, main library, Paramount Theatre, City Hall), overtime for police, fire, and public works employees, and various other emergency costs. The greatest cost in this category was for the hauling and landfill/land application of sludge created by the shutdown of the Water Pollution Control facility, and for the emergency demolition and removal of destroyed houses and buildings. To estimate stage-damage relationships for emergency measures, MVR Planning personnel consulted directly with knowledgeable City of Cedar Rapids Public Works employees. Emergency measure costs incurred during the 2008 event were distributed by city quadrant/riverbank. Costs which would not occur with repeat flooding (such as demolition and removal of houses/buildings which were destroyed) were estimated and reduced from event damage totals. Emergency costs for the 50-year and 100-year (2 percent and 1 percent) flood events were estimated. Also, start-of-damage flood frequency/elevations were estimated. From the above information, four points on a "stage-damage curve" were established and stage-damage relationships for the full range of possible flood events were constructed. Table B-21 reports existing condition emergency costs by flood frequency and riverbank.

Table B-19. 2008 Flood Event – Public Damage Costs by Category

FEMA Category	2008 Event Amount ($)
Debris Removal	$7,654,100
Emergency Protection Measures	$85,761,100
Roads and Bridges	$5,497,100
Water Control Facilities (sewers)	$44,516,100
Buildings, Equipment and Contents	$121,439,600
Utilities	$63,058,200
Parks and Recreation	$1,774,700
Total	**$329,700,900**

Table B-20. Frequency-Damage and Average Annual Damage Data ($)

EXISTING CONDITIONS: DEBRIS REMOVAL

	Frequency-Damage Relationships			Average Annual Damages		
% Chance Occurrence	Left Bank Debris Removal	Right Bank Debris Removal	Total Damages	Left Bank Cumulative EAD	Right Bank Cumulative EAD	Total Cumulative EAD
0.8	0	0	0	0	0	0
0.2	0	9,000	9,000	0	2,700	2,700
0.1	0	150,000	150,000	0	10,700	10,700
0.04	40,000	350,000	390,000	1,200	25,700	26,900
0.02	612,320	1,722,150	2,334,470	7,700	46,400	54,100
0.0133	640,000	2,170,000	2,810,000	11,900	59,400	71,300
0.01	688,860	2,755,440	3,444,300	14,100	67,600	81,700
0.008	725,000	2,950,000	3,675,000	15,500	73,300	88,800
0.005	760,000	3,200,000	3,960,000	17,700	82,500	100,200
0.004	820,000	3,350,000	4,170,000	18,500	85,800	104,300
0.002	930,000	3,670,000	4,600,000	20,300	92,800	113,100
0.001	1,058,000	4,400,000	5,458,000	21,300	96,800	118,100
0.0007	1,148,100	4,745,480	5,893,580	21,600	98,200	119,800
0.0005	1,170,000	4,880,000	6,050,000	21,800	99,200	121,000
0	1,200,000	5,000,000	6,200,000	22,400	101,700	124,100

Table B-21. Frequency-Damage and Average Annual Damage Data ($)

EXISTING CONDITIONS: EMERGENCY PROTECTION MEASURES

	Frequency-Damage Relationships				Average Annual Damages			
% Chance Occurrence	**WPC Emergency Measures**	**Left Bank Emergency Measures**	**Right Bank Emergency Measures**	**Total Damages**	**WPC Cumulative EAD**	**Left Bank Cumulative EAD**	**Right Bank Cumulative EAD**	**Total Cumulative EAD**
0.8	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0
0.04	0	200,000	400,000	600,000	0	6,000	12,000	18,000
0.02	0	3,029,911	14,919,581	17,949,492	0	38,300	165,200	203,500
0.0133	1,000,000	4,200,000	15,300,000	20,500,000	3,300	62,400	266,000	331,700
0.01	3,240,000	5,453,841	15,797,203	24,491,044	10,400	78,500	317,800	406,700
0.008	7,000,000	5,580,000	16,050,000	28,630,000	20,600	89,500	349,600	459,700
0.005	13,000,000	5,700,000	16,350,000	35,050,000	50,600	106,400	398,200	555,200
0.004	18,000,000	5,820,000	16,650,000	40,470,000	66,100	112,200	414,700	593,000
0.002	24,500,000	5,950,000	16,950,000	47,400,000	108,600	124,000	448,300	680,900
0.001	28,000,000	6,000,000	17,220,000	51,220,000	134,900	130,000	465,400	730,300
0.0007	32,400,000	6,059,823	17,552,448	56,012,271	144,000	131,800	470,600	746,400
0.0005	34,000,000	6,100,000	21,200,000	61,300,000	150,600	133,000	474,500	758,100
0	36,000,000	6,200,000	21,500,000	63,700,000	168,100	136,100	485,200	789,400

c. Roads and Bridges. Reduction of Public damages in this category (as reported for the 2008 event and estimated for all potential flood events) does not comprise a significant potential benefit area. Approximately 40 percent of the damages would be incurred in an upstream Parkway area, which is not in an alternative project alignment reach. Another 35 percent of the costs would be for removal of deposited sand on Water Treatment Plant access roads, which are not in an alternative alignment reach. The remaining 25 percent of damages (consisting of damages to road surfaces, sub-bases, curbs and gutters) were attributed to City sections (NW, SW, NE, SE) based upon estimates by knowledgeable City staff. Emergency measure costs incurred during the 2008 event were distributed by City quadrant/riverbank. Emergency costs for the 50-year and 100-year (2 percent and 1 percent) flood events were estimated. Also, start-of-damage flood frequency/elevations were estimated. From the above information, four points on a "stage-damage curve" were established and stage-damage relationships for the full range of possible flood events were constructed. Table B-22 reports existing condition road and bridge damage by flood frequency and riverbank.

d. Water Control Facilities. The 2008 flood event caused more than $44,000,000 in damages to sewer system in Cedar Rapids. To estimate stage-damage relationships for emergency measures, MVR Planning personnel consulted directly with knowledgeable City consultants and Cedar Rapids Public Works employees. Documented (FEMA) damage repairs for the 2008 event were distributed by city quadrant/riverbank. Sewer damage costs which would not occur with repeat flooding (due to replacement of damaged brick sewers with less-damageable lined sewers; nearly 40 percent less damageability) were estimated and reduced from event damage totals. Future flood damage costs for the 50-year and 100-year (2 percent and 1 percent) flood events were estimated. Also, start-of-damage flood frequency/elevations were estimated. From the above information, four points on a "stage-damage curve" were established and stage-damage relationships for the full range of possible flood events were constructed. Table B-23 reports existing condition sewer damages by flood frequency and riverbank.

e. Buildings and Content. Included in structure/content inventory as evaluated by HEC-FDA simulation. Not further addressed in this section.

f. Utilities. Predominately damages and costs incurred at the Water Pollution Control Facility, which is included in the structure/content inventory evaluated by HEC-FDA simulation. Not further addressed in this section.

g. Parks and Recreation. The greatest majority of flood impacts in this category are outside the areas of protection alternative alignments. These include damages to the Jones Golf Course, Ellis Harbor facilities, Cheyenne Park, and City trails. Additional green space areas which may be created at/near the FEMA buyout areas on the west side may result in very minor increases in Parks and Recreation damages (depending upon what, if any, facilities may be in place). Therefore, beneficial impacts of project implementation would not accrue in this category. Table B-24 reports existing condition parks and recreation damage by flood frequency and riverbank.

Table B-22. Frequency-Damage and Average Annual Damage Data ($)

EXISTING CONDITIONS: ROADS AND BRIDGES

	Frequency-Damage Relationships			Average Annual Damages		
% Chance Occurrence	**Left Bank**	**Right Bank**	**Total Damages**	**Left Bank Cumulative EAD**	**Right Bank Cumulative EAD**	**Total Cumulative EAD**
0.8	0	0	0	0	0	0
0.2	0	0	0	0	0	0
0.1	0	0	0	0	0	0
0.04	325,000	1,100,000	1,425,000	9,800	33,000	42,800
0.02	845,240	2,983,200	3,828,440	21,500	73,800	95,300
0.0133	940,000	3,100,000	4,040,000	27,500	94,100	121,600
0.01	1,019,260	3,356,100	4,375,360	30,800	104,800	135,600
0.008	1,040,000	3,420,000	4,460,000	32,900	111,600	144,500
0.005	1,080,000	3,480,000	4,560,000	36,100	122,000	158,100
0.004	1,120,000	3,530,000	4,650,000	37,200	125,500	162,700
0.002	1,160,000	3,590,000	4,750,000	39,500	132,600	172,100
0.001	1,200,000	3,650,000	4,850,000	40,700	136,200	176,900
0.0007	1,243,000	3,729,000	4,972,000	41,100	137,300	178,400
0.0005	1,270,000	3,780,000	5,050,000	41,400	138,100	179,500
0	1,310,000	3,810,000	5,120,000	42,000	140,000	182,000

Table B-23. Frequency-Damage and Average Annual Damage Data ($)

EXISTING CONDITIONS: WATER CONTROL FACILITIES (SEWERS)

	Frequency-Damage Relationships			Average Annual Damages		
% Chance Occurrence	**Left Bank**	**Right Bank**	**Total Damages**	**Left Bank Cumulative EAD**	**Right Bank Cumulative EAD**	**Total Cumulative EAD**
0.8	0	0	0	0	0	0
0.2	0	0	0	0	0	0
0.1	0	0	0	0	0	0
0.04	400,000	900,000	1,300,000	12,000	27,000	39,000
0.02	3,484,800	14,791,920	18,276,720	50,800	183,900	234,700
0.0133	4,450,000	16,000,000	20,450,000	77,300	286,600	363,900
0.01	6,030,640	16,928,340	22,958,980	94,800	341,400	436,200
0.008	6,450,000	17,500,000	23,950,000	107,300	375,800	483,100
0.005	6,760,000	17,900,000	24,660,000	127,100	428,900	556,000
0.004	7,000,000	18,350,000	25,350,000	134,000	447,000	581,000
0.002	7,350,000	18,800,000	26,150,000	148,400	484,200	632,600
0.001	7,600,000	19,080,000	26,680,000	155,900	503,100	659,000
0.0007	7,744,000	19,734,000	27,478,000	158,200	508,900	667,100
0.0005	7,970,000	20,050,000	28,020,000	159,800	512,900	672,700
0	8,000,000	20,200,000	28,200,000	163,800	523,000	686,800

Table B-24. Frequency-Damage and Average Annual Damage Data ($)

EXISTING CONDITIONS: PARKS AND RECREATION

	Frequency-Damage Relationships			Average Annual Damages		
% Chance Occurrence	**Left Bank**	**Right Bank**	**Total Damages**	**Left Bank Cumulative EAD**	**Right Bank Cumulative EAD**	**Total Cumulative EAD**
0.8	0	0	0	0	0	0
0.2	0	0	0	0	0	0
0.1	0	0	0	0	0	0
0.04	25,000	70,000	95,000	800	2,100	2,900
0.02	64,828	259,312	324,140	1,700	5,400	7,100
0.0133	110,000	350,000	460,000	2,300	7,400	9,700
0.01	162,070	648,280	810,350	2,800	9,100	11,900
0.008	190,000	820,000	1,010,000	3,200	10,600	13,800
0.005	220,000	950,000	1,170,000	3,800	13,300	17,100
0.004	250,000	1,020,000	1,270,000	4,000	14,300	18,300
0.002	275,000	1,090,000	1,365,000	4,500	16,400	20,900
0.001	300,000	1,210,000	1,510,000	4,800	17,600	22,400
0.0007	324,140	1,296,560	1,620,700	4,900	18,000	22,900
0.0005	340,000	1,350,000	1,690,000	5,000	18,300	23,300
0	360,000	1,390,000	1,750,000	5,200	19,000	24,200

C. Transportation Delay Analysis. Flooding can temporarily impede traffic by coving roads and bridges. Even the threat of flooding and concern for public safety may make it necessary to close roads and detour traffic. The costs of traffic disruption include 1) the additional operating cost for each vehicle, including depreciation, maintenance, and gasoline per mile of detour; and 2) the traffic delay cost per passenger.

During the June 2008 flood, only the Interstate 380 Bridge remained open out of seven Cedar River bridges in Cedar Rapids, Iowa. The Edgewood Road, 1st, 2nd, 3rd, 8th, 12th, and 16th Avenue Bridges were all closed during the flood. The bridge closures severely impacted north-south traffic along with ambulance, police, and fire services.

Although the City experiences road and bridge closures during extreme flood events, the implementation of the flood mitigation alternatives evaluated in this Study (levees/floodwalls) would not preclude closure. Therefore, in the without and with project conditions there would be closure of these roads during extreme flood events. No transportation benefits were analyzed.

D. Reliability of Existing Levees Small, local levees exist throughout the Study area. District Geotechnical Engineering branch was consulted to determine the protection offered by the existing levees. See Exhibit 4, *Memorandum subject: Evaluation of Existing Levees at Cedar Rapids, Iowa*, which states "it is concluded that all levees in Cedar Rapids that exist do not meet the minimum standards set by the U.S. Army Corps of Engineers. For the purposes of this Study, no measurable level of flood protection shall be taken into account." In the economic analysis, the existing levees in the Study area were not considered to provide flood protection in the Without-Project condition.

IV. BENEFIT ANALYSIS

The benefit categories considered in this report are: Flood damage reduction to Residential and Nonresidential properties, Public Damage Reduction, National Flood Insurance Program Administrative Cost Savings, and Recreation benefits. Public Damage Reduction benefits includes debris removal, emergency protection measures, roads and bridges, utilities, and parks and recreation.

For each alternative, the total annual benefits associated with project implementation were calculated by subtracting average annual With-Project flood damages from average annual Without-Project damages. Thus, the term "benefit" directly implies a reduction in flood related damages. The following sections provide an explanation of the benefits considered in the economic analysis of each alternative.

An enhancement to the existing recreation trail in Cedar Rapids was evaluated in this Study as Recreational Option 1. This recreation plan was evaluated on its own merits, separate from the FRM features.

Throughout this section and Section V. Cost Analysis, guidance in Engineer Regulation (ER) 1105-2-100 was followed. This document outlines the specific methods, procedures, and calculations for determining National Economic Development (NED) benefits.

A. Flood Damage Reduction to Residential and Nonresidential Properties

The overbank flooding damage analysis pertains to the evaluation of flood damages to residential and nonresidential (commercial, industrial, public) structures. Emphasis was placed on residential and nonresidential structures because of significant monetary damage these structures and content incur during flood events. Thus, sampling and surveying efforts were focused on obtaining a comprehensive database of these structures in the Study area.

Several types of input data were required to conduct the overbank flooding damage analysis within the HEC-FDA program. Data included first floor elevation of the structure, depreciated structure value, and damage information specific to each structure. For this analysis, first floor elevations were derived from the 2009 structure inventory. The HEC-FDA compared the first floor elevation of each inventoried structure to the water surface profiles of eight flood return frequencies at the stream station of the structure to determine damages. A depth of flooding for each structure and flood event was then determined and the resultant monetary damages were estimated by the appropriate DDF.

Depreciated structure values were based on the 2009 structure inventory conducted in the Study area. Tax assessor data and M&S were used in the calculation of depreciated structure value.

The third primary type of input data for the overbank flooding damage analysis was information on the damages incurred by each of unique facilities interviewed.

Following data collection and creation of the DDFs, the HEC-FDA program was used to calculate structure damages by evaluated alternative, flood frequency, and flooding depth. For each frequency and depth of flood water, a monetary value was computed for the amount of damage to structures and contents.

The following subsections provide descriptive analyses of the overbank flood damages by each alternative, and the Without-Project condition.

1. No Action Alternative. The no action alternative provides a common base of comparison for all alternatives. In this study there is no difference between the without project condition and no action alternative.

Table B-25 provides a listing of expected annual flood damage estimates by reach and damage category from the HEC-FDA output. Table B-26 provides the number of structures by category.

Table B-25. EAD by Damage Category and Reach for the Without Project Condition (No Action Alternative) - $000's (Base Year 2016) [1]

REACH

West Bank	Commercial/Industrial	Public	Residential	Total
1	10	0	5	15
2A	32	8	222	262
2B	615	152	705	1,472
2C	319	58	102	478
2D	573	99	333	1,005
3	292	0	0	292
West Bank Total	**1,842**	**317**	**1,367**	**3,526**

East Bank	Commercial/Industrial	Public	Residential	Total
4A	213	5	7	226
4B	2,648	0	0	2,648
5A	787	176	81	1,044
5B	935	121	49	1,105
5C	1,623	1	7	1,631
6	0	0	25	25
7	0	30	0	30
9	0	23	0	23
East Bank Total	**6,207**	**356**	**169**	**6,732**
Study Area Total	**8,048**	**674**	**1,535**	**10,257**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars.

Table B-26. Without Project Condition (No Action Alternative) HEC-FDA Structure Inventory Summary (Number of Structures by Category)

Damage Reach	Commercial/Industrial	Public	Residential	Total
1	3	1	8	12
2A	4	2	303	309
2B	84	31	1288	1,403
2C	96	18	622	736
2D	88	23	1073	1,184
3	1	0	0	1
Right Bank Total	**276**	**75**	**3294**	**3,645**
4A	41	7	44	92
4B	9	0	0	9
5A	89	27	7	123
5B	61	14	113	188
5C	2	4	35	41
6	0	1	78	79
7	0	21	0	21
8				
9	0	3	0	3
Left Bank Total	**202**	**77**	**277**	**556**
Entire Study Area	**478**	**152**	**3571**	**4,201**

2. Alternative 1D. Refer to Section I.C.2.b. for a description of Alternative 1D. This alternative provides flood damage reduction for damage reaches 2, 4, and 5 at the "D" height. The optimal height, or height with the greatest net benefits, for Alternative 1 is the Z height with $ -3,294,000 of annual net benefits. Monetary benefits accruing to Alternative 1D were calculated by subtracting the overbank damages that would be incurred for the Alternative 1D from the overbank damages incurred for the Without-Project. The reduced damages represent lower flood induced impacts to commercial, industrial, public, and residential structures and contents. Risk and uncertainty were incorporated into the estimation of benefits. Table B-27 lists the residual Expected Annual Damages with Alternative 1D. Table B-28 provides the total annual overbank flood damages for the Without-Project, residual annual damages for Alternative 1D, and the resultant benefits. Overbank flood damages for Alternative 1D are 96 percent less than damages for the Without-Project Alternative, resulting in an estimated annual benefit of $9,825,000.

Table B-27. Expected Annual Damages by Damage Category and Reach for Alternative 1D - $000's (Base Year 2016) [1]

West Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
1	10	1	6	16
2A	0	0	0	0
2B	0	0	0	0
2C	0	0	0	1
2D	3	1	3	7
3	292	0	0	292
West Bank Total	**305**	**2**	**10**	**317**

East Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
4A	0	0	0	0
4B	0	0	0	0
5A	0	0	0	0
5B	1	0	0	1
5C	27	0	0	28
6	0	0	25	25
7	0	30	0	30
9	0	30	0	30
East Bank Total	**28**	**62**	**25**	**115**
Study Area Total	**333**	**64**	**35**	**432**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars and a discount rate of 4.375%.

Table B-28. Overbank Flooding Benefit Calculations for Alternative 1D

Without-Project Alternative Damage	Alternative 1D Damage	Annual Benefit
10,257,000	432,000	9,825,000

Table B-29. Alternative 1 HEC-FDA Structure Inventory Summary
Number of Structures by Category

Damage Reach	Commercial/Industrial	Public	Residential	Total
Right Bank Total	262	69	3189	3,520
Left Bank Total	197	77	270	544
Entire Study Area	**459**	**146**	**3,459**	**4,064**

3. Alternative 1A-D. Refer to Section I.C.2.c. for a description of Alternative 1A-D. This alternative provides flood damage reduction to reaches 2, 4B, and 5 to the "D" height. The optimal height, or height with the greatest net benefits, for Alternative 1A is the C height with $ -3,098,000 of annual net benefits. Monetary benefits accruing to Alternative 1A-D were calculated by subtracting the overbank damages that would be incurred for the Alternative 1A-D from the overbank damages incurred for the Without-Project. The reduced damages represent lower flood induced impacts to commercial, industrial, public, and residential structures and contents. Risk and uncertainty were incorporated into the estimation of benefits. Table B-30 lists the residual Expected Annual Damages with Alternative 1A-D. Table B-31 provides the total annual overbank flood damages for the Without-Project, annual damages for Alternative 1A-D, and the resultant benefits. Overbank flood damages for Alternative 1A-D are 93 percent less than damages for the Without-Project Alternative, resulting in an estimated annual benefit of $9,510,000. Table B-32 displays structure inventory data for Alternative 1A.

Table B-30. Expected Annual Damage by Damage Category and Reach for Alternative 1A–D
(Base Year 2016, $1,000's) [1]

West Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
1	10	1	6	16
2A	0	0	0	0
2B	0	0	0	0
2C	0	0	0	1
2D	3	1	3	7
3	292	0	0	292
West Bank Total	**305**	**2**	**10**	**317**
East Bank Damage Reach	**Commercial/ Industrial**	**Public**	**Residential**	**Total**
4A	296	7	12	315
4B	0	0	0	0
5A	0	0	0	0
5B	1	0	0	1
5C	27	0	0	28
6	0	0	25	25
7	0	30	0	30
9	0	30	0	30
East Bank Total	325	68	37	430
Study Area Total	**296**	**7**	**12**	**315**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars and a discount rate of 4.375%.

Table B-31. Overbank Flooding Benefit Calculations for Alternative 1A-D

Without-Project Alternative Damage	Alternative 1A-D Damage	Annual Benefit
10,257,000	747,000	9,510,000

Table B-32. Alternative 1 HEC-FDA Structure Inventory Summary
Number of Structures by Category

Damage Reach	Commercial/Industrial	Public	Residential	Total
Right Bank Total	276	75	3294	3,645
Left Bank Total	197	77	270	544
Entire Study Area	**473**	**152**	**3,564**	**4,189**

4. Alternative 4C. Refer to Section I.C.2.d for a description of Alternative 4C. This alternative provides flood damage reduction to damage reaches 4B and 5 to the "C" height. Monetary benefits accruing to Alternative 4C were calculated by subtracting the overbank damages that would be incurred for the Alternative 4C from the overbank damages incurred for the Without-Project Alternative. The reduced damages represent lower flood induced impacts to commercial, industrial, public, and residential structures and contents. Table B-33 lists the residual Expected Annual Damages with Alternative 4C. Table B-34 provides the total annual overbank flood damages for the Without-Project, annual damages for Alternative 4C, and the resultant benefits. Overbank flood damages for Alternative 4C are 57 percent less than damages for the Without-Project Alternative, resulting in an estimated annual benefit of $5,829,000. Table B-35 displays structure inventory data for Alternative 4.

Table B-33. Expected Annual Damage by Damage Category and Reach for Alternative 4C
(Base Year 2016, $1,000's) [1]

West Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
1	10	0	5	16
2A	33	9	234	276
2B	640	158	751	1,550
2C	342	63	123	528
2D	607	106	349	1,062
3	292	0	0	292
West Bank Total	**1,924**	**337**	**1,463**	**3,724**
East Bank Damage Reach	**Commercial/ Industrial**	**Public**	**Residential**	**Total**
4A	235	6	8	249
4B	74	0	0	74
5A	102	29	11	141
5B	43	8	7	57
5C	98	1	1	100
6	0	0	25	25
7	0	30	0	30
9	0	27	0	27
East Bank Total	**551**	**101**	**52**	**704**
Study Area Total	**2,475**	**438**	**1,515**	**4,428**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars and a discount rate of 4.375%.

Table B-34. Overbank Flooding Benefit Calculations for Alternative 4C

Without-Project Alternative Damage	Alternative 4C Damage	Annual Benefit
10,257,000	4,428,000	5,829,000

Table B-35. Alternative 4 HEC-FDA Structure Inventory Summary Number of Structures by Category

Damage Reach	Commercial/Industrial	Public	Residential	Total
Right Bank Total	276	75	3294	3,645
Left Bank Total	197	77	270	544
Entire Study Area	**473**	**152**	**3,564**	**4,189**

5. Alternative 5A. Refer to Section I.C.2.e. for a description of Alternative 5A. This alternative provides flood damage reduction to reach 5C to the "A" height. Monetary benefits accruing to the screened out Alternative 5A were calculated by subtracting the overbank damages that would be incurred for the Alternative 5A from the overbank damages incurred for the Without-Project. The reduced damages represent lower flood induced impacts to commercial, industrial, public, and residential structures and contents. Risk and uncertainty were incorporated into the estimation of benefits. Table B-36 lists the residual Expected Annual Damages with Alternative 5A. Table B-37 provides the total annual overbank flood damages for the Without-Project, annual damages for Alternative 5A, and the resultant benefits. Overbank flood damages for Alternative 5A are 11 percent less than damages for the Without-Project Alternative, resulting in an estimated annual benefit of $1,151,000. Table B-38 displays structure inventory data for Alternative 5.

Table B-36. Expected Annual Damage by Damage Category and Reach for Alternative 5A (Base Year 2016, $1,000's) [1]

West Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
1	10	0	5	15
2A	32	8	225	265
2B	620	153	712	1,486
2C	324	59	105	488
2D	584	100	336	1,020
3	292	0	0	292
West Bank Total	**1,863**	**322**	**1,382**	**3,567**
East Bank Damage Reach	**Commercial/ Industrial**	**Public**	**Residential**	**Total**
4A	219	5	7	231
4B	2,656	0	0	2,656
5A	806	179	83	1,068
5B	937	121	49	1,108
5C	392	1	3	396
6	0	0	25	25
7	0	30	0	30
9	0	23	0	23
East Bank Total	5,010	361	167	5,539
Study Area Total	**6,874**	**682**	**1,550**	**9,106**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars and a discount rate of 4.375%

Table B-37. Overbank Flooding Benefit Calculations for Alternative 5A

Without-Project Alternative Damage	Alternative 5A Damage	Annual Benefit
10,257,000	9,106,000	1,151,000

Table B-38. Alternative 5 HEC-FDA Structure Inventory Summary
Number of Structures by Category

Damage Reach	Commercial/Industrial	Public	Residential	Total
Right Bank Total	276	75	3294	3,645
Left Bank Total	202	76	273	551
Entire Study Area	**478**	**151**	**3,567**	**4,196**

6. Alternative 7B. Refer to Section I. C.2.f. for a description of Alternative 7B. This alternative provides flood damage reduction to reach 4B to the "B" height. Monetary benefits accruing to the screened out Alternative 7B were calculated by subtracting the overbank damages that would be incurred for the Alternative 7B from the overbank damages incurred for the Without-Project. The reduced damages represent lower flood induced impacts to commercial, industrial, public, and residential structures and contents. Risk and uncertainty were incorporated into the estimation of benefits. Table B-39 lists the residual Expected Annual Damages with Alternative 7B. Table B-40 provides the total annual overbank flood damages for the Without-Project, annual damages for Alternative 7B, and the resultant benefits. Overbank flood damages for Alternative 7B are 25 percent less than damages for the Without-Project Alternative, resulting in an estimated annual benefit of $2,572,000. Table B-41 displays structure inventory data for Alternative 7.

Table B-39. Expected Annual Damage by Damage Category and Reach for Alternative 7B
(Base Year 2016, $1,000's) [1]

West Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
1	10	0	5	15
2A	32	8	223	264
2B	615	152	706	1,474
2C	319	58	102	478
2D	574	99	334	1,007
3	292	0	0	292
West Bank Total	**1,843**	**318**	**1,370**	**3,530**
East Bank Damage Reach	**Commercial/ Industrial**	**Public**	**Residential**	**Total**
4A	217	5	7	229
4B	67	0	0	67
5A	787	176	81	1,044
5B	935	121	49	1,105
5C	1,623	1	7	1,631
6	0	0	25	25
7	0	30	0	30
9	0	23	0	23
East Bank Total	3,629	356	169	4,155
Study Area Total	**5,472**	**674**	**1,539**	**7,685**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars and a discount rate of 4.375%

Table B-40. Overbank Flooding Benefit Calculations for Alternative 7B

Without-Project Alternative Damage	Alternative 7B Damage	Annual Benefit
10,257,000	**7,685,000**	**2,572,000**

Table B-41. Alternative 7 HEC-FDA Structure Inventory Summary Number of Structures by Category

Damage Reach	Commercial/Industrial	Public	Residential	Total
Right Bank Total	276	75	3294	3,645
Left Bank Total	202	77	277	556
Entire Study Area	**478**	**152**	**3,571**	**4,201**

7. Alternative 10E. This alternative provides flood damage reduction to reach 5C to the "A" height and reach 4B to the "B" height. This alternative, combines alternatives 5A and 7B. Monetary benefits accruing to the screened out Alternative 10E were calculated by subtracting the overbank damages that would be incurred for the Alternative 10E from the overbank damages incurred for the Without-Project. The reduced damages represent lower flood induced impacts to commercial, industrial, public, and residential structures and contents. Risk and uncertainty were incorporated into the estimation of benefits. Table B-42 lists the residual Expected Annual Damages with Alternative 10E. Table B-43 provides the total annual overbank flood damages for the Without-Project, annual damages for Alternative 10E, and the resultant benefits. Overbank flood damages for Alternative 10E are 36 percent less than damages for the Without-Project alternative, resulting in an estimated annual benefit of $3,740,000. Table B-44 displays structure inventory data for Alternative 10.

Table B-42. Expected Annual Damage by Damage Category and Reach for Alternative 10E (Analysis Year 2016, $1,000's) [1]

West Bank Damage Reach	Commercial/ Industrial	Public	Residential	Total
1	10	0	5	15
2A	32	8	225	265
2B	620	153	712	1,486
2C	324	59	105	488
2D	584	100	336	1,020
3	292	0	0	292
West Bank Total	**1,863**	**322**	**1,382**	**3,567**
East Bank Damage Reach	**Commercial/ Industrial**	**Public**	**Residential**	**Total**
4A	219	5	7	231
4B	67	0	0	67
5A	806	179	83	1,068
5B	937	121	49	1,108
5C	392	1	3	396
6	0	0	25	25
7	0	30	0	30
8	0	0	0	0
9	0	23	0	23
East Bank Total	**2,422**	**361**	**167**	**2,950**
Study Area Total	**4,285**	**682**	**1,550**	**6,517**

[1] Damage estimates incorporate uncertainty and are based on 2010 dollars and a discount rate of 4.375%

Table B-43. Overbank Flooding Benefit Calculations for Alternative 10E

Without Alternative Damage	Alternative 10 Damage	Annual Benefit
10,257,000	6,517,000	3,740,000

Table B-44. Alternative 10 HEC-FDA Structure Inventory Summary
Number of Structures by Category

Damage Reach	Commercial/Industrial	Public	Residential	Total
Right Bank Total	276	75	3294	3,645
Left Bank Total	202	76	273	551
Entire Study Area	**478**	**151**	**3,567**	**4,196**

B. Public Damage Reduction Benefits. Table B-45 summarizes public damage reduction benefits by Category and Alternative. Table B-46 presents public benefit totals by Alternative. Table B-47 presents residual public damage (annual damages remaining with project implementation) by Alternative. As is readily evident by the damage category discussion and the quantification of annual damages and benefits, the Alternative alignments would reduce the presented categorical public damages to a limited degree. The general study area extends for about 12 miles on both banks of the Cedar River (a total of about 24 bank line miles of floodplain, with non-contiguous study reaches). The array of alternatives provides protection for bank line lengths ranging from approximately 2.5 miles to 6 miles. Damages that may occur within the study area, but outside the Alternative alignments (or riverward of alignments), are quantified in annual damage calculations. Damages would not be reduced for these areas, and therefore benefits would not accrue to the presented Alternatives. The dollar amounts and percentages reported in table B-47a reflect this study area situation.

Table B-45. Public Damage/Cost Reduction Benefits by Category and Plan

FEMA Category	Existing Condition Avg Annual Damage ($)	Alternative Height	Alternatives 1 and 1A	Alternative 4	Alternative 5	Alternative 7
Debris Removal	124,100	Z	79,000	13,700	negligible	negligible
		A	84,500	15,500	negligible	negligible
		B	97,300	16,600	negligible	negligible
		C	104,100	17,700	negligible	negligible
		D	108,100	18,100	negligible	negligible
Emergency Protection Measures	789,400	Z	345,400	68,400	negligible	negligible
		A	415,400	85,800	negligible	negligible
		B	495,000	106,400	negligible	negligible
		C	531,000	115,700	negligible	negligible
		D	550,700	120,600	negligible	negligible
Roads and Bridges	182,000	Z	33,300	7,600	negligible	negligible
		A	36,800	84,000	negligible	negligible
		B	41,300	9,500	negligible	negligible
		C	43,800	10,100	negligible	negligible
		D	45,100	10,400	negligible	negligible
Water Control Facilities (sewers)	686,800	Z	423,500	92,300	negligible	negligible
		A	508,600	114,400	negligible	negligible
		B	607,500	141,500	negligible	negligible
		C	652,700	154,100	negligible	negligible
		D	677,000	161,000	negligible	negligible
Buildings, Equipment and Contents	*		included in input/output to HEC-FDA simulation model			
Utilities	*		included in input/output to HEC-FDA simulation model			
Parks and Recreation	24,200		negligible	negligible	negligible	negligible
Total	1,806,500					

Table B-46. Public Damage/Cost Reduction Benefits Totals by Alternative

Existing Condition Avg Annual Damage	Alternative Height	Alternatives 1 and 1A	Alternative 4	Alternative 5	Alternative 7	Alternative 10
$1,806,500	Z	$ 881,200	$ 182,000	negligible	negligible	negligible
	A	$ 1,045,300	$ 224,100	negligible	negligible	negligible
	B	$ 1,241,100	$ 274,000	negligible	negligible	negligible
	C	$ 1,331,600	$ 297,600	negligible	negligible	negligible
	D	$ 1,380,900	$ 310,100	negligible	negligible	negligible

Table B-47. Residual Annual Public Damage Totals by Alternative & Height

Existing Condition Avg Annual Damage	Alternative Height	Alternatives 1 and 1A	Alternative 4	Alternative 5	Alternative 7	Alternative 10
$1,806,500	Z	$ 925,300	$ 1,624,500	$ 1,806,500	$ 1,806,500	$ 1,806,500
	A	$ 761,200	$ 1,582,400	$ 1,806,500	$ 1,806,500	$ 1,806,500
	B	$ 565,400	$ 1,532,500	$ 1,806,500	$ 1,806,500	$ 1,806,500
	C	$ 474,900	$ 1,508,900	$ 1,806,500	$ 1,806,500	$ 1,806,500
	D	$ 425,600	$ 1,496,400	$ 1,806,500	$ 1,806,500	$ 1,806,500

Table B-47a. Residual Annual Public Damages as a Percentage of Total Annual Public Damages

Existing Condition Avg Annual Damage	Alternative Height	Alternatives 1 and 1A	Alternative 4	Alternative 5	Alternative 7	Alternative 10
$1,806,500	Z	51%	90%	100%	100%	100%
	A	42%	88%	100%	100%	100%
	B	31%	85%	100%	100%	100%
	C	26%	84%	100%	100%	100%
	D	24%	83%	100%	100%	100%

C. National Flood Insurance Program Administration Cost Savings. Some of the With-Project Alternatives may reduce the number of policies the FIA would administer compared to the Without-Project conditions, benefits in the form of reduced administrative expenditures can be attributed to these alternatives. Table B-48 displays a summary of Annual Administrative Expenditures and Reduction in Expenditures for each alternative.

1. No Action. Under the without project condition the FIA administers a total of 1,817 policies for the structures located in the Cedar River base floodplain, which represents an average annual administrative cost of $348,864. There is no difference between the future without project and no action alternative, so there is no reduction in administrative expenditures.

2. Alternative 1. The FRM measures implemented for Alternative 1B, 1C, and 1-D would result in a significant reduction in FIA expenditures. Alternative 1, at the "A" height would not be certified to the NFIP standards and therefore would not reduce the flood insurance administrative expenditures. Average annual expenditures are projected to decrease from $348,864 in the without project condition to $226,560 with this alternative. A reduction of $122,304 or about 35 percent less than in the without project condition.

3. Alternative 1A. The FRM measures implemented for Alternative 1A-B, 1A-C, and 1A-D would result in a significant reduction in FIA expenditures. Alternative 1A, at the "A" height would not be certified to the NFIP standards and therefore would not reduce the flood insurance administrative expenditures. Average annual expenditures are projected to decrease from $348,864 in the without project condition to $226,560 with this alternative. A reduction of $122,304 or about 35 percent less than in the without project condition.

4. Alternative 4. The FRM measures implemented for Alternative 4A, 4B, 4C, and 4D would result in a reduction in FIA expenditures. Average annual expenditures are projected to decrease from $348,864 in the without project condition to $332,160 with this alternative. A reduction of $16,704 or 5 percent less than in the without project condition.

5. Alternative 5. Implementing this alternative would result in no reduction in FIA expenditures.

6. Alternative 7. Implementing this alternative would result in no reduction in FIA expenditures.

7. Alternative 10. Implementing this alternative would result in no reduction in FIA expenditures.

Table B-48. Summary of Annual Administrative Expenditures and Reduction in Expenditures by Alternative

	Projected Number of Homes with Flood Insurance Policies	Annual Administrative Expenditures per Policy ($)	Total Annual FIA Expenditures ($)	Annual Flood Insurance Expenditures Reduced (Benefits) ($)
Future w/out Project Condition	1,817	192	348,864	0
Alternative 1	1,180	192	226,560	122,304
Alternative 1A	1,180	192	226,560	122,304
Alternative 4	1,730	192	332,160	16,704

D. Recreation Benefits

1. Introduction. This analysis evaluates the economic feasibility (based upon NED guidelines) of constructing a recreation trail and facilities for the *Cedar Rapids Flood Risk Management Study*, along the Cedar River, near downtown Cedar Rapids, Iowa. The proposed project will enhance the recreation experience and opportunities for area residents and visitors. Throughout this analysis, price levels are stated as of FY 2010, with the required Federal discount rate of 4-3/8 percent for a water resources project being used to amortize costs for comparison with annualized benefits. The benefits from this recreation analysis are not included in the final BCRs in section VI of this appendix because the Recreational Option 1 is not incrementally economically justified and therefore it is not recommended as part of the NED Plan.

2. Existing Conditions. The City is currently served by four trails near the downtown and one trail downstream on the left descending bank. The four trails close to downtown are Ellis Trail, located on the right descending bank; Cedar Lake Loop Trail, located around Cedar Lake on the east side of the river; Bowling Street Trail, located on the south side of the town west of the river; and Cedar River Trail, which is a part of the Cedar Valley Nature Trail (a regional trail). It is connected to the Cedar Lake Loop and winds through downtown Cedar Rapids before running parallel to the left descending bank and then crossing the Cedar River. This trail becomes Hoover Nature Trail as it runs south. The Sac and Fox Trail is a trail east of Cedar Rapids and does not connect to any Cedar Rapids trails. The City provided a map of the existing system.

3. With-Project Recreational Opportunities. The proposed With-Project condition would include Recreational Option 1 with the Alternative 4C levee/floodwall. The Cedar River Trail will be re-aligned starting at the location near Cedar Lake. The recreational trail will align southward at this location, cross the railroad tracks, then will be located adjacent to the riverfront. The recreational trail will be located on the river side of the flood protection wall. The new recreation trail will then tie into the existing riverfront recreation trail at 8th Avenue SE. With Recreational Option 1 in place the recreational experience, aesthetic value, and the overall safety of the trail will increase. In general, the expected users include walkers, joggers, in-line skaters and cyclists. Weekend use may extend to special event attendees, families and regional tourists.

There is an additional alternative that was discussed, but not analyzed. This Recreational Option 2 proposes trail enhancements identical to Recreational Option 1, while also adding an amphitheater along the east bank near the trail. This alternative was not evaluated for economic feasibility due to time constraints and a lack of information pertaining to the proposed amphitheater's size and type, location, projected visitation, and its anticipated event schedule.

4. Benefit Computation. Figure 6.7 of the Guidelines for Conducting Civil Works Planning Studies (ER 1105-2-100) gives the criteria used to select the procedure for evaluating recreation projects. The steps indicated in the Guidelines are shown in table B-49 and result in the Unit Day Value (UDV) Method being used to determine the NED benefits for this project.

Table B-49. Criteria for Selecting an Appropriate Procedure

Criteria	
1. Is a regional model available?	No
2. If "No," do uses affected involve specialized recreation activities?	No
3. If "No," do expected annual visits affected exceed 750,000?	No
4. Do specific annual Federal recreation costs exceed $1,000,000 (FY82 price levels)?	No
5. If "No," then use UDVs for evaluating recreation benefits resulting from the proposed Project.	

Federal interest for participating in this proposed recreation plan was evaluated based upon ER 1105-2- 100 and Economic Guidance Memorandum 10-03 (UDV method). This method is appropriate given the above referenced Guidelines. The UDV method assigns point values (convertible to dollar values) for recreational facility attributes including recreation experience, availability, carrying capacity, accessibility, and environmental/aesthetic quality.

Determination of Unit Day Values. Unit day value points are determined for both the existing Without Project and the proposed With Project conditions. Because of the activities possible at the proposed trail facilities, estimation of UDVs was determined for general recreational activities. Activities will include walking, running, biking, in-line skating, and other general activities. The UDV increases were based upon the comparison of General Recreation Criteria (EGM 10-03) in the existing condition versus the improved With Project condition, as follows. Table B-50 displays the UDV points assigned to each category for the Without Project and the proposed With Project conditions.

Recreation Experience. The City currently has a west bank and a short east bank riverfront recreational trail system providing a venue for general activities, including walking, biking, running, and in-line skating. With Recreational Option 1 in place, the venue on the east side will be enhanced. These activities will be enjoyed in an aesthetically improved riverfront destination as opposed to the current trail segment that winds through downtown Cedar Rapids.

Availability of Opportunity. The facility quality of recreational activities available in the Without and With-Project condition can be found within a half hour of the proposed project.

Carrying Capacity. In the without project condition the trail system offers adequate facilities to conduct general recreation activities. With Recreational Option 1 the trail along the riverfront will provide optimum facilities with which to conduct a variety of high-quality general recreational activities. The new trail segment will be a significant upgrade from the existing conditions due to the re-routed location on the riverbank and away from the downtown.

Accessibility. Recreational Option 1 will not affect accessibility to the trail.

Environmental. Users of the Recreational Option 1 facilities with a riverfront setting will experience a slightly improved esthetic quality compared to the without project condition of a trail through downtown.

Table B-50. Unit Day Value Analysis

UDV Categories	Without Project (Existing Condition)	Recreational Option 1
Recreation Experience	8	10
Availability of Opportunity	3	3
Carrying Capacity	7	11
Accessibility	11	11
Environmental	8	10
Total	**37**	**45**
Conversion of Points to $ Values	$6.23	$7.10

Trail usage estimates were taken from actual counts by the City using an infrared counter. The approximate yearly usage for Recreational Option 1 is 37,000 user days.

5. Average Annual Costs and Benefits. Construction and O&M costs detailed in this report are in FY 2010 price levels. Annualized costs are computed using a 4.375 percent rate as mandated for Federal water resource projects. A 50-year project life has been used for the period of analysis. Table B-51 summarizes the calculations for annual charges and benefits for Recreational Option 1.

Table B-51. Annual Costs and Benefits

	Without Project	Recreational Option 1
Annual Benefits	$230,800	$263,000
Incremental Difference		**$32,200**
Project Cost Estimate		$595,000 [1]
Interest During Construction		$13,900
Total First Costs		$608,000
Annualized First Cost		$30,100
Annualized Operation, Maintenance, & Replacement [2]		$5,200
Total Annual Cost		**$35,300**
BCR		**.91**
Net Benefits		**($3,100)**

[1] This cost does not include an estimate to acquire land necessary for the construction of the recreation trail. Whether or not land would have to be acquired for construction of Recreational Option 1 has not been determined. Per discussion with the Project Engineer, it was assumed by engineering that a small amount of land may have to be acquired and the cost would be negligible.

[2] Consists of $4,000 every 5 years for crack sealing, and $200,000 at 25 and 50 years for project overhaul. The $4,000 cost for crack sealing is not incurred in years of project overhaul (at years 25 and 50). The present value of these costs are summed and annualized over the project life.

E. Induced Damages. The HEC-FDA program calculates expected annual damages (EAD) in the study area for the without project condition and each With-Project condition utilizing water surface elevation information and stage-damage curves. The reduction in EAD calculated by comparing each With-Project condition to the Without-Project condition is a large portion of the average annual benefits of each alternative project. The HEC-FDA program was used to calculate $10,257,000 in Without-Project EAD for all damage reaches in the study area. With Alternative 4C levee/floodwall in place, the water surface elevation for each flood event is higher in the unprotected sections of the study area and lower in the protected area (until the top of levee elevation is reached). The HEC-FDA program was used to calculate $4,428,000 in residual EAD for all damage reaches with Alternative 4C in place. This amount includes EAD induced in the non-protected damage reaches and residual EAD in the protected reaches. The Without-Project EAD less the With-Project residual EAD equals $5,829,000 for Alternative 4C. This amount is the EAD reduced with the project in place. It is also the flood damage reduction benefit of the project. Negative benefits (induced expected annual damages in the non-protected reaches) were included in the total benefits (EAD reduced) for this alternative and all the alternatives that were evaluated in HEC-FDA. The induced EAD reduced the benefit amount that was used to calculate the BCR for each alternative. Implementation of Alternative 4C is expected to cause induced increases in water surface elevations, and consequently increases in EAD (negative benefits), for damage reaches 1, 2A, 2B, 2C, 2D, 4A, and 9.

Table B-52 lists the expected average increase in water surface elevation in each damage reach with Alternative 4C in place. The four damage reaches listed as “protected” in the table (4B, 5A, 5B, 5C) are the damage reaches with a levee or floodwall under Alternative 4C.

Tables B-53 and B-54 list the amount of EAD reduced or induced in each damage reach with Alternative 4C and Alternative 10E in place. As an example, table B-53, lists $5,829,000 EAD reduced (benefits) with Alternative 4C in place. This benefit amount includes $227,000 of EAD induced (negative benefits). Table B-53 displays results of the overbank flooding damage analysis and therefore does not include EAD reduced or induced to the property included in the public damage reduction benefits section of this appendix. The EAD reduced was calculated by river bank instead of damage reach for the public damage analysis. No analysis of potential induced EAD to the properties included in the public damage analysis has been completed for this study by economics. No analysis of potential induced damage to areas outside of the damage reaches has been completed for this study by economics.

Refer to Appendix A, *Hydrology and Hydraulics*, table A-31 and figure A-6 for further discussion of induced water surface elevations. Refer to the main report for a discussion of required mitigation (if needed). Section VI of Appendix E, *Real Estate*, states: “This real estate plan does not include any costs for induced flooding as a result of the construction of the project. Minimal flooding on the west bank is expected during high water events. The induced flooding is expected to be infrequent and minimal based on hydraulic modeling (see table 17 in the main report). If subsequent engineering during design phase determines changes in the hydraulic data, this issue will be revisited.”

Table B-52. Average Increase in Water Surface Elevation With Alternative 4C

Damage Reach	Damage Reach Description	Exceedance Probability 0.04 Increase (ft)	Exceedance Probability 0.02 Increase (ft)	Exceedance Probability 0.01 Increase (ft)	Exceedance Probability 0.005 Increase (ft)	Exceedance Probability 0.002 Increase (ft)	Downstream Station	Upstream Station
1	Manhattan Robbins Lake Park	0	0.02	0.12	0.14	0.31	71108	75651
2A	Ellis Lane to O Av	0.01	0.06	0.22	0.24	0.5	59539	62789
2B	O Avenue to 1st Ave	0.01	0.06	0.24	0.25	0.56	54547	59539
2C	1st Avenue to 8th Av	0.02	0.03	0.23	0.61	0.89	51667	54547
2D	8th Avenue to Skejskal Park	0.01	0.02	0.13	0.32	0.55	47445	51667
3	Power Plant	0	0	0	0	0	34185	35452
4A	Long Bluff Road to I-380	0.01	0.05	0.21	0.23	0.48	57814	66550
4B	Industrial Area South of Cedar Lake	Protected	Protected	Protected	Protected	Protected	55279	57814
5A	I-380 to 8th Ave	Protected	Protected	Protected	Protected	Protected	51667	55279
5B	8th Ave to VanVechten Park	Protected	Protected	Protected	Protected	Protected	48340	51667
5C	Industrial Area Downtown S.	Protected	Protected	Protected	Protected	Protected	43801	48340
6	Otis Road to Otis Av	0	0	0	0	0	34185	41573
7	Bertram Road to East Gate	0	0	0	0	0	12161	15530
9	Mays Island	0.02	0.06	0.23	0.52	0.81	51667	55279

Table B-53. Residential, Commercial, Industrial and Public Structures and Content Expected Annual Damage (EAD) With Alternative 4C

Damage Reach	w/out Project EAD $000	Residual EAD With Protect $000	EAD Reduced (Benefits) With Project $000	EAD Induced [1] (Negative Benefits) With Project $000	EAD Reduced (for protected reaches) as a % of w/out Project EAD	EAD Induced (for non-protected reaches) as a % of w/out Project EAD
1, 2A, 2B, 2C, 2D, 3, 4A, 4B, 5A, 5B, 5C, 6, 7, 9	10,257	4,428	5,829	227	56.8%	2.2%
1	15	16	0	1	0.0%	6.7%
2A	262	276	0	14	0.0%	5.3%
2B	1,472	1,550	0	78	0.0%	5.3%
2C	478	528	0	50	0.0%	10.5%
2D	1,005	1,062	0	57	0.0%	5.7%
3	292	292	0	0	0.0%	0.0%
4A	226	249	0	23	0.0%	10.2%
4B (Protected)	2,648	74	2,574	0	97.2%	0.0%
5A (Protected)	1,044	141	903	0	86.5%	0.0%
5B (Protected)	1,105	57	1,048	0	94.8%	0.0%
5C (Protected)	1,631	100	1,531	0	93.9%	0.0%
6	25	25	0	0	0.0%	0.0%
7	30	30	0	0	0.0%	0.0%
9	23	27	0	4	0.0%	17.4%

[1] EAD Induced (Negative Benefits) amounts are included in Residual EAD With Project. Therefore, $227,000 in induced damage is included in the EAD Reduced (benefit) amount of $5,829,000 for Alternative 4C.

Table B-54. Residential, Commercial, Industrial and Public Structures and Content Expected Annual Damage with Alternative 10E

Damage Reach	W/out Project EAD $000	Residual EAD With Protect $000	EAD Reduced (Benefits) With Project $000	EAD Induced (Negative Benefits)	EAD Reduced (for protected reaches) as a % of w/out Project	EAD Induced (for non-protected reaches) as a % of w/out Project EAD
1, 2A, 2B, 2C, 2D, 3, 4A, 4B, 5A, 5B, 5C, 6, 7, 9	10,257	6,517	3,740	74	36.5%	0.7%
1	15	15	0	0	-0.4%	0.0%
2A	262	265	0	3	0.0%	1.1%
2B	1,472	1486	0	14	0.0%	1.0%
2C	478	488	0	10	0.0%	2.1%
2D	1,005	1020	0	15	0.0%	1.5%
3	292	292	0	0	0.0%	0.0%
4A	226	231	0	5	0.0%	2.2%
4B (Protected)	2,648	67	2,581	0	97.5%	0.0%
5A	1,044	1,068	0	24	0.0%	2.3%
5B	1,105	1,108	0	3	0.0%	0.3%
5C (Protected)	1,631	396	1,235	0	75.7%	0.0%
6	25	25	0	0	0.0%	0.0%
7	30	30	0	0	0.0%	0.0%
9	23	23	0	0	0.0%	0.0%

F. Summary of Benefits

Table B-55. Summary of Expected Annual Damage, Benefit Estimates, and Residual Damage by Category and Alternative

Total Expected Annual Damage for Without-Project by Alternative ($1,000's)				
Alternative	**Residential, Commercial, Industrial, Public Structures and Content EAD**	**Other Public Flood Damage EAD**	**Annual Flood Insurance Administration Costs**	**Total Without Project EAD**
Without-Project EAD ($1,000)	10,257	1,807	349	12,413
Total Expected Annual Damage Reduced (Benefits) by Category and Alternative				
Alternative	**Residential, Commercial, Industrial, Public Structures and Content EAD**	**Other Public Flood Damage Reduction**	**Annual Flood Insurance Administration Costs**	**Total Project Benefits**
1C	9,001	1,332	122	10,455
1A-C	8,715	1,332	122	10,169
4C	5,829	298	17	6,144
5A	1,151	negligible	0	1,151
7B	2,572	negligible	0	2,572
10E	3,740	negligible	0	3,740
Total Residual Expected Annual Damage by Category and Alternative				
Alternative	**Residential, Commercial, Industrial, Public Structures and Content Residual EAD**	**Other Public Flood Damage Residual EAD**	**Remaining Annual Flood Insurance Administration Costs**	**Total Residual Damage With Project**
1C	1,256	475	227	1,957
1A-C	1,542	475	227	2,244
4C	4,428	1,509	332	6,269
5A	9,106	1,807	349	11,261
7B	7,685	1,807	349	9,840
10E	6,518	1,807	349	8,673

G. Risk and Uncertainty Analysis. Given the uncertainty associated with the various hydraulic, hydrologic, and economic relationships used in the analysis, there is likewise some uncertainty regarding an alternative's ability to provide a given amount of benefits or level of protection.

Plan and damage reach performance analysis are based on target standards defined for the Without-Project conditions for the Study. The standards used by the HEC-FDA program are based on the residual damage associated with a specific exceedance probability event. Consistent criterion for comparing the impacts of different measures and plans is a goal. The HEC-FDA program utilizes target stage, target stage annual exceedance probability, long term risk, and conditional non-exceedance probability by event to characterize flood risk.

Target Stage, for reaches without levees, is the stage typically associated with the start of significant damage for the Without-Project conditions. The stage is determined as the stage associated with the percent of residual damage of a specific exceedance probability event. For this Study the HEC-FDA default criterion of 5 percent of the total damage for the 1 percent event was utilized. Target stage, for damage reaches with levees and floodwalls without geotechnical failure (all damage reaches in this Study) is the top of levee/floodwall in the reach.

Target Stage Annual Exceedance Probability is the median and expected annual exceedance probabilities associated with the target stage. The median value is calculated from the input discharge-probability and stage-discharge functions. The expected value is computed from the results of Monte Carlo simulation.

Long-Term Risk is the probability of the target stage being exceeded in a 10-, 30-, and 50- year period. The expected value of long term risk is reported as the average over all Monte Carlo simulations

Conditional **Non-Exceedance Probability by Event** is the chance of containing the specific 0.10; 0.04; 0.02; 0.01; 0.004; and 0.002 exceedance probability event within the target stage, should that event occur.

The flood risk for each levee alternative is described using expected annual stage exceedance probability, long-term risk, and conditional probability of non-exceedance in Appendix A, *Hydrology and Hydraulics*, section "FDA Results for Hydrologic and Hydraulic Performance of Alternatives". Tables B-56 and B-57 include this information for the without project condition and Alternative 4. Table B-58 includes this information for Alternative 10. The last alternative, 10E, was a combination of Alternative 7B with Alternative 5A. No new HEC-RAS or HEC-FDA runs were made. Alternative 10E was evaluated using existing analyses. Performance would be found in table B-58 with Alternative 10A used for Reach 5C and Alternative 10B used for Reach 4B.

Refer to Appendix A, *Hydrology and Hydraulics*, tables A-34 through A-40 for this information about additional alternatives.

Table B-56. Performance for Without-Project

		Target Stage Annual Exceedance Prob.		Long Term Risk			Conditional Non-Exceedance Probability by Events					
Economic Reaches from Downstream to Upstream Left & Right	**Target Stage**	**Median**	**Expected**	**10-yr**	**30-yr**	**50-yr**	**0.10**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
Left Reach 7	711.72	0.0166	0.0195	0.1789	0.3891	0.6267	0.9999	0.9264	0.6046	0.2484	0.0512	0.0131
Left Reach 6	716.31	0.0303	0.0332	0.2866	0.5701	0.8152	0.9994	0.7230	0.1710	0.0134	0.0001	0.0000
Left Reach 5C	716.47	0.0574	0.0612	0.4681	0.7936	0.9574	0.9490	0.1600	0.0060	0.0000	0.0000	0.0000
Left Reach 5B	717.99	0.0719	0.0759	0.5458	0.8609	0.9807	0.8383	0.0515	0.0007	0.0000	0.0000	0.0000
Left Reach 9 (Mays Is.)	722.78	0.0205	0.0227	0.2049	0.4362	0.6822	1.0000	0.9372	0.4546	0.0718	0.0012	0.0000
Left Reach 5A	720.74	0.0383	0.0413	0.3438	0.6511	0.8783	0.9977	0.5185	0.0624	0.0018	0.0000	0.0000
Left Reach 4B	722.20	0.0458	0.0490	0.3950	0.7153	0.9189	0.9914	0.3338	0.0209	0.0002	0.0000	0.0000
Left Reach 4A	726.02	0.0200	0.0222	0.2013	0.4299	0.6750	1.0000	0.9478	0.4654	0.0672	0.0008	0.0000
Right Reach 3	717.18	0.0155	0.0181	0.1665	0.3657	0.5977	1.0000	0.9446	0.6444	0.2768	0.0594	0.0138
Right Reach 2D	719.63	0.0416	0.0446	0.3664	0.6804	0.8979	0.9952	0.4373	0.0433	0.0010	0.0000	0.0000
Right Reach 2C	721.08	0.0344	0.0373	0.3162	0.6133	0.8505	0.9991	0.6219	0.0990	0.0041	0.0000	0.0000
Right Reach 2B	722.69	0.0452	0.0484	0.3912	0.7108	0.9163	0.9920	0.3471	0.0231	0.0003	0.0000	0.0000
Right Reach 2A	724.53	0.0432	0.0468	0.3811	0.6987	0.9092	0.9919	0.3900	0.0329	0.0006	0.0000	0.0000
Right Reach 1	725.71	0.1058	0.1125	0.6970	0.9495	0.9974	0.4080	0.0055	0.0000	0.0000	0.0000	0.0000

Table B-57. Performance for Alternative 4 (Only East Bank Levee-Not West Bank Levee)

			Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
Alternative & Height	**Levee Crest at Index Station**	**Target Stage**	**Median**	**Expected**	**10-yr**	**30-yr**	**50-yr**	**0.10**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
4Z	Left Levee crest 5A	levee	0.0067	0.0079	0.0762	0.1797	0.3270	1.0000	0.9999	0.9797	0.7432	0.1866	0.0303
4A	Left Levee crest 5A	levee	0.0039	0.0047	0.0464	0.1120	0.2115	1.0000	1.0000	0.9977	0.9310	0.5030	0.1764
4B	Left Levee crest 5A	levee	0.0018	0.0022	0.0222	0.0546	0.1062	1.0000	1.0000	0.9999	0.9948	0.8561	0.5304
4C	Left Levee crest 5B	levee	0.0006	0.0006	0.0060	0.0148	0.0295	1.0000	1.0000	1.0000	0.9999	0.9897	0.9124
4D	Left Levee crest 5C	levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9961

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table B-58. Performance for Alternative 10 (Ring Levees Reach 4B & 5C)

			Target Stage Annual Exceedance Prob.		Long Term Risk [1]			Conditional Non-Exceedance Probability by Events					
Alternative & Height	**Levee Crest at Index Station**	**Target Stage**	**Median**	**Expected**	**10-yr**	**30-yr**	**50-yr**	**0.10**	**0.04**	**0.02**	**0.01**	**0.004**	**0.002**
10Z	Left Levee crest 5C	Levee	0.0055	0.0066	0.0644	0.1532	0.2830	1.0000	0.9999	0.9885	0.8272	0.2935	0.0660
	Left Levee crest 4B	Levee	0.0058	0.0069	0.0665	0.1581	0.2912	1.0000	0.9999	0.9886	0.8141	0.2659	0.0555
10A	Left Levee crest 5C	Levee	0.0030	0.0038	0.0371	0.0901	0.1722	1.0000	1.0000	0.9993	0.9677	0.6379	0.2678
	Left Levee crest 4B	Levee	0.0030	0.0039	0.0380	0.0922	0.1759	1.0000	1.0000	0.9991	0.9619	0.6255	0.2673
10B	Left Levee crest 5C	Levee	0.0015	0.0019	0.0186	0.0458	0.0896	1.0000	1.0000	1.0000	0.9970	0.8990	0.6183
	Left Levee crest 4B	Levee	0.0005	0.0004	0.0043	0.0108	0.0214	1.0000	1.0000	1.0000	0.9999	0.9947	0.9472
10C	Left Levee crest 5C	Levee	0.0005	0.0005	0.0050	0.0124	0.0247	1.0000	1.0000	1.0000	0.9999	0.9929	0.9320
	Left Levee crest 4B	Levee	0.0001	0.0000	0.0003	0.0006	0.0013	1.0000	1.0000	1.0000	1.0000	0.9999	0.9978
10D	Left Levee crest 5C	Levee	0.0001	0.0001	0.0006	0.0015	0.0029	1.0000	1.0000	1.0000	1.0000	0.9998	0.9962
	Left Levee crest 4B	Levee	0.0001	0.0000	0.0003	0.0008	0.0016	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

[1] The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

For example, table B-57 shows that for Alternative 4C there is a 91.24 percent probability that the target stage (target stage equals top of levee/floodwall) will not be exceeded, given the occurrence of a 500- year flood (.2 percent chance event). On the other hand there is still a 8.76 percent probability (1 - .9124) that the 500-year flood will exceed the target stage. In addition, table B-57 shows that alternative 4C, will have a 1.48 percent chance of exceeding the target stage one or more times within a period of 30 years. This compares to a without project chance of 86.09 percent. Another way to state this risk is that Alternative 4C would have a 1 in 67.57 chance of exceeding the target stage within a period of 30 years. This example data is for reach 5B which is located on the east bank in the downtown area of Cedar Rapids. The levee performance at the index station of the reach with the worst performance is summarized in these tables.

As the period of time increases in length, the probability for an event that exceeds the target stage for any of the alternatives increases. For any given period of time, the probability of exceedance will decrease as the level of protection increases.

Table B-59 displays expected annual damages and probabilistic values of expected annual damages and benefits from the HEC-FDA model results.

Table B-59 Alternative 4 Expected Value and Probabilistic Values of EAD and EAD Reduced ($'000)

	EAD		EAD Reduced	EAD Reduced (Benefit) That Is Exceeded with Specified Probability		
Alternative & Height	**W/out Project**	**With Project**	**(Benefit)**	**0.75**	**0.50**	**0.25**
4Z	10,257	6,298	3,959	2,473	3,632	5,086
4A	10,257	5,478	4,780	2,994	4,385	6,130
4B	10,257	4,972	5,286	3,257	4,816	6,800
4C	10,257	4,428	5,829	3,530	5,268	7,510
4D	10,257	4,137	6,121	3,626	5,470	7,891

H. Consequence Of Project Exceedance/Residual Risk. Table B-60 shows that for Alternative 4C there is a 91.24 percent probability that the target stage (target stage equals top of levee/floodwall) will not be exceeded, given the occurrence of a 500- year flood (.2 percent chance event). Note that target stage is greater than 500 year event. On the other hand, there is still an 8.76 percent probability (1-.9124) that the 500-year flood will exceed the target stage. In addition, table B-60 shows that alternative 4C, will have a 1.48 percent chance of target stage exceedance within a period of 30 years. This compares to a without project chance of 65.11 percent. Another way to state this risk is that Alternative 4C would have a 1 in 67.6 chance of target stage exceedance within a period of 30 years. This example data is for reach 5B which is located on the east bank in the downtown area of Cedar Rapids. The levee performance at the index station of this damage reach is summarized in table B-59. This damage reach has the lowest performance statistics of the reaches within the Alternative 4 area of protection.

Table B-60. Performance for Alternative 4C
Levee crest at index station in damage reach 5B

Target Stage Annual Exceedance		**Long Term Risk**			**Conditional Non-Exceedance Probability by Events**					
Median	Expected	10-yr	30-yr	50-yr	0.10	0.04	0.02	0.01	0.004	0.002
0.0006	0.0006	0.0060	0.0148	0.0295	1.0000	1.0000	1.0000	0.9999	0.9897	0.9124

Loss of Human Life and Human Safety. A levee failure of Alternative 4C by overtopping would produce flood elevations close to those observed during the 2008 flood. To obtain an estimate of the population at risk the structural inventory from a profile very close to the crest of Alternative 4C was examined. The results of this data query appear in table B-61. The maximum computed depth of water above a first floor elevation is 16 feet. The ground level could easily be 3 feet lower than the first floor elevation so the maximum water depth would be about 19 feet. This is in approximate agreement with observed maximum flood depth of 20 feet.

Table B-61. Elevation of Flood Above First Floor in the Event of Alternative 4C Overtopping

		Structures by Category			
Depth of Flooding	**Structure Total**	**Apartment**	**Commercial**	**Public**	**Residential**
-1 to 0	34		12	2	20
0-2	60		25	1	34
2-4	75	1	31	4	39
4-6	87	1	53	1	32
6-8	131	4	50	4	73
8-10	38	2	29		7
10-12	32		29		3
>12	16		16		
TOTALS		**8**	**245**	**12**	**208**

Two key elements to the severity of the consequences of capacity exceedance are the time of year of flooding and the amount of warning time. The distance from the river bank to high ground varies from 1,000 to 3,700 linear feet. These distances could be walked in 4 to 15 minutes during daylight hours and 8 to 30 minutes during the night. This short evacuation time would still allow a reasonable time for emergency personnel to recognize the threat and issue evacuation orders in the event of levee failure. For the Without-Project condition the warning time is estimated to be 6 to 12 hours. Under normal With-Project conditions for Alternative 4C the warning time for a gradual levee overtop would also be 6 to 12 hours. For the With-Project condition of sudden, catastrophic levee failure, warning time would be 1 to 3 hours. Two new stream gages on the Cedar River between Waterloo and Cedar Rapids (part of the without project condition) are used by the national weather service that allow an increase in warning time measured in hours over what was available in 2008. During the 2008 event, the river elevation rose 5.6 feet in 18.5 hours. Several elderly people were removed by boat from their homes, but no injuries or fatalities occurred.

The most critical time for capacity exceedance of the proposed levee would be at night. About 208 single family residences (estimate of 600 people) and about 650 multifamily units (apartments and condos, estimate of 1000 people) could eventually be surrounded by water. Note that the majority of multifamily units are multi-story structures, and would not have water on first floor of condo unit but residents would still need to evacuate. People living in these residences would likely have the time necessary to evacuate to safety. Water velocities and damage to homes by moving debris is expected to be minor as compared to a dam failure for both Without-Project and with-project.
The capacity exceedance of the proposed levee during the day would involve many more people because of public and commercial activity, but management of the evacuation during the day would be easier because of the formal and informal emergency evacuation networks offered by the City and other employers.

V. COST ANALYSIS

The costs associated with implementing each alternative are subdivided into three principal components: construction costs, operations and maintenance, and interest during construction. Refer to the Engineering Appendices for a detailed review of the costs associated with each alternative.

A. Total Project Costs

1. Without-Project Alternative. For the Without-Project Alternative, no substantial construction work would be undertaken and there would be no costs.

2. Alternative 1. The construction cost estimate for Alternative 1 includes utility relocations; construction of fish and wildlife facilities; construction of channels, canals, levees, and floodwalls; preconstruction engineering and design (PED); and construction management costs. The total project cost estimate for Alternative 1 for various levee crest heights, is listed in table B-62a. The estimated total yearly cost to implement Alternative 1 for various levee crest heights, are listed in table B-62b.

3. Alternative 1A. The construction cost estimate for Alternative 1A includes utility relocations; construction of fish and wildlife facilities; construction of channels, canals, levees, and floodwalls; PED; and construction management costs. The total project cost estimate for Alternative 1A for the various levee crest heights is in table B-63a. The estimated total yearly cost to implement Alternative 1A for various levee crest heights, are listed in table B-63b.

4. Alternative 4. The construction cost estimate for Alternative 4 includes utility relocations; construction of fish and wildlife facilities; construction of channels, canals, levees, and floodwalls; PED; and construction management costs. The total project cost estimate for Alternative 4 at various levee crest heights is in table B-64a. The estimated total yearly cost to implement Alternative 4 for various levee crest heights, are listed in table B-64b.

5. Alternative 5. The total project cost estimate for Alternative 5 are reported in table B-65a. The estimated total yearly cost to implement Alternative 5 for various levee crest heights, are listed in table B-65b.

6. Alternative 7. The total project cost estimate for Alternative 7 are reported in table B-66a. The estimated total yearly cost to implement Alternative 7 for various levee crest heights, are listed in table B-66b.

7. Alternative 10. The total project cost estimate for Alternative 10 are reported in table B-67a. The estimated total yearly cost to implement Alternative 10 for various levee crest heights, are listed in table B-67b.

Table B-62a. Alternative 1 (Measures 2B & 18B) - Total Project Costs
Dollars Shown in ($000) - Last Updated: 2010-02-25

	1Z	1A	1B	1C	1-D
Construction Cost - Measure 2B [1]	$42,973	$55,671	$62,929	$71,608	$81,485
Construction Cost - Measure 18B [1]	$43,960	$57,204	$66,716	$76,431	$89,529
Total Construction Costs	**$86,933**	**$112,875**	**$129,645**	**$148,039**	**$171,014**
PE&D (18%)	$15,648	$20,318	$23,336	$26,647	$30,783
S&A (10%)	$8,693	$11,288	$12,965	$14,804	$17,101
Subtotal	**$111,274**	**$144,480**	**$165,946**	**$189,490**	**$218,898**
Real Estate [3,4,5]	$52,600	$52,600	$52,600	$52,600	$52,600
Environmental Mitigation	$681	$681	$793	$908	$1,034
Cultural Mitigation (1%)	$869	$1,129	$1,296	$1,480	$1,710
Total	**$165,425**	**$198,890**	**$220,635**	**$244,478**	**$274,242**
Annual O&M Costs	**$80**	**$80**	**$80**	**$80**	**$80**

[1] Costs based on estimates from Stanley Consultants dated 2-2-2010 and 2-8-2010.
[2] 1.33% event is a rough estimate based on reduced cost on levees, floodwalls, and interior storm water systems.
[3] HTRW cleanup costs are not included since the plan is to avoid any land where it is found.
[4] Costs to mitigate for induced damages are not included.
[5] Real Estate estimates are based solely on the 2008 project footprint for each level of protection. from overtopping at specified frequency

Table B-62b. Alternative 1 (Measures 2B & 18B) – Annual Costs to Implement [1]
Dollars Shown in ($000) - Last Updated: 2010-02-25

	1Z	1A	1B	1C	1-D
Construction Cost	$86,933	$112,875	$129,645	$148,039	$171,014
PE&D	$15,648	$20,318	$23,336	$26,647	$30,783
S&A	$8,693	$11,288	$12,965	$14,804	$17,101
Year 1					
PE&D (30%)	$4,694	$6,095	$7,001	$7,994	$9,235
Construction (10%)	$8,693	$11,288	$12,965	$14,804	$17,101
S&A (10%)	$869	$1,129	$1,296	$1,480	$1,710
Real Estate	$54,150	$54,410	$54,689	$54,988	$55,344
Year 2					
PE&D (30%)	$4,694	$6,095	$7,001	$7,994	$9,235
Construction (25%)	$21,733	$28,219	$32,411	$37,010	$42,754
S&A (25%)	$2,173	$2,822	$3,241	$3,701	$4,275
Year 3					
PE&D (15%)	$2,347	$3,048	$3,500	$3,997	$4,617
Construction (30%)	$26,080	$33,863	$38,894	$44,412	$51,304
S&A (30%)	$2,608	$3,386	$3,889	$4,441	$5,130
Year 4					
PE&D (15%)	$2,347	$3,048	$3,500	$3,997	$4,617
Construction (20%)	$17,387	$22,575	$25,929	$29,608	$34,203
S&A (20%)	$1,739	$2,258	$2,593	$2,961	$3,420
Year 5					
PE&D (10%)	$1,565	$2,032	$2,334	$2,665	$3,078
Construction (15%)	$13,040	$16,931	$19,447	$22,206	$25,652
S&A (15%)	$1,304	$1,693	$1,945	$2,221	$2,565

[1] Assumes 5-year construction duration

Table B-63a. Alternative 1A (Measures 2B & 27B) - Total Project Costs
Dollars Shown in ($000) - Last Updated: 2010-02-25

	1A-Z	1A-A	1A-B	1A-C	1A-D
Construction Cost - Measure 2B [1]	$42,973	$55,671	$62,929	$71,608	$81,485
Construction Cost - Measure 27B [1]	$46,379	$56,297	$63,844	$70,896	$80,307
Total Construction Costs	**$89,352**	**$111,968**	**$126,773**	**$142,504**	**$161,792**
PE&D (18%)	$16,083	$20,154	$22,819	$25,651	$29,123
S&A (10%)	$8,935	$11,197	$12,677	$14,250	$16,179
Subtotal	**$114,371**	**$143,319**	**$162,269**	**$182,405**	**$207,094**
Real Estate [3,4,5]	$49,800	$49,800	$49,800	$49,800	$49,800
Environmental Mitigation	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$894	$1,120	$1,268	$1,425	$1,618
Total	**$165,065**	**$194,239**	**$213,337**	**$233,630**	**$258,512**
Annual O&M Costs	**$75**	**$75**	**$75**	**$75**	**$75**

[1] Costs based on estimates from Stanley Consultants, 2-2-2010 and 2-8-2010. A 25% contingency was used on all construction estimates.
[2] 1.33% event is a rough estimate based on reduced cost on levees, floodwalls, and interior storm water systems.
[3] HTRW cleanup costs are not included since the plan is to avoid any land where it is found.
[4] Costs to mitigate for induced damages are not included
[5] Real Estate estimates are based solely on the 2008 project footprint for each level of protection.

Table B-63b. Alternative 1A (Measures 2B & 27B) – Annual Costs to Implement [1]
Dollars Shown in ($000) - Last Updated: 2010-02-25

	1A-Z	1A-A	1A-B	1A-C	1A-D
Construction Cost	$89,352	$111,968	$126,773	$142,504	$161,792
PE&D	$16,083	$20,154	$22,819	$25,651	$29,123
S&A	$8,935	$11,197	$12,677	$14,250	$16,179
Year 1					
PE&D (30%)	$4,825	$6,046	$6,846	$7,695	$8,737
Construction (10%)	$8,935	$11,197	$12,677	$14,250	$16,179
S&A (10%)	$894	$1,120	$1,268	$1,425	$1,618
Real Estate	$50,694	$50,920	$51,068	$51,225	$51,418
Year 2					
PE&D (30%)	$4,825	$6,046	$6,846	$7,695	$8,737
Construction (25%)	$22,338	$27,992	$31,693	$35,626	$40,448
S&A (25%)	$2,234	$2,799	$3,169	$3,563	$4,045
Year 3					
PE&D (15%)	$2,413	$3,023	$3,423	$3,848	$4,368
Construction (30%)	$26,806	$33,590	$38,032	$42,751	$48,538
S&A (30%)	$2,681	$3,359	$3,803	$4,275	$4,854
Year 4					
PE&D (15%)	$2,413	$3,023	$3,423	$3,848	$4,368
Construction (20%)	$17,870	$22,394	$25,355	$28,501	$32,358
S&A (20%)	$1,787	$2,239	$2,535	$2,850	$3,236
Year 5					
PE&D (10%)	$1,608	$2,015	$2,282	$2,565	$2,912
Construction (15%)	$13,403	$16,795	$19,016	$21,376	$24,269
S&A (15%)	$1,340	$1,680	$1,902	$2,138	$2,427

[1] Assumes 5-year construction duration

Table 64a. Alternative 4 (Measure 27B) - Total Project Costs
Dollars Shown in ($000) - Last Updated: 2010-02-25

	4Z	4A	4B	4C	4D
Construction Cost - Measure 27B [1]	$46,379	$56,297	$63,844	$70,896	$80,307
PE&D (18%)	$8,348	$10,133	$11,492	$12,761	$14,455
S&A (10%)	$4,638	$5,630	$6,384	$7,090	$8,031
Subtotal	**$59,365**	**$72,060**	**$81,720**	**$90,747**	**$102,793**
Real Estate [3,4,5]	$11,100	$11,100	$11,100	$11,100	$11,100
Environmental Mitigation	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$464	$563	$638	$709	$803
Total	**$70,929**	**$83,723**	**$93,459**	**$102,556**	**$114,696**
Annual O&M Costs	**$35**	**$35**	**$35**	**$35**	**$35**

[1] Costs based on estimates from Stanley Consultants, 2-8-2010 and 2-2- 2010. A 25% contingency was used on all construction estimates.
[2] 1.33% event is a rough estimate based on reduced cost on levees, floodwalls, and interior storm water systems.
[3] HTRW cleanup costs are not included since the plan is to avoid any land where it is found.
[4] Costs to mitigate for induced damages are not included
[5] Real Estate estimates are based solely on the 2008 project footprint for each level of protection.

Table 64b. Alternative 4 (Measures 27B) - Annual Costs to Implement [1]
Dollars Shown in ($000) - Last Updated: 2010-02-25

	4Z	4A	4B	4C	4D
Construction Cost	$46,379	$56,297	$63,844	$70,896	$80,307
PE&D	$8,348	$10,133	$11,492	$12,761	$14,455
S&A	$4,638	$5,630	$6,384	$7,090	$8,031
Year 1					
PE&D (30%)	$2,504	$3,040	$3,448	$3,828	$4,337
Construction (10%)	$4,638	$5,630	$6,384	$7,090	$8,031
S&A (10%)	$464	$563	$638	$709	$803
Real Estate	$11,564	$11,663	$11,738	$11,809	$11,903
Year 2					
PE&D (30%)	$2,504	$3,040	$3,448	$3,828	$4,337
Construction (25%)	$11,595	$14,074	$15,961	$17,724	$20,077
S&A (25%)	$1,159	$1,407	$1,596	$1,772	$2,008
Year 3					
PE&D (15%)	$1,252	$1,520	$1,724	$1,914	$2,168
Construction (30%)	$13,914	$16,889	$19,153	$21,269	$24,092
S&A (30%)	$1,391	$1,689	$1,915	$2,127	$2,409
Year 4					
PE&D (15%)	$1,252	$1,520	$1,724	$1,914	$2,168
Construction (20%)	$9,276	$11,259	$12,769	$14,179	$16,061
S&A (20%)	$928	$1,126	$1,277	$1,418	$1,606
Year 5					
PE&D (10%)	$835	$1,013	$1,149	$1,276	$1,446
Construction (15%)	$6,957	$8,445	$9,577	$10,634	$12,046
S&A (15%)	$696	$844	$958	$1,063	$1,205

[1] Assumes 5-year construction duration

Table 65a. Alternative 5 (Measure 19B) - Total Project Costs
Dollars Shown in ($000) - Last Updated: 2010-03-24

	5Z	5A	5B	5C	5D
Construction Cost - Measure 19B [1]	$11,740	$13,013	$15,482	$17,727	$20,425
PE&D (18%)	$2,113	$2,342	$2,787	$3,191	$3,677
S&A (10%)	$1,174	$1,301	$1,548	$1,773	$2,043
Subtotal	**$15,027**	**$16,657**	**$19,817**	**$22,691**	**$26,144**
Real Estate [2, 3, 4]	$2,266	$2,300	$2,333	$2,366	$2,400
Environmental Mitigation	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$117	$130	$155	$177	$204
Total	**$17,411**	**$19,087**	**$22,305**	**$25,234**	**$28,748**
Annual O&M Costs	**$2**	**$2**	**$2**	**$2**	**$2**

[1] Project Costs based on estimates from Stanley Consultants dated Feb 02 and Mar 24, 2010.
[2] HTRW cleanup costs are not included (City responsibility)..
[3] Costs to mitigate for induced damages are not included.
[4] Real Estate estimates are based on the 100-year and 2008 event. Straight line spread applied to the rest

Table 65b. Alternative 5 (Measure 19B) - Annual Costs to Implement[1]
Dollars Shown in ($000) - Last Updated: 2010-03-24

	5Z	5A	5B	5C	5D
Construction Cost	11740	$13,013	$15,482	$17,727	$20,425
PE&D	$2,113	$2,342	$2,787	$3,191	$3,677
S&A	$1,174	$1,301	$1,548	$1,773	$2,043
Total	**$15,027**	**$16,657**	**$19,817**	**$22,691**	**$26,144**
Year 1					
PE&D (50%)	$1,057	$1,171	$1,393	$1,595	$1,838
Construction (20%)	$2,348	$2,603	$3,096	$3,545	$4,085
S&A (20%)	$235	$260	$310	$355	$409
RE Mitigation	$2,383	$2,430	$2,488	$2,543	$2,604
Year 1 Total	**$6,023**	**$6,464**	**$7,287**	**$8,039**	**$8,936**
Year 2					
PE&D (30%)	$634	$703	$836	$957	$1,103
Construction (50%)	$5,870	$6,507	$7,741	$8,864	$10,213
S&A (50%)	$587	$651	$774	$886	$1,021
Year 2 Total	**$7,091**	**$7,860**	**$9,351**	**$10,707**	**$12,337**
Year 3					
PE&D (20%)	$423	$468	$557	$638	$735
Construction (30%)	$3,522	$3,904	$4,645	$5,318	$6,128
S&A (30%)	$352	$390	$464	$532	$613
Year 3 Total	**$4,297**	**$4,762**	**$5,666**	**$6,488**	**$7,476**

[1] Assumes 3-year construction duration

Table 66a. Alternative 7 (Measure 28B) - Total Project Costs
Dollars Shown in ($000) - Last Updated: 2010-02-25

	7Z	7A	7B	7C	7D
Construction Cost - Measure 28B [1]	$18,619	$22,856	$27,308	$31,081	$35,706
PE&D (18%)	$3,351	$4,114	$4,915	$5,595	$6,427
S&A (10%)	$1,862	$2,286	$2,731	$3,108	$3,571
Subtotal	**$23,832**	**$29,256**	**$34,954**	**$39,784**	**$45,704**
Real Estate [2, 3, 4]	$2,100	$2,100	$2,100	$2,100	$2,100
Environmental Mitigation	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$186	$229	$273	$311	$357
Total	**$26,119**	**$31,584**	**$37,327**	**$42,194**	**$48,161**
Annual O&M Costs	**$15**	**$15**	**$15**	**$15**	**$15**

1 Project Costs based on estimates from Stanley Consultants dated Feb 11, 2010.

2. 7Z is a rough estimate based on reduced cost on levees, floodwalls and interior storm water systems

3 HTRW cleanup costs are not included (City responsibility)..

4 Costs to mitigate for induced damages are not included.

5 Real Estate estimates are based solely on the 2008 project footprint for each level of protection.

Table 66b. Alternative 7 (Measure 28B) - Annual Costs to Implement[1]
Dollars Shown in ($000) - Last Updated: 2010-02-25

	7Z	7A	7B	7C	7D
Construction Cost	**18619**	$22,856	$27,308	$31,081	$35,706
PE&D	$3,351	$4,114	$4,915	$5,595	$6,427
S&A	$1,862	$2,286	$2,731	$3,108	$3,571
Total	**$23,832**	**$29,256**	**$34,954**	**$39,784**	**$45,704**
Year 1					
PE&D (50%)	$1,676	$2,057	$2,458	$2,797	$3,214
Construction (20%)	$3,724	$4,571	$5,462	$6,216	$7,141
S&A (20%)	$372	$457	$546	$622	$714
RE Mitigation	$2,286	$2,329	$2,373	$2,411	$2,457
Year 1 Total	**$8,058**	**$9,414**	**$10,839**	**$12,046**	**$13,526**
Year 2					
PE&D (30%)	$1,005	$1,234	$1,475	$1,678	$1,928
Construction (50%)	$9,310	$11,428	$13,654	$15,541	$17,853
S&A (50%)	$931	$1,143	$1,365	$1,554	$1,785
Year 2 Total	**$11,246**	**$13,805**	**$16,494**	**$18,773**	**$21,566**
Year 3					
PE&D (20%)	$670	$823	$983	$1,119	$1,285
Construction (30%)	$5,586	$6,857	$8,192	$9,324	$10,712
S&A (30%)	$559	$686	$819	$932	$1,071
Year 3 Total	**$6,815**	**$8,365**	**$9,995**	**$11,376**	**$13,068**

1 Assumes 3-year construction duration

Table 67a. Alternative 10 (Measures 19B & 28B) - Total Project Costs
Dollars Shown in ($000) - Last Updated: 2010-03-24

	10-Z	10A	10B	10C	10D
Construction Cost - Measure 19B [1]	$9,944	$13,013	$15,482	$17,727	$20,425
Construction Cost - Measure 28B [1]	$18,619	$22,856	$27,308	$31,081	$35,706
Total Construction Costs	**$28,563**	**$35,869**	**$42,790**	**$48,808**	**$56,131**
PE&D (18%)	$5,141	$6,456	$7,702	$8,785	$10,104
S&A (10%)	$2,856	$3,587	$4,279	$4,881	$5,613
Subtotal	**$36,561**	**$45,912**	**$54,771**	**$62,474**	**$71,848**
Real Estate [2, 3, 4]	$4,366	$4,400	$4,433	$4,466	$4,500
Environmental Mitigation	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$286	$359	$428	$488	$561
Total	**$41,212**	**$50,671**	**$59,632**	**$67,428**	**$76,909**
Annual O&M Costs	**$17**	**$17**	**$17**	**$17**	**$17**

[1] Project Costs based on estimates from Stanley Consultants dated Feb 02, Feb 11, and Mar 24, 2010.
[2] HTRW cleanup costs are not included (City responsibility)..
[3] Costs to mitigate for induced damages are not included.
[4] Real Estate estimates are based solely on the 2008 project footprint for each level of protection for Measure 28B. Real Estate estimates for Measure 19B are based on the 100-year and 2008 events. Straight line spread applied to the rest.

Table 67b. Alternative 10 (Measures 19B & 28B) - Annual Costs to Implement[1]
Dollars Shown in ($000) - Last Updated: 2010-03-24

	10-Z	10A	10B	10C	10D
Percent Chance Event	**1.33% [2]**	**1.00%**	**0.50%**	**0.20%**	**2008 Event**
Construction Cost	$28,563	$35,869	$42,790	$48,808	$56,131
PE&D	$5,141	$6,456	$7,702	$8,785	$10,104
S&A	$2,856	$3,587	$4,279	$4,881	$5,613
Year 1					
PE&D (50%)	$2,571	$3,228	$3,851	$4,393	$5,052
Construction (20%)	$5,713	$7,174	$8,558	$9,762	$11,226
S&A (20%)	$571	$717	$856	$976	$1,123
Year 2					
PE&D (30%)	$1,542	$1,937	$2,311	$2,636	$3,031
Construction (50%)	$14,282	$17,935	$21,395	$24,404	$28,066
S&A (50%)	$1,428	$1,793	$2,140	$2,440	$2,807
Year 3					
PE&D (20%)	$1,028	$1,291	$1,540	$1,757	$2,021
Construction (30%)	$8,569	$10,761	$12,837	$14,642	$16,839
S&A (30%)	$857	$1,076	$1,284	$1,464	$1,684

[1] Assumes 3-year construction duration

Table 67c. Alternative 10 (Measures 19B & 28B) – Total Project Costs 10E
Dollars Shown in ($000)

	10E
Construction Cost [1]	$40,321
PE&D (18%)	$7,258
S&A (10%)	$4,032
Subtotal	**$51,6111**
Real Estate [2, 3, 4, 5]	$4,400
Environmental Mitigation	$0
Cultural Mitigation (1%)	$403
Total	**$56,414**
Annual O&M Costs	**$17**

[1] Project Costs based on estimates from Stanley Consultants dated Feb 02, 2010.
[2] 75-year level is a rough estimate based on reduced cost on levees, floodwalls, and interior storm water system..
[3] HTRW cleanup costs are not included (City responsibility)...
[4] Costs to mitigate for induced damages are not included
[5] Real Estate estimates are based solely on the 100-year and 2008 events. Straight line spread applied to the rest..

B. Operations and Maintenance. Annual O& M costs were listed in the total cost estimate tables provided by engineering. The total dollar amount listed in those tables was the only OMRR&R information provided for the screening level-of-detail analysis. The annual OMRR&R estimates provided by engineering for each alternative are listed in tables B-61 through B-66.

C. Interest During Construction. Interest during construction and annualized costs are computed using a 4.375 percent rate (the FY 2010 Federal discount rate mandated for Federal water resource projects). A 50-year project life has been used for the period of analysis. Construction and O&M costs detailed in this report are in February 2010 price levels. Engineering estimated that Alternatives 1, 1A, and 4 would take 5 years to construct, and Alternatives 5, 7, and 10 would take 3 years to construct. Engineering provided construction, project engineering and design, and supervision and administration estimates for each construction year by alternative and height. It was assumed that the total Real Estate, Cultural, and Environmental mitigation costs would be expended in the first year of construction for all alternatives. Tables B-68 and B-69 summarize (for examples) the calculations for interest during construction and annual charges for the Alternative 4, height "C".

Table B-68. Interest During Construction Alternative 4C Example
Feb 2010 prices, 4-3/8% Discount Rate, Mid-Year Expenditure Convention)

Project Year	**Project Costs**	**Mid-Year Period to Base Year**	**Interest Factor**	**Accumulated Interest**
1	23,435,904	0.21501	Year 1	5,038,954
2	23,324,784	0.16355	Year 2	3,814,768
3	25,309,872	0.11427	Year 3	2,892,159
4	17,511,312	0.06707	Year 4	1,174,484
5	12,973,968	0.02188	Year 5	283,870
Totals	**102,555,840**			**13,204,235**

Table B-69. Summary of Annual Charges Alternative 4C Example
(Feb 2010 prices, 4-3/8% Discount Rate, 50-Year Evaluation Period)

Description	Amount
Estimated Construction Cost	102,555,840
Interest During Construction	13,204,235
Total Economic Costs	115,760,075
Annual Interest & Amortization	5,739,056
Annual Operation & Maintenance[1]	35,000
Total Annual Charges	5,774,056

[1] Annual Operation and Maintenance amount was provided in the cost estimate from Engineering

Table B-70 displays the cost incurred due to interest payments over the construction period for each alternative.

Table B-70. Summary of Costs for the Alternatives
(Feb 2010 prices, 4.375% Discount Rate, 50 year evaluation period, $1,000's)

Alternative & Height	Project Cost [1]	Interest During Construction[2]	Total Investment Costs [3]	Annual Investment Costs	Annual O&M Costs	Total Annual Costs
1Z	165,425	24,720	190,145	9,427	80	9,507
1A	198,890	28,679	227,568	11,282	80	11,362
1B	220,635	31,262	251,897	12,488	80	12,568
1C	244,478	34,093	278,571	13,811	80	13,891
1-D	274,242	37,625	311,868	15,462	80	15,542
1A-Z	165,065	24,341	189,406	9,390	75	9,465
1A-A	194,239	27,792	222,031	11,008	75	11,083
1A-B	213,337	30,051	243,388	12,066	75	12,141
1A-C	233,630	32,451	266,081	13,192	75	13,267
1A-D	258,512	35,394	293,906	14,571	75	14,646
4Z	70,929	9,463	80,392	3,986	35	4,021
4A	83,723	10,977	94,700	4,695	35	4,730
4B	93,459	12,128	105,587	5,235	35	5,270
4C	102,556	13,204	115,760	5,739	35	5,774
4D	114,696	14,640	129,336	6,412	35	6,447
5Z	17,411	1,258	18,668	926	2	928
5A	19,087	1,370	20,457	1,014	2	1,016
5B	22,305	1,584	23,889	1,184	2	1,186
5C	25,234	1,779	27,012	1,339	2	1,341
5D	28,748	2,012	30,760	1,525	2	1,527
7Z	26,119	1,824	27,943	1,385	15	1,400
7A	31,584	2,185	33,769	1,674	15	1,689
7B	37,327	2,563	39,891	1,978	15	1,993
7C	42,194	2,884	45,079	2,235	15	2,250
7D	48,161	3,278	51,439	2,550	15	2,565
10-Z	41,212	2,929	44,141	2,188	17	2,205
10A	50,671	3,555	54,226	2,688	17	2,705
10B	59,632	4,147	63,779	3,162	17	3,179
10C	67,428	4,663	72,091	3,574	17	3,591
10D	76,909	5,290	82,199	4,075	17	4,092
10E	56,414	3,933	60,347	2,992	17	3,009

[1.] includes construction costs, design costs, construction supervision costs, environmental and cultural mitigation costs, and real estate costs.
[2.] Interest During Construction was calculated based on assumptions listed in section V.C. of this appendix.
[3.] Total Investment Costs include Project cost and Interest During Construction costs.

VI. SUMMARY OF ECONOMIC EVALUATION

The economic feasibility of each alternative was determined by performing a benefit-to-cost analysis. For each plan, the BCR was computed by dividing the annual benefits accruing to each With-Project Alternative by the annual costs of implementing the project. Net benefits are the difference between the annual benefits and annual costs. Potential alternatives were screened out according to planning guidance and objectives during the plan formulation iterative process (Refer to Appendix O, *Plan Formulation*). The economic performance of the alternatives is presented in table B-71. Table B-72 summarizes Annual Damage, Benefit Estimates, and Residual Damages.

A. Optimization of Alternative Plans. Costs and benefits of alternatives were evaluated at multiple top of levee heights offering various levels of protection. As indicated by the evaluation results in table B-71, Alternative 10 optimizes at the levee heights designated as "E". This alternative and levee height provides the greatest net benefits of the alternatives. Incremental benefits continue to rise, offsetting incremental costs, up to the optimal height.

B. Summary Results. Among the alternatives considered and presented in table B-71, Alternatives 1 and 1A have BCRs less than 1.0 and accordingly, negative net benefits. Alternatives 4, 5, 7, and 10 are economically feasible. Among the alternatives, the plan which maximizes net benefits is Alternative 10, height E with $731,000 in annual net benefits and a BCR of 1.24. Alternative 10, height E, includes a levee or floodwall in damage reaches 4B and 5C.

Table B-71. Economic Performance of the Alternatives
(Feb. 2010 Prices, 4.375% Interest Rate, 50 year period of analysis, $1,000's)

Alternative & Height	With Project Residual EAD	Project Investment Costs	Total Annual Costs	Total Annual Benefits	BCR	Annual Net Benefits
1Z	6,199	190,145	9,507	6,213	0.65	-3,294
1A	4,788	227,568	11,362	7,625	0.67	-3,737
1B	3,450	251,897	12,568	8,963	0.71	-3,605
1C	1,957	278,571	13,891	10,455	0.75	-3,436
1-D	1,084	311,868	15,542	11,329	0.73	-4,213
1A-Z	6,256	189,406	9,465	6,157	0.65	-3,308
1A-A	4,900	222,031	11,083	7,513	0.68	-3,570
1A-B	3,657	243,388	12,141	8,756	0.72	-3,386
1A-C	2,244	266,081	13,267	10,169	0.77	-3,098
1A-D	1,399	293,906	14,646	11,013	0.75	-3,633
4Z	8,271	80,392	4,021	4,141	1.03	121
4A	7,392	94,700	4,730	5,021	1.06	291
4B	6,836	105,587	5,270	5,576	1.06	307
4C	6,269	115,760	5,774	6,144	1.06	370
4D	5,965	129,336	6,447	6,447	1.00	0
5Z	11,470	18,668	928	943	1.02	16
5A	11,261	20,457	1,016	1,151	1.13	135
5B	11,172	23,889	1,186	1,240	1.05	54
5C	11,037	27,012	1,341	1,375	1.03	34
5D	10,969	30,760	1,527	1,444	0.95	-83
7Z	10,440	27,943	1,400	1,973	1.41	572
7A	10,162	33,769	1,689	2,251	1.33	562
7B	9,840	39,891	1,993	2,572	1.29	580
7C	9,779	45,079	2,250	2,634	1.17	384
7D	9,773	51,439	2,565	2,640	1.03	74
10-Z	9,499	44,141	2,205	2,914	1.32	709
10A	9,007	54,226	2,705	3,405	1.26	700
10B	8,592	63,779	3,179	3,820	1.20	641
10C	8,398	72,091	3,591	4,015	1.12	424
10D	8,312	82,199	4,092	4,101	1.00	9
10E [1]	8,673	60,347	3,009	3,740	1.24	731

[1] Alternative 10E is a combination of Alternative 5A and 7B.

Table B-72. Summary of Expected Annual Damage, Benefit Estimates, and Residual Damage by Category and Alternative

Total Expected Annual Damage for Without-Project by Alternative ($1,000's)				
Alternative	**Residential, Commercial, Industrial, Public Structures and Content EAD**	**Other Public Flood Damage EAD**	**Annual Flood Insurance Administration Costs**	**Total w/out Project EAD and Costs**
W/out-Project EAD ($1,000)	10,257	1,807	349	12,413
Total Expected Annual Damage Reduced (Benefits) by Category and Alternative				
Alternative	**Residential, Commercial, Industrial, Public Structures and Content EAD**	**Other Public Flood Damage Reduction**	**Annual Flood Insurance Administration Costs**	**Total Project Benefits**
1C	9,001	1,332	122	10,455
1A-C	8,715	1,332	122	10,169
4C	5,829	298	17	6,144
5A	1,151	negligible	0	1,151
7B	2,572	negligible	0	2,572
10E	3,740	negligible	0	3,740
Total Residual Expected Annual Damage by Category and Alternative				
Alternative	**Residential, Commercial, Industrial, Public Structures and Content Residual EAD**	**Other Public Flood Damage Residual EAD**	**Remaining Annual Flood Insurance Administration Costs**	**Total Residual Damage w/ Project**
1C	1,256	475	227	1,957
1A-C	1,542	475	227	2,244
4C	4,428	1,509	332	6,269
5A	9,106	1,807	349	11,261
7B	7,685	1,807	349	9,840
10E	6,518	1,807	349	8,673

C. Updates to Alternative 4C Cost Estimate and Federal Discount Rate. The results of utilizing the total project cost estimate from the Cost Schedule Risk Analysis (CSRA) for Alternative 4C are presented in table B-73a. This cost estimate was developed to a different level-of-detail than the cost estimates used in the rest of this economic appendix to compare alternatives. Therefore the costs, BCR, and net benefits listed in table B-73a are not comparable to the values listed in table B-71 for the other alternatives. The FY 2011 federal discount rate of 4 1/8 percent was used to calculate the BCR presented below.

The total project cost including the contingency estimate that resulted from the CSRA for Alternative 4C is $99,004,000. The Relocation Assistance Expenses ($460,000) were subtracted (per ER 1105-2-100 and Public Law 91-464) from the total project cost of $99,004,000 to calculate $98,544,000 in NED costs. Total annual NED cost is $5,125,000. Total annual benefits are $6,144,000. The BCR is 1.20 to 1.00, with net benefits of $1,019,000. Alternative 4C includes a levee or floodwall in damage reaches 4B, 5A, 5B, and 5C on the East bank of the Cedar River in downtown Cedar Rapids.

Table B-73a. Total Project Cost from CSRA Compared to Benefits for Alternative 4C
(Oct 2010 prices, 4-1/8% discount rate, 50 yr evaluation period, $'000)

NED Project Cost	Interest During Construction	Total Economic Cost	Annual Interest & Amortization	Annual O&M Cost	Total Annual Cost	Total Annual Benefits	BCR	Net Annual Benefits
$98,544	$8,864	$107,408	$5,107	$18	$5,125	$6,144	1.20	$1,019

Interest during construction and annualized costs are computed using a 4.125 percent rate (the FY 2011 Federal discount rate mandated for Federal water resource projects). The period of analysis is 50 years. Construction and O&M costs are in Oct 2010 price levels. Engineering estimated that Alternative 4C would take 5 years to construct. Engineering provided Construction, Project Engineering and Design, Supervision and Administration, Real Estate, Cultural, and Environmental mitigation costs estimates for each construction year. Tables B-73b and B-73c summarize the calculations for interest during construction and annual charges for the Alternative 4, height "C".

Table B-73b. Interest During Construction for Alternative 4C
Oct 2010 prices, 4-1/8% Discount Rate, Mid-Year Expenditure Convention)

Project Year	Project Costs	Mid-Year Period to Base Year	Interest Factor	Accumulated Interest
1	9,559,834	0.20170	Year 1	1,928,219
2	14,056,014	0.15362	Year 2	2,159,285
3	24,975,969	0.10747	Year 3	2,684,167
4	24,975,969	0.06316	Year 4	1,577,482
5	24,975,969	0.02062	Year 5	515,004
Totals	**98,543,755**			**8,864,157**

Table B-73c. Summary of Annual Charges for Alternative 4C
(Oct 2010 prices, 4-1/8% Discount Rate, 50-Year Evaluation Period)

Description	Amount
Estimated NED Cost	98,543,755
Interest During Construction	8,864,157
Total Economic Costs	107,407,912
Annual Interest & Amortization	5,107,353
Annual Operation & Maintenance[1]	17,679
Total Annual Charges	5,125,032

[1] Yearly Operation and Maintenance $7,200 for mowing and maintenance and pump replacement cost of $720,000 at year 30.

VII. FINANCIAL ANALYSIS

A. Cost Apportionment. The cost apportionment table for Alternative 4C is presented in table B-74.

Table B-74. Cost Apportionment Table for Alternative 4C

Total Project Cost Estimate	$99,004,000
Federal Cost Share (65%)	$64,353,000
Non-Federal Cost Share (35%)	$34,651,000
Lands, Damages, Relocations	$23,460,000
Cash Contribution	$11,191,000

[1] $23,780,000 total LERRD total less $320,300 Incidental Federal Acquisition Costs = $23,460,000 Non-Federal share for Lands, Damages, Relocations

B. Ability to Pay. According to EGM 09-05, potential projects with an eligibility factor less than zero are not eligible for reduced cost sharing requirements. With an eligibility factor of -4.418 for Alternative 4C, Cedar Rapids is not eligible for reduced cost sharing requirements. Refer to the cited EGM for technical background of the Ability to Pay analysis (table B-75).

C. Financial Capability. The statement of financial capability from the City is included as Exhibit 4.

Table B-75. Ability to Pay Table for Alternative 4C

Step 1 - The Benefits Test

Annual Cost:	$5,125,000	
Annual Benefits:	6,144,000	for flood risk management
Total Cost:	99,004,000	
Local Sponsor Share:	34,651,000	
Benefit/Cost Ratio (BCR):	1.2	
Base Benefits Floor (BCR multiplied by 25%):	30%	
Standard Non-Federal Share:	35%	

The BCR multiplied by 25% and stated as a percentage, is less than the standard cost sharing percentage (based upon the benefits test per Section 103 of PL 99-662, ER 1165-2-121, & EGM 09-05). Therefore, go to Step 2.

Step 2 - The Income Test

Per Capita Personal Income Comparison

Period	Average U. S.	Average Iowa	State Index	Linn County Index
2005-2007	$36,700	$33,077	90.1	99.4

Eligibility Factor (EF) Calculation:

Formula:

EF = a -b1 x (state income index) - b2 x (county income index)
where a, b1 and b2 are parameters set by USACE in Economic Guidance Memorandum (EGM) 09-05, dated 30 June 2009

EF = 15.805 - .07 x (90.1) - .14 (99.4)
EF =-4.418

VIII. PLAN FOR ECONOMIC UPDATES

It is Corps' policy to report and maintain current estimates of project benefits, costs, and economic justification of all active funded projects and separable elements beginning with the Report of the Chief of Engineers. The purpose of the policy is to provide reasonable estimates of economic justification to non-Federal sponsors, Congress and Federal decision makers throughout the project development process. An analysis is considered current if it was approved within 3 fiscal years of the pertinent decision date. If more than three fiscal years have elapsed since the release of the Report of the Chief of Engineers, an economic reevaluation must be the first item of work upon receipt of any funds intended to further project implementation.

Study Assumptions and the Evolving Conditions Within the Study Area. At the time of the Study, the study area was experiencing rapidly changing conditions due to the flood damage from the June

2008 flood of record. As this report is being prepared, the City's recovery efforts include a voluntary property acquisition program funded by two Federal sources and a potential local source (city/state). The City's buyout programs activity as of July 30, 2010 include:

Housing and Urban Development, Community Development Block Grant (HUD CDBG) Program Property Acquisition Program

1,211 properties targeted for voluntary property acquisition; 110 refused to participate. Currently in Duplication of Benefits process with the State of Iowa

FEMA Hazard Mitigation Grant Program (HGMP) Property Acquisition Program

117 properties targeted for voluntary property acquisition; 20 refused to participate
96 Purchase Agreement signed
87 closing held

The properties acquired using the FEMA HGMP were not included in the study inventory according to the assumptions regarding the without project condition. The properties acquired using the HUD CDBG Program were included in the study inventory according to the assumptions regarding the without project condition. Refer to Section III of this appendix for a description of the study assumptions.

IX. REFERENCES

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CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX B
ECONOMIC ANALYSIS

EXHIBIT 1

REGIONAL ECONOMIC DEVELOPMENT ANALYSIS
FOR
THE CEDAR RIVER, CEDAR RAPIDS, IOWA FRM FEASIBILITY STUDY

Prepared for: U.S. Army Corps of Engineers, Rock Island District

Prepared by: U.S. Army Corps of Engineers, New Orleans District

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DEFINITIONS

Gross Regional Product: total economic activity in the Study area during the model year as measured by either production value of final goods and services (final demand) or income generation to factors of production (value added).

Employment: average annual jobs, both full and part time, not full time equivalents.

Labor Income: all forms of employment income, including employee compensation (wages and benefits) and proprietor income.

Tax Revenue: the sum total of all state and local tax revenue types as reported in the Annual Survey of State and Local Government Finances generated by the Study area.

Output: represents the value of industry production, includes both value added and intermediate goods purchased in the economy.

Direct Effects: the response (change in employment, income, output, or gross regional product) for a given industry to a change in its final demand.

Indirect Effects: the impacts caused by industries purchasing from other industries in response to final demand changes, a multiplier effect.

Induced Effects: the impacts on all local industries caused by the expenditures of new household income generated by the direct and indirect effects of final demand changes, a multiplier effect.

EXECUTIVE SUMMARY

In response to a rare flooding event that impacted Cedar Rapids, Iowa in 2008, the U.S. Army Corps of Engineers, Rock Island District is currently examining four levee alignments (Alignments 1, 4, 5, and 7) for the evaluation area. The levees are designed to contain the stages associated with various exceedance probabilities. The construction period for these levee alignments ranges from 3 to 5 years based on the design of the levees, and the estimated costs of the levee alignments range from approximately $17 million to $274 million. The regional impacts that these proposed construction alternatives would have on the local economy of Linn County and to a lesser extent on the other counties of Iowa will be addressed in this portion of the feasibility report.

This Regional Economic Development (RED) analysis was conducted using the Impacts for Planning (IMPLAN) computer model, produced by the Minnesota IMPLAN Group. This model employs input-output economic analysis. This model estimates the effects that a change in the final demand for one or more industries would have on local and regional employment, labor income, output, gross domestic output, and tax revenue. The model also estimates which industries will benefit from the secondary, or multiplier effects, of spending.

The analysis revealed that the proposed construction would generate an estimated range of 60 to 460 jobs annually over the life of the construction project depending on which alternative is implemented. Labor income is estimated to range from $3 million to $25 million, while output is estimated to range from $8 million to $64 million. Gross regional product (GRP) is estimated to range from $4 million to $32 million. Tax revenue ranges from $550,000 to $2 million. The spillover effects on the remaining counties of Iowa were found to be minimal.

The effects of the proposed construction on sales tax and state income tax revenues were also examined. The increase in sales tax revenue was estimated to range from $76,000 to $600,000, while the increase in state income tax revenues ranged from $57,000 to $450,000. In the year 2008, Linn County generated $325,725,000 in sales tax revenue and $189,321,000 in state income tax revenue. The construction stimulus would increase this base by an estimated maximum 0.1 percent for both sales and state income tax revenues.

When considering GRP and output, the retail trade, wholesale trade, finance and insurance, retail trade, and health and social services sectors are projected to benefit the most from the multiplier effects of the construction spending. When considering employment, the accommodation and food services sector replaces the wholesale trade sector as one of the top beneficiaries of the multiplier effects of construction.

REGIONAL ECONOMIC IMPACTS (RED ANALYSIS)

Background. The City experienced a devastating flood in June of 2008. Most of the downtown area and some surrounding residential areas were flooded during the event. A more detailed account of the Study area can be found in the main report.

Construction Alternatives. The alternatives that are analyzed in this section of the report are based on four levee alignments (1, 4, 5, and 7) and various levee designs (100-year through larger than 500-year levee design) that are described elsewhere in the main report. Alignment 1 has a 5-year construction period and the effects on the regional economy of building to the 2008 levee design are analyzed in this section of the report. Alignment 4 has a 5-year construction period and the 500-year event levee design. Alignment 5 has a 3-year construction period and the 100-year event levee design. Alignment 7 has a 3-year construction period and the 200-year event levee design. The effects of Alignments 5 and 7 with their respective flood event levee designs are analyzed together under alternative 10. The construction alternatives that are derived from these variations are identified as the following: 1-D, 4C, 5A, and 7B. The number represents the alignment, and the letter represents the levee design.

Regional Impacts of Construction. The construction of levee systems has effects that extend beyond flood protection. The RED analysis here attempts to quantify the impacts of large construction projects to Linn County and the State of Iowa as a whole. The Study area is defined as Linn County and the remaining counties in Iowa. Substantial projects such as this usually have significant impacts on local economies and these effects should be documented and provided to the public.

Methodology. This RED analysis employs input-output economic analysis, which measures the interdependence among industries and workers in an economy. This analysis uses a matrix representation of a area's economy to predict the effect of changes in one industry on others. The greater the interdependence among industry sectors, the larger the multiplier effect on the economy. Changes to government spending drive the input-output model to project new levels of sales, employment, and income for each industry.

The IMPLAN model was selected for use in this analysis due to its ease of use, the availability of data inputs, and its ability to provide results that are consistent with Corps guidelines. The IMPLAN model is a linear and static model, showing relationships and impacts at certain points in time. The stimulus (construction action by the Federal government) is assumed to begin and end in the same year and the construction years' impacts are not summed, but they are analyzed as separate events. Impacts are broken down into three different effects: direct, indirect, and induced.

Direct effects represent the impacts the new Federal expenditures have on industries which directly support the new project. Labor and construction materials can be considered direct components to the project. Example: fill material purchased locally for the levee project.

Indirect effects represent changes to secondary industries that support the direct industries. Rock quarries used in making cement or fuel for construction equipment could be considered indirect pieces of the project.

Induced effects are changes in consumer spending patterns caused by the change in employment and income within the 'direct' and 'indirect' industries. The additional income workers receive via a project may be spent on clothing, groceries, dining out, and other items in the local/regional area. Example: Increase in sales for local restaurants because of the influx of money and employees for the construction project.

The inputs for the IMPLAN model are construction costs that are entered separately as the following: construction, preconstruction, engineering and design (PED), supervision and administration (S & A), environmental mitigation, and cultural mitigation. The following IMPLAN industry sectors are used for the model:

- sector 369, engineering services
- sector 390, environmental remediation services
- sector 376, archeological research and development services
- sector 384, administrative management services
- sector 36, construction of new nonresidential structures

The baseline data used by IMPLAN to represent the regional economy of Iowa are annual averages from the Bureau of the Census, the Bureau of Labor Statistics, and the Bureau of Economic Analysis for the year 2008. Prices are expressed in nominal 2009 dollars, the nominal dollars used for the model inputs.

Assumptions. Input-output analysis rests on the following assumptions. The production functions of industries have constant returns to scale, so if output is to increase, inputs will increase in the same proportion. Industries face no supply constraints; they have access to all the materials they can use. Industries have a fixed commodity input structure; they will not substitute any commodities or services used in the production of output in response to price changes. Industries produce their commodities in fixed proportions, homogenous sector output, so an industry will not increase production of a commodity without increasing production in every other commodity it produces. Finally, industries use the same technology to produce all of its commodities.

This RED analysis rests on the following assumptions. A percentage of the expenditures for the project will be spent outside of Linn County. The local purchase percentage varies by industry according to the underlying trade flow data of IMPLAN. The local purchase percentages estimated by the model are as follows: Construction-99.87 percent, S & A- 90.36 percent, PED-53.05 percent, Environmental Mitigation-64.58 percent, and Cultural Mitigation-19.38 percent.

The costs for cultural mitigation and environmental mitigation are one-time expenses during the construction process. As a result, these costs are entered for the first year of each alternative's proposed level of protection. Costs for real estate were not included in the model since the purchase of land represents a transfer payment. Operations and maintenance costs were also excluded.

The economic conditions of 2008, the year of the Socio-economic data in the IMPLAN model database, will prevail during the years of the construction process.

Column Descriptions for Tables 1 and 2. In tables 1 and 2, the level of protection for each alternative is represented by a letter. The 100-year level is represented by "a," the 200-year level by "b," the 500-year level by "c," and the 2008 flood level by "D." The "Years" column contains the number of years of construction necessary to complete an alternative.

Total Construction Stimulus is the sum of all inputs over all the years of construction for each alternative's level of protection and includes construction, preconstruction, engineering, and design (PED), supervision and administration (S & A), cultural mitigation, and environmental mitigation. Output is the sum total of transactions that take place as a result of the construction project, including both value added and intermediate goods purchased in the economy.
Labor Income includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income.

Gross Regional Product (GRP) is the "value-added" output of the Study area. This metric captures all final goods and services produced in the Study areas because of the project's existence. It is different from output in the sense that one dollar of a "final" good or service may have multiple transactions associated with it. Example: a pencil is made up of several things: wood, graphite, metal, rubber, paint, etc. Each of these inputs requires at least one transaction for a pencil making company to obtain; however, there is only one final good: the pencil.

Employment is the estimated man-years of labor required to build the project. It includes both full and part-time employment. It is not the number of permanent jobs created. If an area already has sufficient industrial capacity to perform the project work, the number of created jobs may be limited.

Tax Revenue includes the following state and local taxes: social insurance taxes, corporate profit taxes, dividends taxes, sales taxes, income taxes, fees for motor vehicle licenses, and fees for fishing and hunting licenses, severance taxes, fees for business licenses, documentary and stamp taxes, rents and royalties, special assessments, fines, settlements, and donations. The model calculates tax revenue as a proportion of value added. This proportion is area specific and is made up of a distribution of sub-categories, such as sales tax, income tax, fees and fines, etc., which are taken from the Annual Survey of Government Finances for the year of the data, 2008. The model assumes that this proportion for the data year will remain the same throughout the years of construction.

All metrics are listed on a year by year basis and are also reported by peak and average over the life of the alternative. "Peak" is the year of construction in which construction expenditures are the highest for a particular alternative's measure of protection; "Average" is the average value of all years of construction for a particular alternative's measure of protection and represents the recurring benefits of an alternative over the years of its construction. The results are not summed across years since some metrics (most notably employment) do not lend themselves well to summing and each year is considered a separate event. Example: it takes 200 people to perform the work required in year 1. In year 2 it requires 210. The difference represents a change of 10. If the metric were summed, it would appear as if 410 jobs were needed, which is not the case.

Results. The estimated employment in Linn County generated annually over the construction period ranges from a low of 60 to 460 jobs annually over the life of the construction project depending on

which alternative is implemented. Labor income ranges from $3 million to $25 million. Output ranges from $8 million to $64 million. Gross regional product ranges $4 million to $32 million. Tax revenue ranges from $550,000 to $2 million. The spillover effects on the remaining counties of Iowa were found to be minimal.

Using the local purchase percentages mentioned above reveals that about 92 percent of the total construction stimulus for each proposed alternative and level of protection is captured in the local economy of Linn County.

The combined indirect and induced multiplier effects of the spending on the project in Linn County accounts for about 43 percent of the total impact on employment, about 32 percent of the impact on income, about 42 percent of the impact on gross regional product, and about 36 percent of the impact on output. The spending impacts on the remaining counties of Iowa are attributed to the multiplier effects of the government spending in Linn County (See tables 10 through 19 for direct, indirect, and induced components of the total impacts).

As seen in table 1, the level of protection for the 2008 flood in Cedar Rapids in Alternative 1D creates the greatest impacts throughout Cedar Rapids across all output categories. This result is to be expected since construction expenditures are the highest compared to all the other alternatives. The relationship between inputs and outputs is largely the same for all alternatives and their respective levels of protection. As a result, the impacts of the construction of the various alternatives will vary in direct proportion to the dollar amount spent by the government for their construction. Alternative 4 appears to have more leakage outside of the local economy than the other alternatives. This leakage appears to be the result of the relatively large proportion of project expenditures allocated to PED, nearly half of which is estimated to be spent outside of Linn County.

The same relationship between inputs, outputs, and spending in Linn County can also be observed in the remaining counties of Iowa as seen in table 2. Impacts on the remaining Iowa counties are fairly minimal. Such a light impact suggests that the impacts of the construction stimulus for the projects in Linn County will not significantly leak from its local economy.

Tables 3 through 9 decompose total impacts of the construction stimulus by industry aggregates for the average spending and peak year of spending on each alternative in Linn County. The industries are aggregated according to two-digit NAICS codes. When considering GRP and output, the industry aggregates of retail trade, wholesale trade, finance and insurance, retail trade, and health and social services are projected to benefit the most from the multiplier effects of the construction spending. When considering employment, accommodation and food services replaces wholesale trade as one of the top beneficiaries of the multiplier effects of construction.

Table 20 displays the estimated annual state income and sales tax revenue generated by each alternative for Linn County. The increase in sales tax revenues is estimated to range from $76,000 to $600,000. State income tax revenue increases range from $57,000 to $450,000. In the year 2008, Linn County generated $325,725,000 in sales tax revenue and $189,321,000 in state income tax revenue. The construction stimulus would increase this base by an estimated 0.1 percent for both sales and state income tax revenues.

Exhibit 1, Table 1. Summary of Regional Economic Impacts – Linn County, Iowa
(Dollars are in $1,000s)

			Employment		Income		Output		Regional Product		Tax Revenue	
Alternative	**Years**	**Total Construction Stimulus**	**Peak**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**	**Average**
1-D	5	$221,642	657	464	$35,036	$24,854	$90,496	$63,532	$44,801	$31,735	$2,982	$2,105
4C	5	91,456	272	192	14,525	10,278	37,517	26,250	18,573	13,114	1,236	869
5A	3	16,787	84	59	4,497	3,144	11,588	8,031	5,748	4012	382	266
7B	3	35,227	177	123	9,435	6,598	24,314	16,852	12,060	8,419	802	558
10E	3	52,014	261	182	13,932	9,743	35,901	24,883	17,807	12,431	1,184	824

1. 2010 Price Level
2. Years = Number of Years that construction activities impact the regional economy.
3. See narrative for definition of alternatives.
4. Total Construction Stimulus includes construction, PED, S&A, Cultural Mitigation, and Environmental Mitigation where applicable. It does not include Real Estate or O&M.
5. Peak is the year of construction in which construction expenditures are the highest for a particular alternative's measure of protection
6. "Average" is the average value of all years of construction for a particular alternative's measure of protection and represents the recurring benefits of an alternative over the years of its construction.

Exhibit 1, Table 2. Summary of Regional Economic Impacts – Remaining Counties in Iowa
(Dollars are in $1,000s)

			Employment		Income		Output		Regional Product		Tax Revenue	
Alternative	**Years**	**Total Construction Stimulus**	**Peak**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**	**Average**
1-D	5	$221,642	35	24	1,603	1,114	5,157	3,574	2,467	1,718	175	122
4C	5	91,456	14	10	665	460	2,138	1,475	1,023	709	73	50
5A	3	16,787	4	3	205	141	659	451	315	217	22	15
7B	3	35,227	9	6	430	295	1,382	947	662	455	47	32
10E	3	52,014	14	9	635	436	2,040	1,398	977	672	69	48

1. 2010 Price Level
2. Years = Number of Years that construction activities impact the regional economy.
3. See narrative for definition of alternatives.
4. Total Construction Stimulus includes construction, PED, S&A, Cultural Mitigation, and Environmental Mitigation where applicable. It does not include Real Estate or O&M.
5. Peak is the year of construction in which construction expenditures are the highest for a particular alternative's measure of protection
6. "Average" is the average value of all years of construction for a particular alternative's measure of protection and represents the recurring benefits of an alternative over the years of its construction.

Exhibit 1, Table 3. Total Impacts by Industry.
Alternative 1D Peak Year, Linn County Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	2,665	9,416	25,048
Mining	0	960	1,525	2,621
Utilities	1	178,953	647,107	876,031
Construction	328	20,006,939	21,231,018	51,499,490
Manufacturing	2	124,702	190,473	679,025
Wholesale Trade	10	678,286	1,163,743	1,799,947
Retail trade	62	1,539,058	2,531,012	3,725,075
Transportation & Warehousing	9	363,490	510,451	966,468
Information	7	421,290	959,260	2,403,949
Finance & insurance	14	943,041	1,796,393	3,181,097
Real estate & rental	14	467,170	3,286,320	5,040,593
Professional- Scientific & Tech Services	49	3,647,553	3,922,407	6,531,327
Management of Companies	0	38,663	51,723	88,456
Administrative & Waste Services	58	3,213,978	4,220,291	6,098,207
Educational Services	8	194,176	214,851	393,540
Health & Social Services	36	1,770,522	2,029,539	3,292,632
Arts- Entertainment & Recreation	5	86,467	140,794	313,284
Accommodation & Food Services	27	439,302	647,398	1,342,767
Other Services	24	728,973	1,045,051	1,810,479
Government & Non NAICs	3	189,658	202,689	425,477
TOTAL	**657**	**35,035,845**	**44,801,461**	**90,495,511**

Exhibit 1, Table 4. Total Impacts by Industry.
Alternative 1D Average, Linn County, Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	1,878	6,676	17,735
Mining	0	643	1,022	1,756
Utilities	1	126,012	455,667	616,866
Construction	219	13,346,157	14,163,621	34,348,891
Manufacturing	1	86,326	131,950	472,056
Wholesale Trade	7	469,240	805,080	1,245,208
Retail trade	43	1,075,981	1,769,474	2,604,496
Transportation & Warehousing	6	253,007	355,541	670,904
Information	5	300,997	685,269	1,718,997
Finance & insurance	10	679,314	1,294,503	2,294,874
Real estate & rental	10	325,236	2,328,226	3,557,162
Professional- Scientific & Tech Services	47	3,499,937	3,715,725	6,214,886
Management of Companies	0	28,008	37,469	64,079
Administrative & Waste Services	42	2,236,856	2,945,608	4,315,812
Educational Services	6	138,171	152,869	280,001
Health & Social Services	26	1,257,054	1,440,973	2,337,737
Arts- Entertainment & Recreation	3	61,872	100,553	223,714
Accommodation & Food Services	20	320,785	472,729	980,510
Other Services	17	509,573	725,886	1,261,109
Government & Non NAICs	2	137,258	146,257	305,276
TOTAL	**464**	**24,854,305**	**31,735,098**	**63,532,069**

Exhibit 1, Table 5. Total Impacts by Industry.
Alternative 4C Peak Year, Linn County Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	1,105	3,904	10,384
Mining	0	398	632	1,087
Utilities	1	74,189	268,272	363,178
Construction	136	8,294,239	8,801,704	21,350,045
Manufacturing	1	51,698	78,964	281,504
Wholesale Trade	4	281,197	482,453	746,205
Retail trade	26	638,049	1,049,285	1,544,309
Transportation & Warehousing	4	150,692	211,618	400,669
Information	3	174,656	397,683	996,613
Finance & insurance	6	390,959	744,736	1,318,797
Real estate & rental	6	193,675	1,362,416	2,089,688
Professional- Scientific & Tech Services	21	1,512,145	1,626,091	2,707,657
Management of Companies	0	16,029	21,443	36,671
Administrative & Waste Services	24	1,332,546	1,749,776	2,528,373
Educational Services	3	80,500	89,071	163,151
Health & Social Services	15	734,010	841,391	1,365,034
Arts- Entertainment & Recreation	2	35,847	58,370	129,879
Accommodation & Food Services	11	182,123	268,394	556,676
Other Services	10	302,211	433,247	750,571
Government & Non NAICs	1	78,627	84,029	176,391
TOTAL	**272**	**14,524,893**	**18,573,480**	**37,516,881**

Exhibit 1, Table 6. Total Impacts by Industry.
Alternative 4C Average, Linn County, Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	777	2,761	7,334
Mining	0	267	423	728
Utilities	0	52,058	188,247	254,842
Construction	91	5,532,682	5,871,549	14,239,501
Manufacturing	1	35,706	54,578	195,253
Wholesale Trade	3	194,089	333,000	515,047
Retail trade	18	445,235	732,199	1,077,723
Transportation & Warehousing	3	104,402	146,701	276,990
Information	2	124,280	282,924	709,663
Finance & insurance	4	280,311	534,213	946,852
Real estate & rental	4	134,461	962,634	1,470,878
Professional- Scientific & Tech Services	19	1,449,893	1,539,127	2,574,331
Management of Companies	0	11,498	15,382	26,307
Administrative & Waste Services	17	910,408	1,194,521	1,727,692
Educational Services	2	57,143	63,222	115,799
Health & Social Services	11	519,854	595,913	966,769
Arts- Entertainment & Recreation	1	25,563	41,555	92,454
Accommodation & Food Services	8	132,474	195,222	404,919
Other Services	7	210,666	300,147	521,416
Government & Non NAICs	1	56,445	60,148	125,556
TOTAL	**192**	**10,278,213**	**13,114,467**	**26,250,055**

Exhibit 1, Table 7. Total Impacts by Industry.
Alternative 5A Peak Year, Linn County Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	341	1,208	3,212
Mining	0	122	194	333
Utilities	0	22,926	82,902	112,230
Construction	42	2,537,780	2,693,082	6,532,296
Manufacturing	0	15,926	24,330	86,795
Wholesale Trade	1	86,617	148,610	229,854
Retail trade	8	196,978	323,935	476,767
Transportation & Warehousing	1	46,449	65,235	123,445
Information	1	54,129	123,246	308,918
Finance & insurance	2	121,366	231,210	409,515
Real estate & rental	2	59,726	421,654	646,239
Professional- Scientific & Tech Services	7	502,066	538,242	896,426
Management of Companies	0	4,976	6,657	11,384
Administrative & Waste Services	7	409,757	537,976	777,483
Educational Services	1	24,939	27,594	50,543
Health & Social Services	5	227,289	260,541	422,688
Arts- Entertainment & Recreation	1	11,116	18,094	40,261
Accommodation & Food Services	3	56,712	83,575	173,344
Other Services	3	93,272	133,548	231,491
Government & Non NAICs	0	24,414	26,075	54,672
TOTAL	**84**	**4,496,902**	**5,747,908**	**11,587,895**

Exhibit 1, Table 8. Total Impacts by Industry.
Alternative 5A Average, Linn County, Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	238	845	2,244
Mining	0	82	130	223
Utilities	0	15,926	57,591	77,964
Construction	28	1,692,674	1,796,347	4,356,447
Manufacturing	0	10,924	16,697	59,734
Wholesale Trade	1	59,378	101,876	157,571
Retail trade	5	136,212	224,004	329,711
Transportation & Warehousing	1	31,940	44,881	84,741
Information	1	38,021	86,555	217,106
Finance & insurance	1	85,755	163,431	289,669
Real estate & rental	1	41,136	294,499	449,987
Professional- Scientific & Tech Services	6	443,543	470,842	787,524
Management of Companies	0	3,518	4,706	8,048
Administrative & Waste Services	5	278,480	365,386	528,476
Educational Services	1	17,482	19,341	35,427
Health & Social Services	3	159,039	182,308	295,764
Arts- Entertainment & Recreation	0	7,821	12,713	28,284
Accommodation & Food Services	2	40,527	59,724	123,875
Other Services	2	64,450	91,825	159,519
Government & Non NAICs	0	17,268	18,401	38,411
TOTAL	**59**	**3,144,413**	**4,012,100**	**8,030,724**

Exhibit 1, Table 9. Total Impacts by Industry.
Alternative 7B Peak Year, Linn County Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	716	2,534	6,739
Mining	0	256	406	698
Utilities	0	48,103	173,946	235,482
Construction	87	5,325,164	5,651,040	13,707,075
Manufacturing	1	33,417	51,050	182,118
Wholesale Trade	3	181,746	311,825	482,295
Retail trade	17	413,306	679,691	1,000,368
Transportation & Warehousing	2	97,461	136,880	259,019
Information	2	113,571	258,590	648,158
Finance & insurance	4	254,647	485,118	859,230
Real estate & rental	4	125,319	884,713	1,355,944
Professional- Scientific & Tech Services	14	1,053,441	1,129,344	1,880,889
Management of Companies	0	10,440	13,966	23,885
Administrative & Waste Services	16	859,292	1,128,170	1,630,452
Educational Services	2	52,326	57,897	106,048
Health & Social Services	10	476,895	546,663	886,879
Arts- Entertainment & Recreation	1	23,323	37,964	84,473
Accommodation & Food Services	7	118,988	175,352	363,699
Other Services	6	195,708	280,219	485,728
Government & Non NAICs	1	51,224	54,710	114,711
TOTAL	**177**	**9,435,346**	**12,060,080**	**24,313,890**

Exhibit 1, Table 10. Total Impacts by Industry.
Alternative 10E Peak Year, Linn County Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	13,931,798	17,807,431	35,900,851
Mining	0	1,058	3,742	9,951
Utilities	1	378	600	1,031
Construction	129	71,027	256,841	347,702
Manufacturing	1	7,862,942	8,344,119	20,239,367
Wholesale Trade	4	49,343	75,379	268,907
Retail Trade	25	268,359	460,426	712,136
Transportation & Warehousing	3	610,270	1,003,601	1,477,098
Information	3	143,907	202,111	382,456
Finance & insurance	6	167,695	381,823	957,043
Real estate & rental	6	375,998	716,300	1,268,694
Professional- Scientific & Tech Services	21	185,041	1,306,326	2,002,123
Management of companies	0	1,555,171	1,667,239	2,776,736
Administrative & waste services	23	15,415	20,622	35,267
Educational Services	3	1,269,033	1,666,125	2,407,904
Health & social services	14	77,263	85,488	156,586
Arts- Entertainment & Recreation	2	704,161	807,177	1,309,524
Accommodation & Food Services	11	34,438	56,056	124,729
Other Services	9	175,692	258,915	537,018
Government & non NAICs	1	288,973	413,759	717,203
TOTAL	**261**	**75,635**	**80,783**	**169,377**

Exhibit 1, Table 11. Total Impacts by Industry.
Alternative 10E Average Year, Linn County Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	736	2,617	6,952
Mining	0	253	401	690
Utilities	0	49,346	178,440	241,566
Construction	86	5,244,379	5,565,587	13,497,494
Manufacturing	1	33,846	51,734	185,081
Wholesale Trade	3	183,977	315,651	488,214
Retail Trade	17	422,040	694,054	1,021,578
Transportation & Warehousing	2	98,963	139,058	262,559
Information	2	117,807	268,187	672,697
Finance & insurance	4	265,710	506,387	897,533
Real estate & rental	4	127,456	912,489	1,394,255
Professional- Scientific & Tech Services	18	1,374,441	1,459,030	2,440,355
Management of companies	0	10,899	14,581	24,936
Administrative & waste services	16	863,013	1,132,336	1,637,749
Educational Services	2	54,167	59,928	109,767
Health & social services	10	492,774	564,872	916,409
Arts- Entertainment & Recreation	1	24,232	39,391	87,639
Accommodation & Food Services	8	125,574	185,054	383,829
Other Services	7	199,691	284,510	494,251
Government & non NAICs	1	53,505	57,015	119,016
TOTAL	**182**	**9,742,810**	**12,431,323**	**24,882,572**

Exhibit 1, Table 12. Total Impacts by Industry.
Alternative 7B Average, Linn County, Iowa

Industry	Employment	Labor Income	GRP	Output
Ag, Forestry, Fish & Hunting	0	499	1,772	4,708
Mining	0	171	272	467
Utilities	0	33,420	120,850	163,602
Construction	58	3,551,834	3,769,377	9,141,379
Manufacturing	0	22,922	35,038	125,348
Wholesale Trade	2	124,600	213,778	330,648
Retail trade	11	285,830	470,054	691,872
Transportation & Warehousing	2	67,023	94,178	177,820
Information	1	79,785	181,630	455,586
Finance & insurance	3	179,953	342,953	607,858
Real estate & rental	3	86,321	617,988	944,268
Professional- Scientific & Tech Services	12	930,903	988,192	1,652,839
Management of Companies	0	7,382	9,875	16,888
Administrative & Waste Services	11	584,367	766,730	1,108,962
Educational Services	2	36,685	40,587	74,341
Health & Social Services	7	333,734	382,562	620,643
Arts- Entertainment & Recreation	1	16,411	26,677	59,353
Accommodation & Food Services	5	85,046	125,328	259,950
Other Services	4	135,243	192,687	334,737
Government & Non NAICs	0	36,237	38,614	80,604
TOTAL	**123**	**6,598,365**	**8,419,143**	**16,851,873**

Exhibit 1, Table 13. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 1D, Linn County, Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$24,522,000	163	$10,673,000	$11,470,000
Indirect	5,954,000	49	2,282,000	3,435,000
Induced	8,511,000	78	2,735,000	5,085,000
Total	38,986,000	290	15,690,000	19,990,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$51,459,000	$335	$21,525,000	$23,233,000
Indirect	11,883,000	97	4,607,000	6,880,000
Induced	17,102,000	156	5,496,000	10,217,000
Total	80,445,000	588	31,628,000	40,331,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$58,321,000	377	$23,801,000	$25,822,000
Indirect	13,261,000	107	5,155,000	7,680,000
Induced	18,913,000	173	6,079,000	11,300,000
Total	90,496,000	657	35,036,000	44,801,000

Year 4

Effects	Output	Employment	Income	Regional Product
Direct	$39,697,000	257	$16,351,000	$17,705,000
Indirect	9,079,000	74	3,526,000	5,257,000
Induced	12,992,000	119	4,176,000	7,762,000
Total	61,768,000	450	24,052,000	30,724,000

Year 5

Effects	Output	Employment	Income	Regional Product
Direct	$29,569,000	191	$12,142,000	$13,156,000
Indirect	6,749,000	55	2,622,000	3,909,000
Induced	9,648,000	88	3,101,000	5,764,000
Total	45,966,000	334	17,865,000	22,829,000

Exhibit 1, Table 14. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 1D, Remaining Counties in Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	1,436,000	9	445,000	662,000
Induced	675,000	6	217,000	371,000
Total	2,111,000	15	662,000	1,033,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	3,105,000	19	955,000	1,398,000
Induced	1,393,000	12	448,000	768,000
Total	4,498,000	31	1,403,000	2,166,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	3,590,000	22	1,100,000	1,603,000
Induced	1,567,000	13	503,000	864,000
Total	5,157,000	35	1,603,000	2,467,000

Year 4

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	2,426,000	15	744,000	1,086,000
Induced	1,070,000	9	344,000	590,000
Total	3,495,000	24	1,088,000	1,676,000

Year 5

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	1,811,000	11	555,000	810,000
Induced	796,000	7	256,000	439,000
Total	2,607,000	18	811,000	1,249,000

Exhibit 1, Table 15. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 4C, Linn County, Iowa

		Year 1		
Effects	**Output**	**Employment**	**Income**	**Regional Product**
Direct	$9,889,000	66	$4,352,000	$4,638,000
Indirect	2,374,000	20	914,000	1,374,000
Induced	3,461,000	32	1,112,000	2,068,000
Total	15,724,000	117	6,378,000	8,079,000

		Year 2		
Effects	**Output**	**Employment**	**Income**	**Regional Product**
Direct	$21,332,000	139	$8,923,000	$9,631,000
Indirect	4,926,000	40	1,910,000	2,852,000
Induced	7,090,000	65	2,278,000	4,236,000
Total	33,348,000	244	13,111,000	16,719,000

		Year 3		
Effects	**Output**	**Employment**	**Income**	**Regional Product**
Direct	$24,178,000	156	$9,867,000	$10,705,000
Indirect	5,498,000	44	2,137,000	3,184,000
Induced	7,841,000	72	2,520,000	4,685,000
Total	37,517,000	272	14,525,000	18,573,000

		Year 4		
Effects	**Output**	**Employment**	**Income**	**Regional Product**
Direct	$16,457,000	107	$6,778,000	$7,340,000
Indirect	3,764,000	30	1,462,000	2,179,000
Induced	5,386,000	49	1,731,000	3,218,000
Total	25,606,000	186	9,971,000	12,737,000

		Year 5		
Effects	**Output**	**Employment**	**Income**	**Regional Product**
Direct	$12,257,000	79	$5,033,000	$5,454,000
Indirect	2,798,000	23	1,087,000	1,620,000
Induced	4,000,000	37	1,285,000	2,389,000
Total	19,055,000	139	7,406,000	9,463,000

Exhibit 1, Table 16. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 4C, Remaining Counties in Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	570,000	4	177,000	262,000
Induced	272,000	2	88,000	150,000
Total	842,000	6	265,000	412,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	1,287,000	8	396,000	580,000
Induced	578,000	5	186,000	318,000
Total	1,865,000	13	582,000	898,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	1,488,000	9	456,000	664,000
Induced	650,000	5	209,000	358,000
Total	2,138,000	14	665,000	1,023,000

Year 4

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	1,006,000	6	309,000	450,000
Induced	443,000	4	142,000	244,000
Total	1,449,000	10	451,000	695,000

Year 5

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	751,000	5	230,000	336,000
Induced	330,000	3	106,000	182,000
Total	1,081,000	7	336,000	518,000

Exhibit 1, Table 17. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 5A, Linn County, Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$3,481,000	23	$1,513,000	$1,618,000
Indirect	826,000	7	319,000	478,000
Induced	1,202,000	11	386,000	718,000
Total	5,510,000	41	2,218,000	2,815,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$7,460,000	48	$3,056,000	$3,313,000
Indirect	1,700,000	14	661,000	985,000
Induced	2,428,000	22	780,000	1,451,000
Total	11,588,000	84	4,497,000	5,748,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$4,500,000	29	$1,848,000	$2,002,000
Indirect	1,027,000	8	399,000	595,000
Induced	1,468,000	13	472,000	877,000
Total	6,995,000	51	2,718,000	3,474,000

Exhibit 1, Table 18. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 5A, Remaining Counties in Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	203,000	1	63,000	93,000
Induced	95,000	1	31,000	52,000
Total	298,000	2	94,000	145,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	458,000	3	140,000	205,000
Induced	201,000	2	64,000	111,000
Total	659,000	4	205,000	315,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	276,000	2	85,000	123,000
Induced	121,000	1	39,000	67,000
Total	397,000	3	123,000	190,000

Exhibit 1, Table 19. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 7B, Linn County, Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$7,305,000	48	$3,175,000	$3,396,000
Indirect	1,734,000	14	669,000	1,004,000
Induced	2,523,000	23	811,000	1,508,000
Total	11,563,000	86	4,655,000	5,907,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$15,652,000	101	$6,412,000	$6,950,000
Indirect	3,567,000	29	1,386,000	2,066,000
Induced	5,095,000	47	1,638,000	3,044,000
Total	24,314,000	177	9,435,000	12,060,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$9,443,000	61	$3,878,000	$4,201,000
Indirect	2,155,000	17	837,000	1,248,000
Induced	3,081,000	28	990,000	1,841,000
Total	14,679,000	107	5,705,000	7,290,000

Exhibit 1, Table 20. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 7B, Remaining Counties in Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	426,000	3	132,000	195,000
Induced	200,000	2	64,000	110,000
Total	626,000	4	196,000	305,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	961,000	6	294,000	429,000
Induced	421,000	4	135,000	232,000
Total	1,382,000	9	430,000	662,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	578,000	4	177,000	259,000
Induced	254,000	2	82,000	140,000
Total	833,000	6	259,000	399,000

Exhibit 1, Table 21. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 10E, Linn County, Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$10,785,000	71	$4,687,000	$5,013,000
Indirect	2,560,000	21	988,000	1,482,000
Induced	3,725,000	34	1,197,000	2,226,000
Total	17,071,000	126	6,872,000	8,721,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$23,111,000	149	$9,467,000	$10,263,000
Indirect	5,267,000	43	2,047,000	3,050,000
Induced	7,523,000	69	2,418,000	4,494,000
Total	35,901,000	261	13,932,000	17,807,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$13,944,000	90	$5,726,000	$6,204,000
Indirect	3,183,000	26	1,236,000	1,843,000
Induced	4,550,000	42	1,462,000	2,718,000
Total	21,676,000	158	8,425,000	10,765,000

Exhibit 1, Table 22. Direct, Indirect, and Induced Effects of Spending by Year.
Alternative 10E, Remaining Counties in Iowa

Year 1

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	629,000	4	195,000	288,000
Induced	295,000	2	95,000	163,000
Total	925,000	6	290,000	450,000

Year 2

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	1,419,000	9	435,000	634,000
Induced	622,000	5	200,000	343,000
Total	2,040,000	14	635,000	977,000

Year 3

Effects	Output	Employment	Income	Regional Product
Direct	$0	0	$0	$0
Indirect	854,000	5	262,000	382,000
Induced	375,000	3	121,000	207,000
Total	1,229,000	8	383,000	589,000

Exhibit 1, Table 23. State Sales and Income Tax Revenue Project Averages, All Alternatives
(Dollars are in thousands)

Alternative	Sales Tax	Income Tax
1-D	$600	$450
4C	$248	$186
5A	$76	$57
7B	$159	$119
10E	**$235**	**$176**

CEDAR RIVER
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APPENDIX B
ECONOMIC ANALYSIS

EXHIBIT 2

COMMERCIAL AND INDUSTRIAL FLOOD DAMAGE SURVEY

(Personal Interview)
OMB Control Number: 0710-0001
Expires: June 26, 2011

The public report burden for this information collection is estimated to average 60 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this data collection, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Executive Services Directorate, Information Management Division, and the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503, Attn.: Desk Officer for U.S. Army Corps of Engineers. Respondents should be aware that notwithstanding any other provision of law, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Please DO NOT RETURN your completed form to either of these offices.

*** Be sure to notify each person to be interviewed that responding to questions is voluntary.**

STATEMENT OF PURPOSE

The U.S. Army Corps of Engineers, Rock Island District (District) is conducting a survey of selected businesses in the Cities of Cedar Rapids and Iowa City, Iowa. The purpose of this survey is to collect information that will help us better determine potential economic losses from future flood events. The increased understanding of flood losses that we get from this survey will help us more accurately quantify the benefits of potential FRM projects for this area. You have been selected to participate in this survey because your facility characteristics and we want to ensure that these characteristics are reflected in our analysis.

Participation in this survey is completely voluntary. Should you choose to provide your name, title, and e-mail address, this information will be used only to contact you regarding your input; otherwise, responses will be anonymous. Comments provided will only be shared with the planning staff at the District during the evaluation of the overall Study. Reports generated with these evaluations will show impacts only as aggregated by broad categories (such as commercial, industrial, public, and residential), no information will be released that can be used to identify you or your facility. The information collected will be managed in accordance with AR 25-400-2 records retention requirements. The point of contact for the survey is Ms. Katie Hatch, (309) 794-5827 of the District's Planning Branch.

OMB#: 0710-0001
Expires: XXXX

COMMERCIAL AND INDUSTRIAL FLOOD DAMAGE SURVEY

PRIMARY SURVEY FORM

Attach Business Card Here

Firm Name: _____

This survey is focused on damages that could occur to the contents of structures at your facility in the event of future flooding. Contents are defined as items that would be relocated in the event that the facility moves to another location, such as furniture, equipment, products, and raw materials. For this survey contents were divided in three categories:

- **Equipment:** Physical items that are used for the production process or the operation of the facility (e.g., generators, machinery, production tables, paint booths, robotics, racks, conveyors, floor scrubbers, computers/servers, etc.). These items would most likely be removed if the business relocates to another facility.
- **Furniture:** Physical items necessary for the conduct of business or delivery of a product (e.g., desks, chairs, bookcases, artwork, etc.). As with equipment, this category is focused on free-standing and attached furniture that would be removed in the event of relocation.
- **Inventory/Products:** Items that are used in the production process or result from the production process, or consumables used as part of the business activities. Items include raw materials, finished products, replacement parts, medical consumables, cleaning products, food, pharmaceuticals, software, building materials, office supplies, etc.

BUSINESS INFORMATION

Address_____

Contact Name _____

Contact's Title _____ Telephone # _____

Interviewer_____ Date_____ Time _____

1. Type of business _____
2. Total number of buildings on site _____
3. Number of years business has been at this location _____

FLOOD HISTORY AND MITIGATION

4. Has your facility been flooded in the past? Yes No
If "Yes," please complete Questions 5 and 6. If "No," skip to Question 7

5. Please estimate the damages to your business from past flooding events. Please give a single set of combined damages for all floors in all buildings.

Date of the flooding event:		Date of the flooding event:	
Water depth above first floor:		Water depth above first floor:	
Contents damage estimate		Contents damage estimate ($):	
Structure damage estimate		Structure damage estimate ($):	
Number of lost business days:		Number of lost business days:	
Amount of lost net income		Amount of lost net income	
Cost of cleanup ($):		Cost of cleanup ($):	

6. Briefly describe any permanent flood mitigation measures that have been implemented to reduce potential flood damage. _____

BUILDING INFORMATION

*(Questions 7-17 are to be answered for your **primary building only**. If there are multiple buildings at the facility, a supplemental sheet is provided that asks for similar information.)*

7. Building #: _____

8. Brief description of function of the building and its contents: _____

9. Year building was constructed: _____

10. Building Construction Type (e.g. brick): _____

11. Number of floors (including basement, if any): _____

12. Building footprint: _____ feet by _____ feet = _____square feet

13. Does the building have a basement? Yes No If yes: _____ square feet finished area
_____ square feet unfinished area

14. Is there a seasonal variation in the value of inventory in this building? Yes No

If yes, what is the average value of your inventory during the following time periods:

January – March $_____ April – June $_____

July – September $_____ October – December $_____

15. Relative to the 1st floor elevation of the building, what is the value of the contents and where are they located vertically?

Height (ft)	Equipment ($)	Furniture ($)	Inventory/products ($)
0.0 ft			
1.0 ft			
3.0 ft			
6.0 ft +			
Total			

Notes to interviewer:

- Shaded areas are for buildings with a subterranean level only. Please fill in appropriate values for the depth (e.g., -1.0 ft, -3.0 ft, -6.0 ft). Leave shaded areas blank if no subterranean level exists.
- The values in the columns should be a cumulative total, starting from the lowest level of the structure, for all contents located at or below the specified height.

SUSCEPTIBILITY TO FLOOD DAMAGE

The amount of damage due to flooding can vary considerably depending on conditions (e.g., quality of water, duration of flood). When completing the following section, you will be asked to provide a range for potential damages. In addition to the most likely damage amount due to flooding, you will also be asked to provide a low and high estimate. Please use the following definitions:

Most Likely – reasonable amount of damage expected to occur during an average flood.

Low – reasonable low estimate of damages assuming that the flood conditions are less than a typical flood (e.g., short duration, relatively clean floodwaters) or the contents were less impacted than typically estimated (e.g., motors were sealed well).

High – reasonable high estimate of damages assuming that the flood conditions are worse than a typical flood (e.g., long duration, highly contaminated floodwaters) or the contents were more impacted than typically estimated (e.g., motors need total replacement).

16. At what elevation, relative to the 1st floor of the building, does flood damage to **contents** begin? (+ or – ; will only be negative if there is a subterranean level) _____ feet

17. Please estimate damage to contents corresponding with water depths above/below the building's 1st floor elevation. (Express damage in either **$ or % of total value**.)

Flood Depth	Equipment			Furniture			Inventory/products		
	Low	Most Likely	High	Low	Most Likely	High	Low	Most Likely	High
0.0 ft									
0.5 ft									
1.0 ft									
3.0 ft									
6.0 ft									

Notes to interviewer:
- Shaded areas are for buildings with a subterranean level only. Please fill in appropriate values for the depth (e.g., -1.0 ft, -3.0 ft, -6.0 ft). Leave shaded areas blank if no subterranean level exists.
- The values in the columns should be a cumulative total, starting from the lowest level of the structure, for all contents located at or below the specified height.

OTHER INFORMATION

18. Other than the principal structures, are there any other valuable items on your property that flood waters could damage?

Movable (cars, trucks, trailers, etc.)

Type	Current Value ($)

Not readily movable (landscaping, electrical equipment, pipes, trailers on blocks, etc.)

Type	Current Value ($)	Height Above Ground (ft)

19. Emergency Measures/Plans:

A. What emergency measures/plans, if any, would you take to reduce damage if flooding was imminent? _____
_____
_____
_____

B. What is the estimated cost to implement these emergency measures? $_____

C. How much time is required to implement these emergency measures? _____ hours

CEDAR RIVER
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APPENDIX B
ECONOMIC ANALYSIS

EXHIBIT 3

MEMO: EVALUATION OF EXISTING LEVEES AT CEDAR RAPIDS, IOWA

CEMVR-ED-G

Memorandum Through ED-G

Subject: Evaluation of Existing Levees at Cedar Rapids, Iowa

A discussion in connection with the evaluation of the levee's performance at Cedar Rapids, Iowa, is presented in this memorandum. Based on the cursory site visits and various references, the conclusions drawn herein are presented in the following text.

1. Existing levee embankment and surrounding ground is covered with a growth of trees and vegetation encouraging considerable rodent burrowing activity throughout, thereby, comprising the levee integrity. The root system is likely to rot upon the demise of the trees resulting in a potential seepage path through the levee embankment. The extensive vegetation present also hinders the visibility required for the periodic inspection of the levees.

2. Permanent tie-offs to high ground do not exist for the Time Check Levee.

3. Existing levees do not have a permanent pump stations. Gravity storm drains that pass underneath the existing levees have no permanent closure gates.

4. The existing side slopes of the levees are not safe. For example, the landside slope at Cedar River Levee along the Time Check neighborhood averages 1H:1V and the riverside slope averages ½ H: 1V

5. The levees do not meet the minimum Public Law 84-99 levee eligibility standards for levees, as outlined by the US Army Corps of Engineers.

6. These non-Federal levees are not accredited by FEMA.

7. Seepage cutoff trenches were likely not provided in the original construction.

Based on the above discussion, it is concluded that all levees in Cedar Rapids that exist do not meet the minimum standards set by the U.S. Army Corps of Engineers.

For the purposes of the Cedar Rapids feasibility, no measurable level of flood protection shall be taken into account.

Padmakar Srivastava, Ph.D., P.E.
Geotechnical Branch

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

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EXHIBIT 4

SELF-CERTIFICATION OF FINANCIAL CAPABILITY

NON-FEDERAL SPONSOR'S
SELF-CERTIFICATION OF FINANCIAL CAPABILITY
FOR AGREEMENTS

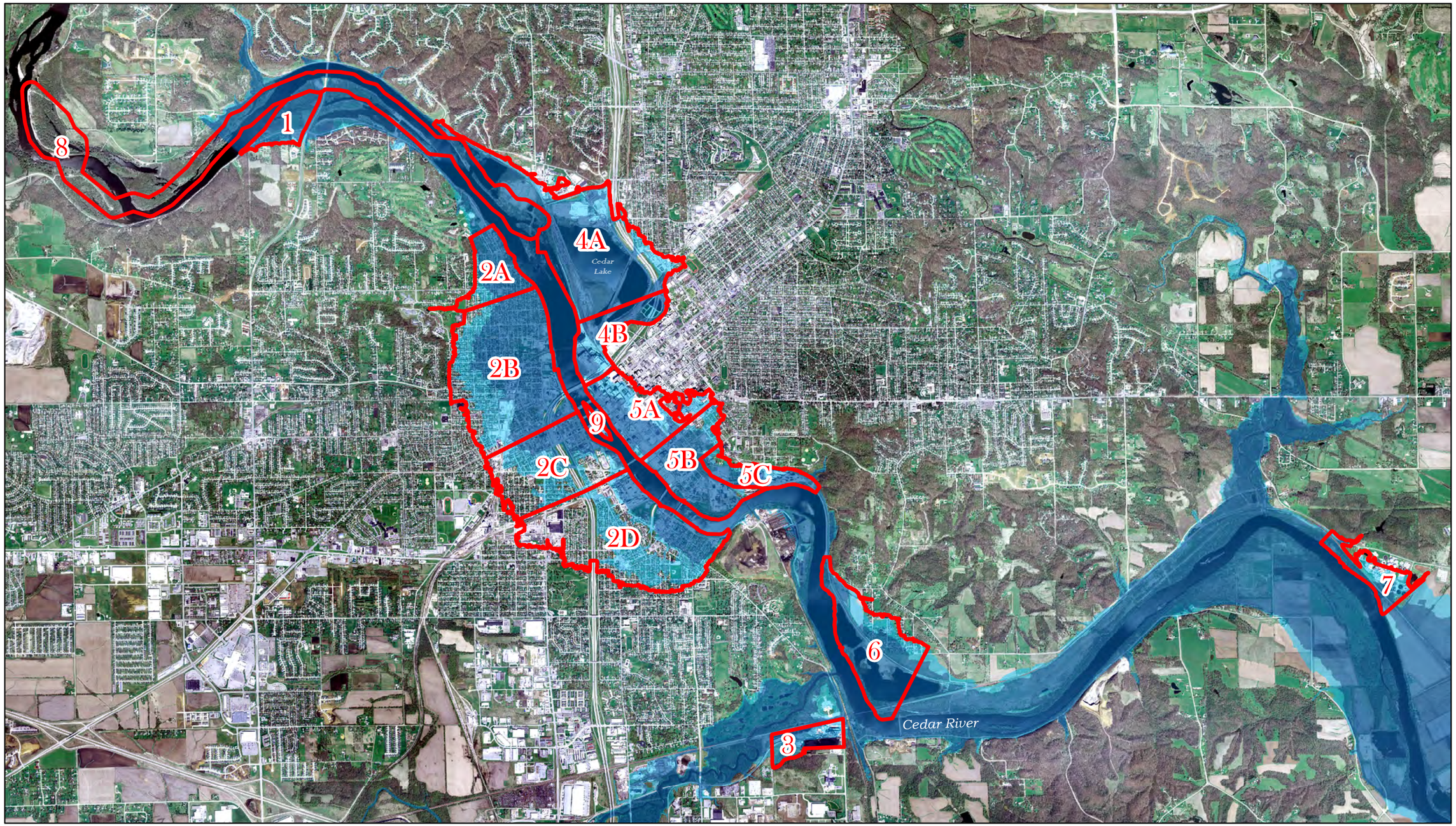
I, Casey Drew, do hereby certify that I am the Finance Director of the City of Cedar Rapids, Iowa (the "Non-Federal Sponsor"); that I am aware of the financial obligations of the Non-Federal Sponsor for the Design Agreement for the Cedar River Levee project; and that the Non-Federal Sponsor has the financial capability to satisfy the Non-Federal Sponsor's obligations under the Design Agreement between the Department of the Army and the City of Cedar Rapids, Iowa for the design of the Cedar River Levee project.

IN WITNESS WHEREOF, I have made and executed this certification this 12th day of October, 2010.

BY: Casey J Drew

TITLE: Finance Director

DATE: 10/12/10



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 720 1,440 2,160 2,880 Meters

0 1,700 3,400 5,100 6,800 Feet

N S

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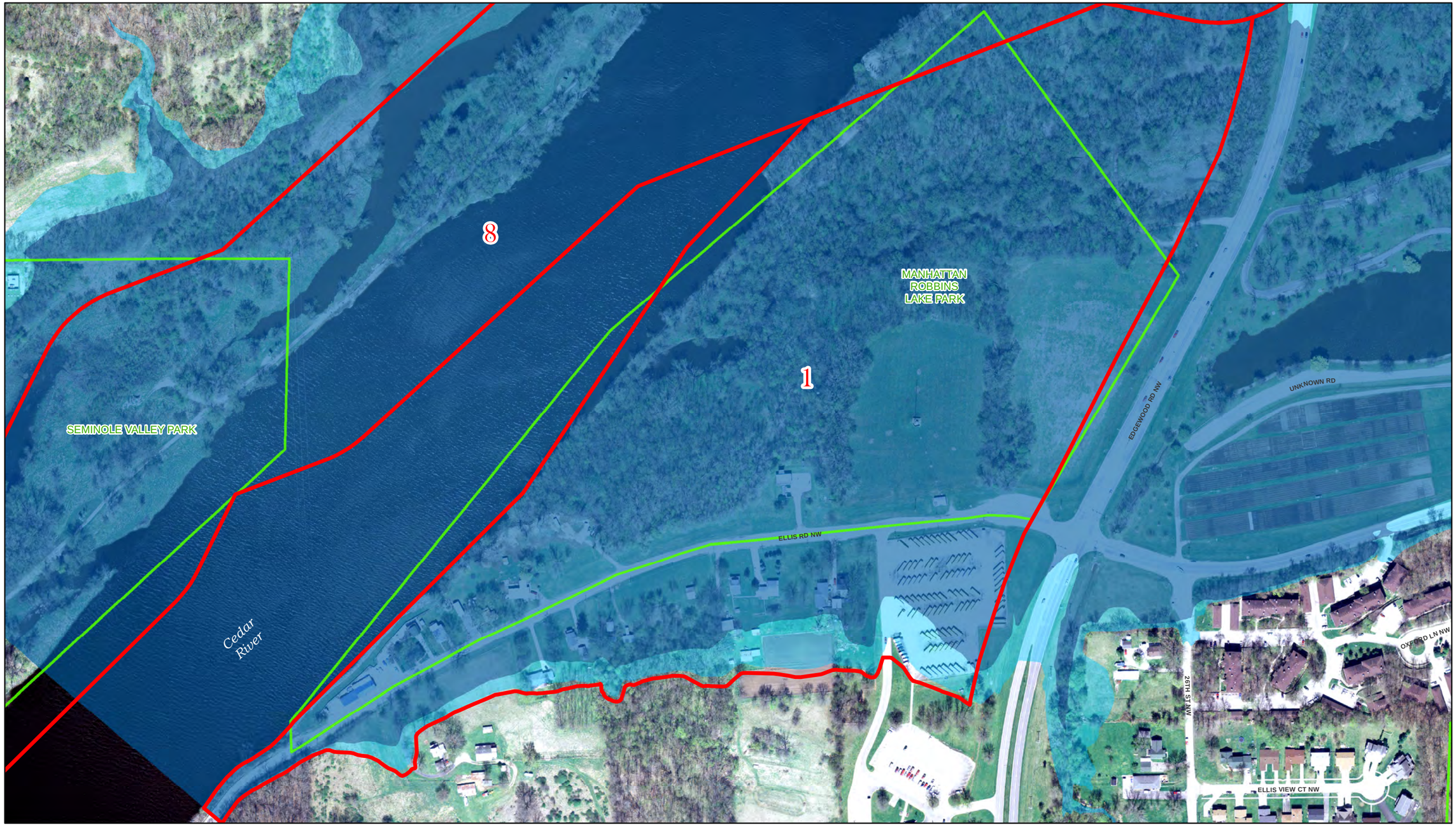
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS — *26 March 2010*

INDEX



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 50 100 150 200 *Meters*

0 190 380 570 760 *Feet*

N S

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Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 1



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 70 140 210 280 *Meters*
0 260 520 780 1,040 *Feet*

N S

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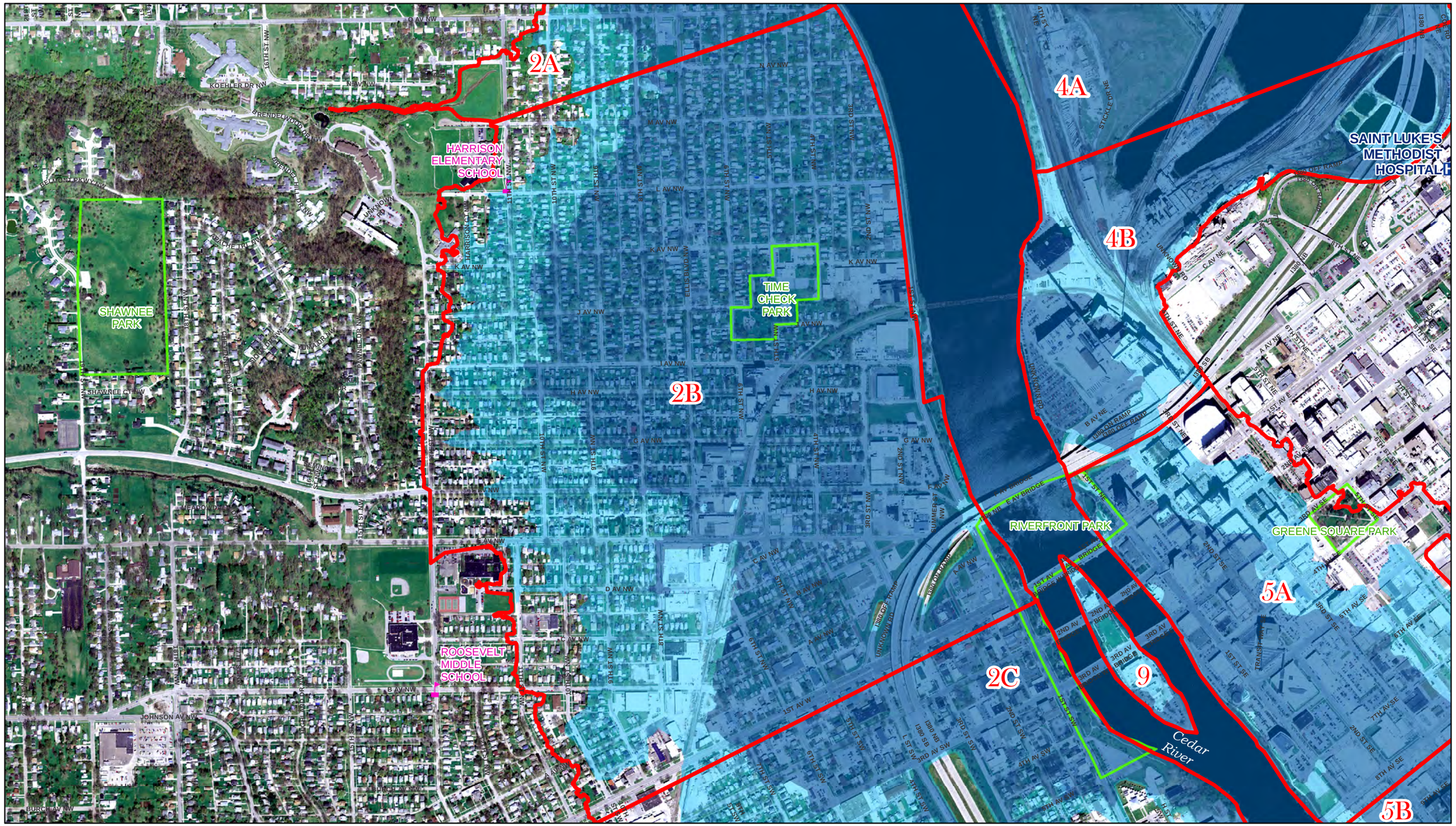
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*



LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 140 280 420 560 Meters

0 525 1,050 1,575 2,100 Feet

N S

US Army Corps of Engineers
Rock Island District

GRGIS

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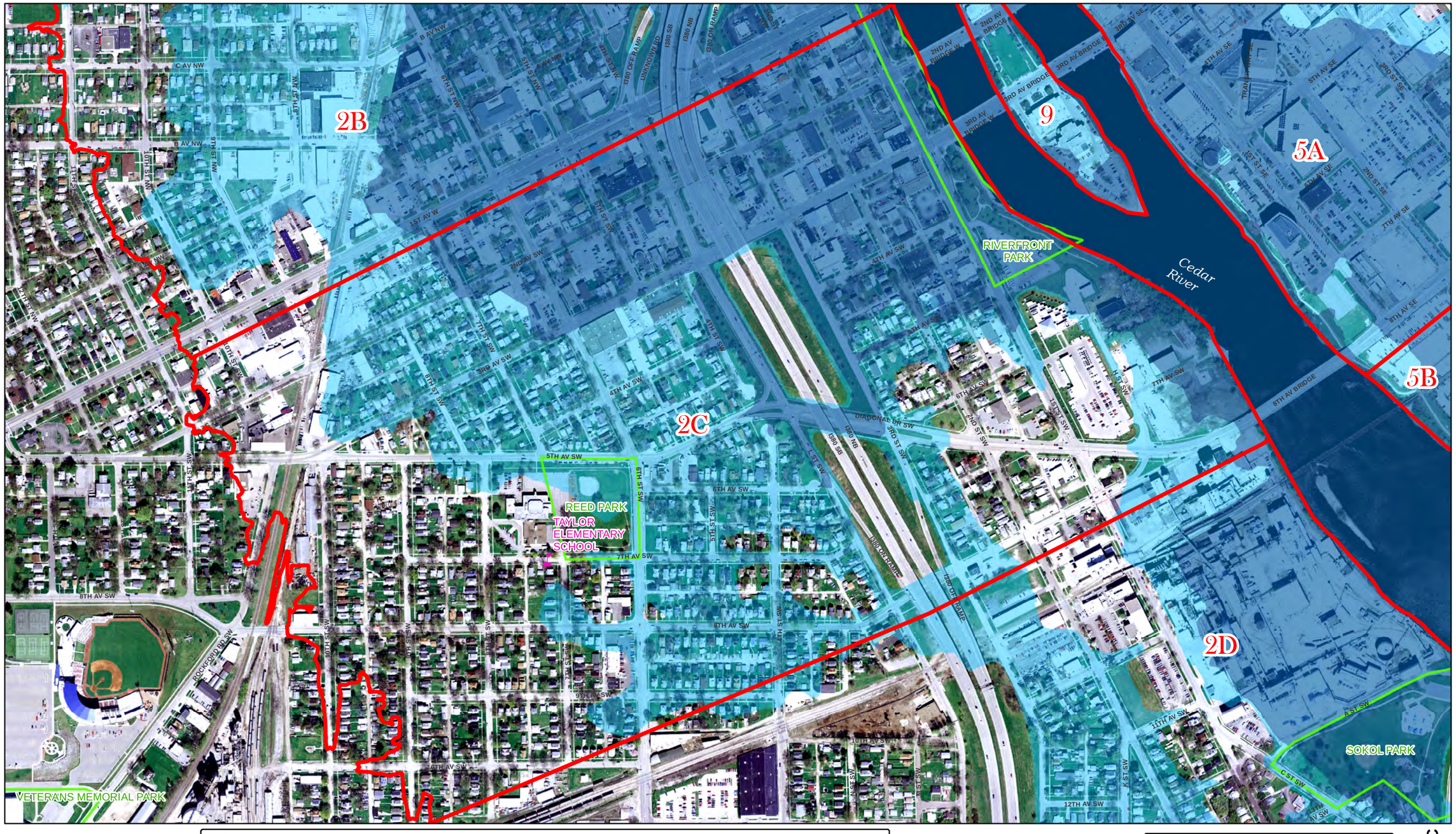
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 2B



LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 90 180 270 360 *Meters*

0 330 660 990 1,320 *Feet*

N S

US Army Corps of Engineers
Rock Island District

CRGIS

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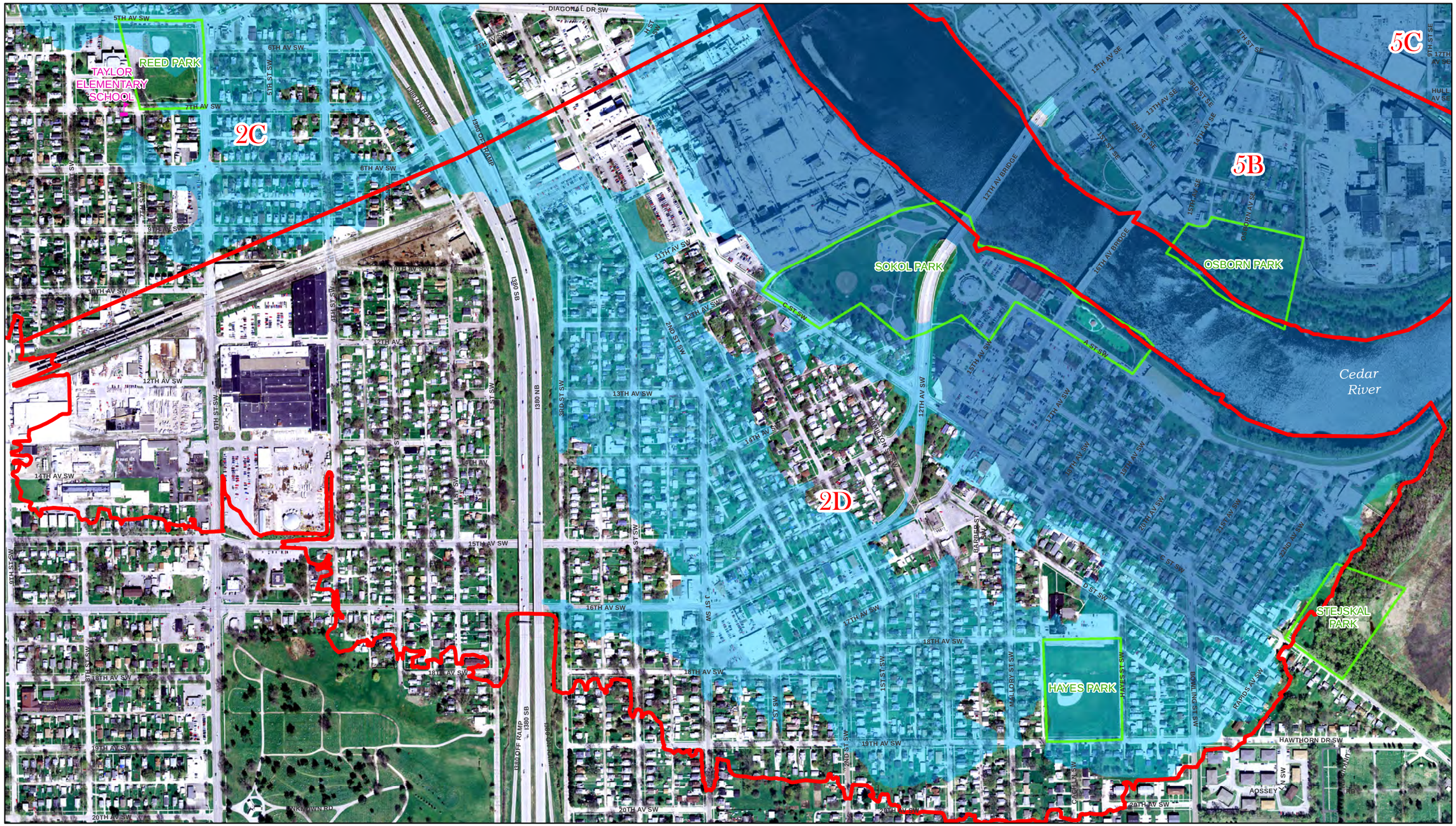
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 2C



LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 100 200 300 400 *Meters*

0 380 760 1,140 1,520 *Feet*

N S

US Army Corps of Engineers
Rock Island District

CRGIS

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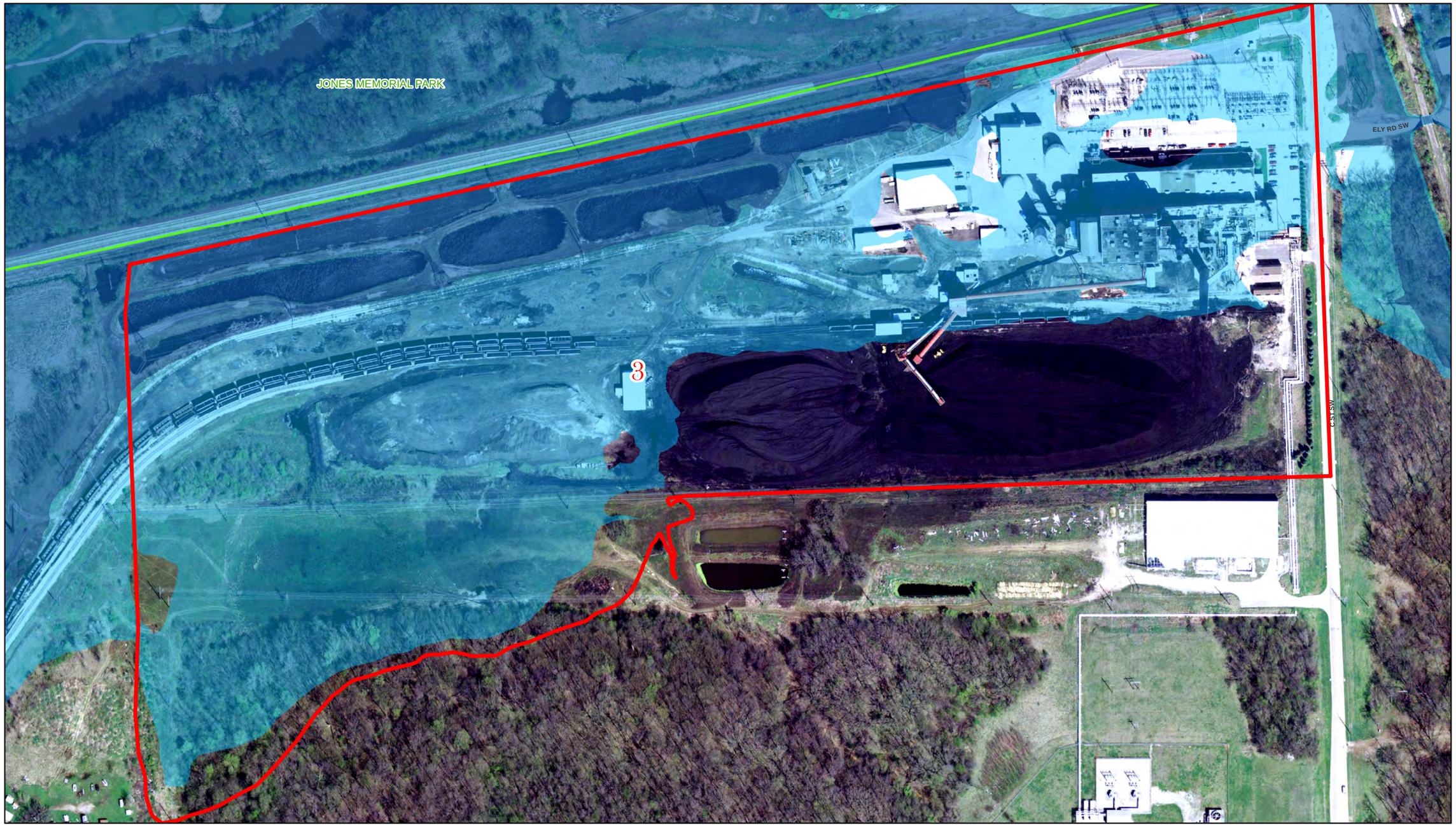
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 2D



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 40 80 120 160 *Meters*

0 160 320 480 640 *Feet*

N S

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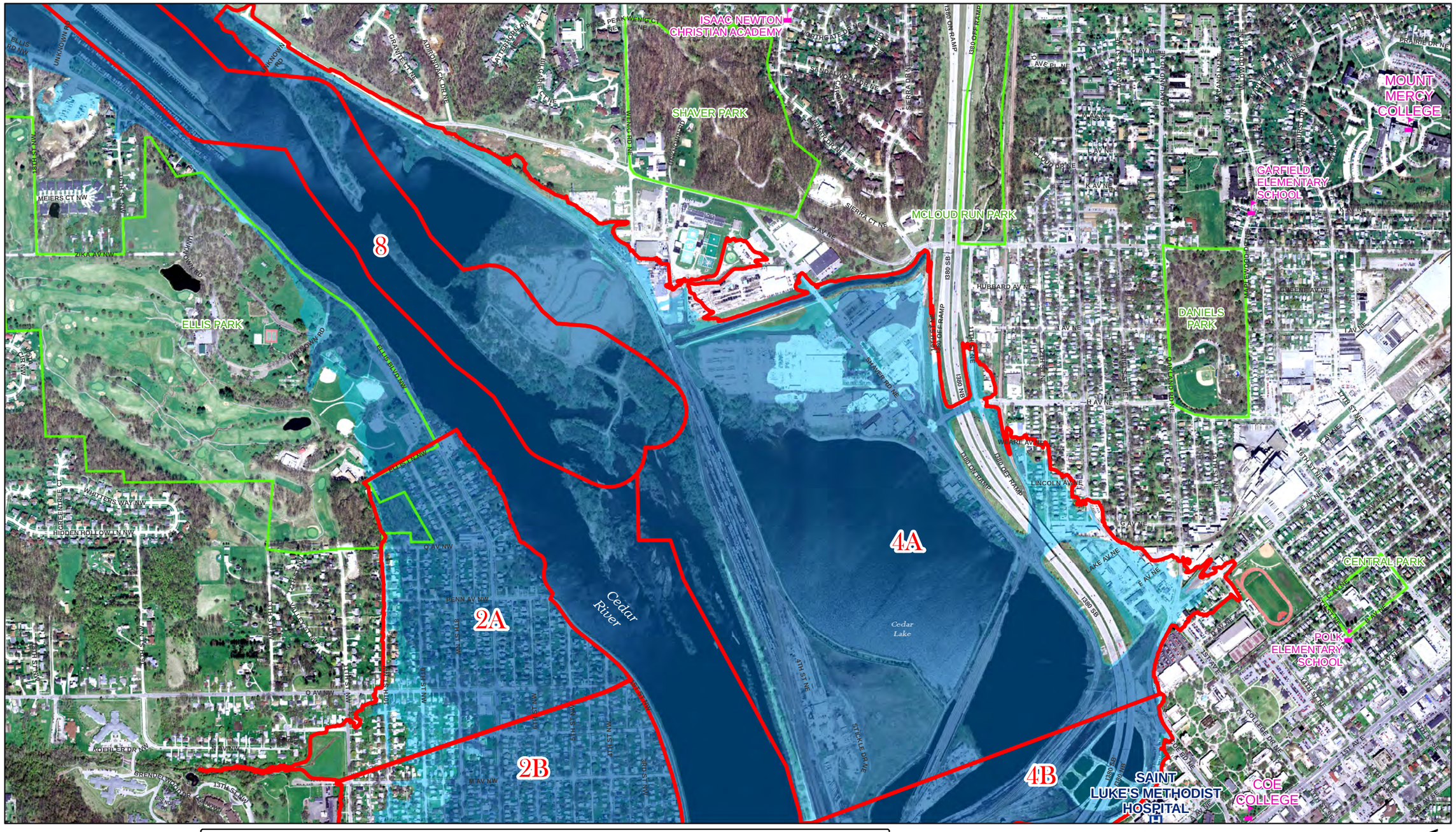
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 3



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

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Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 4A



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 80 160 240 320 Meters

0 325 650 975 1,300 Feet

N S

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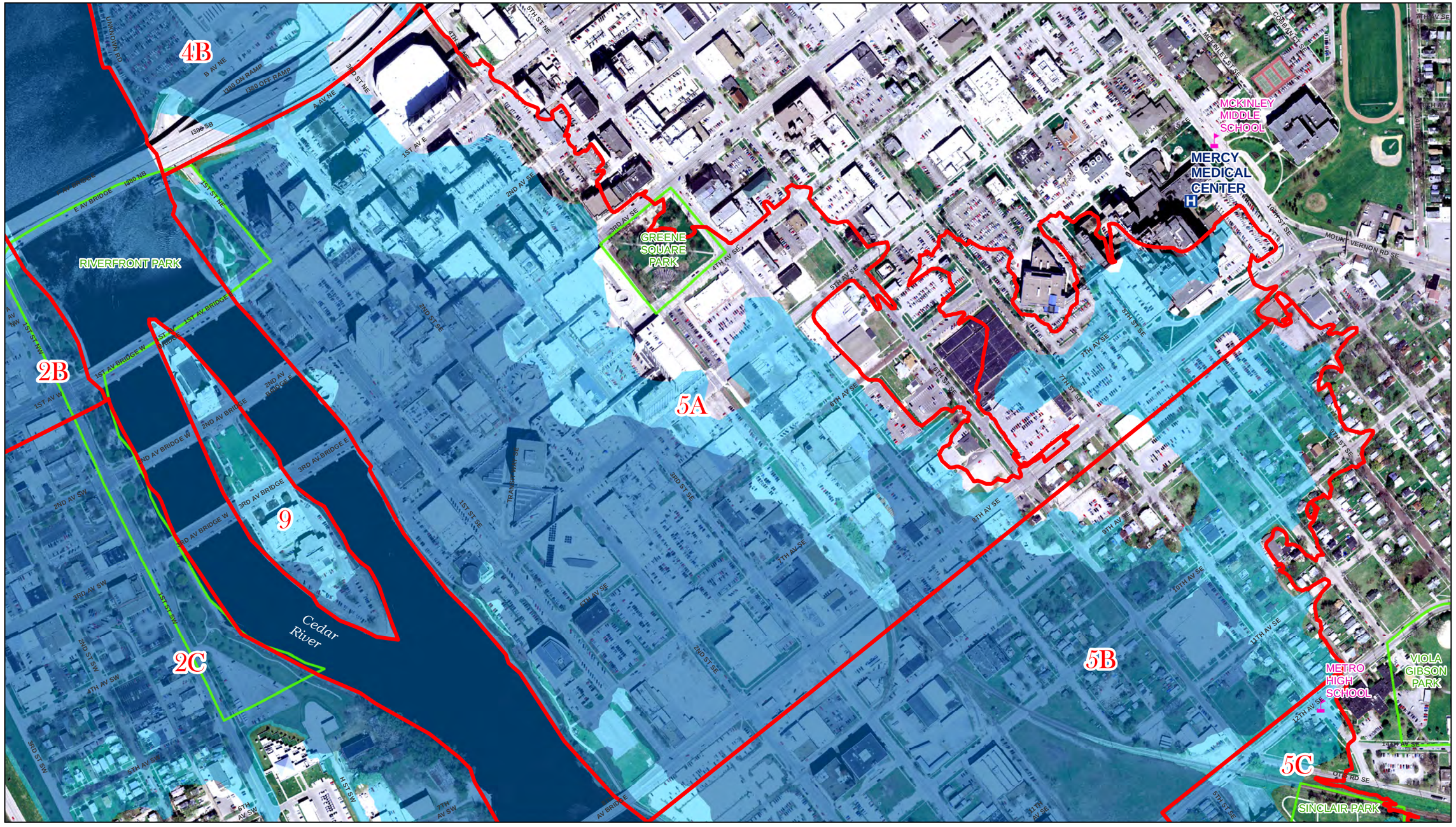
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 4B



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 80 160 240 320 Meters

0 325 650 975 1,300 Feet

N S

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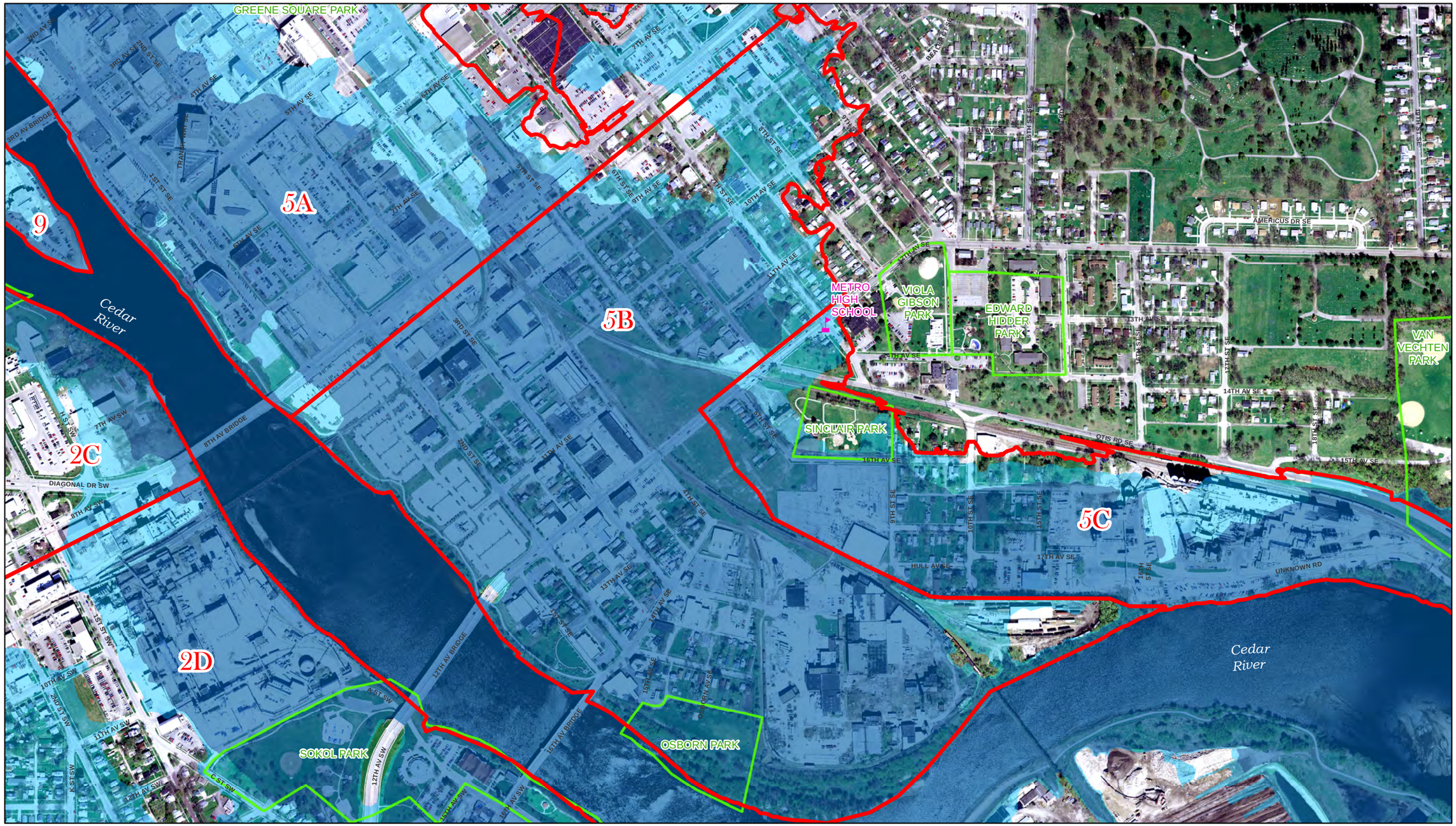
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 5A



LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 100 200 300 400 Meters

0 410 820 1,230 1,640 Feet

N S

US Army Corps of Engineers
Rock Island District

GRGIS

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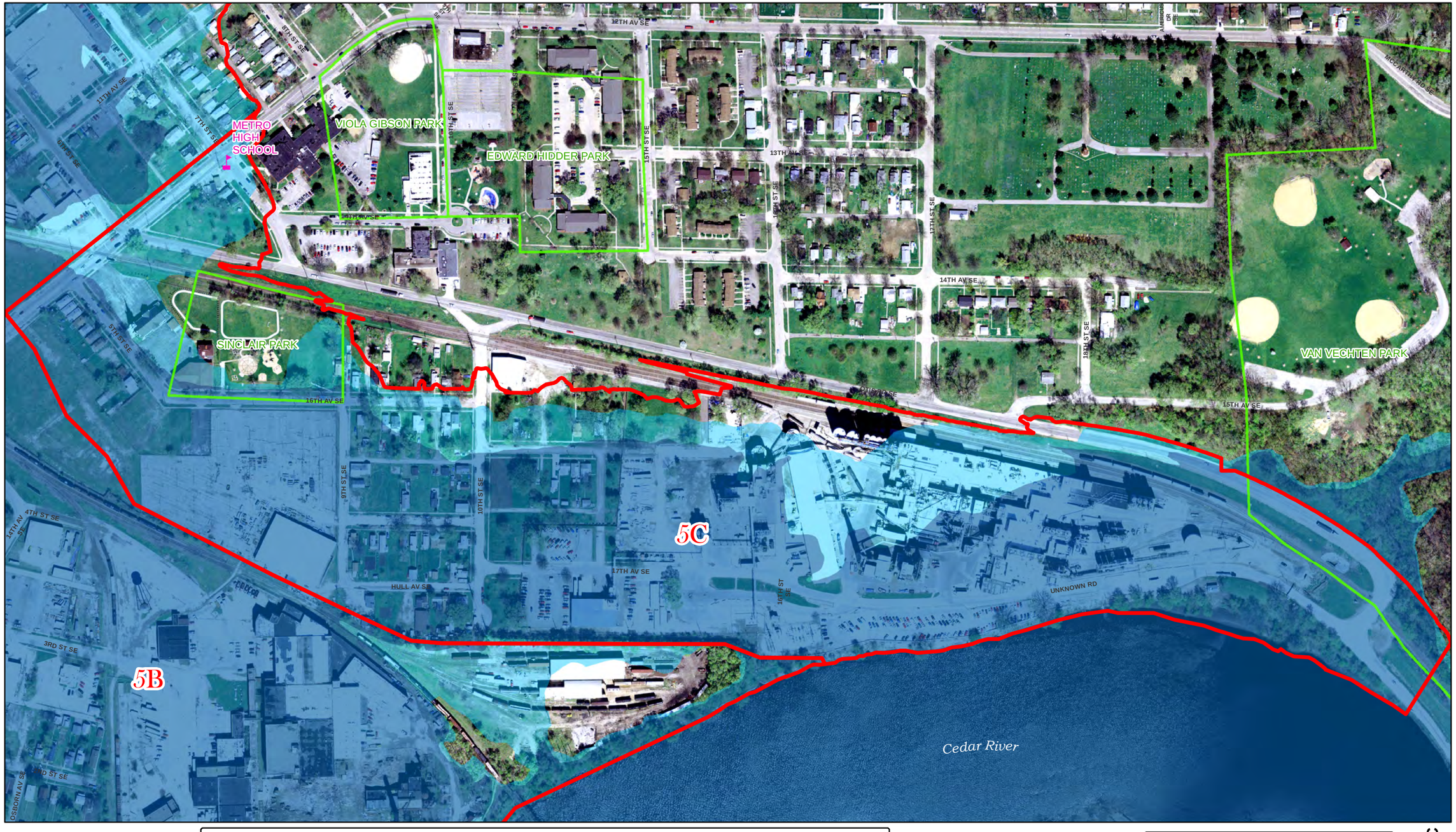
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 5B



US Army Corps of Engineers
Rock Island District

GRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 60 120 180 240 *Meters*

0 230 460 690 920 *Feet*

N S

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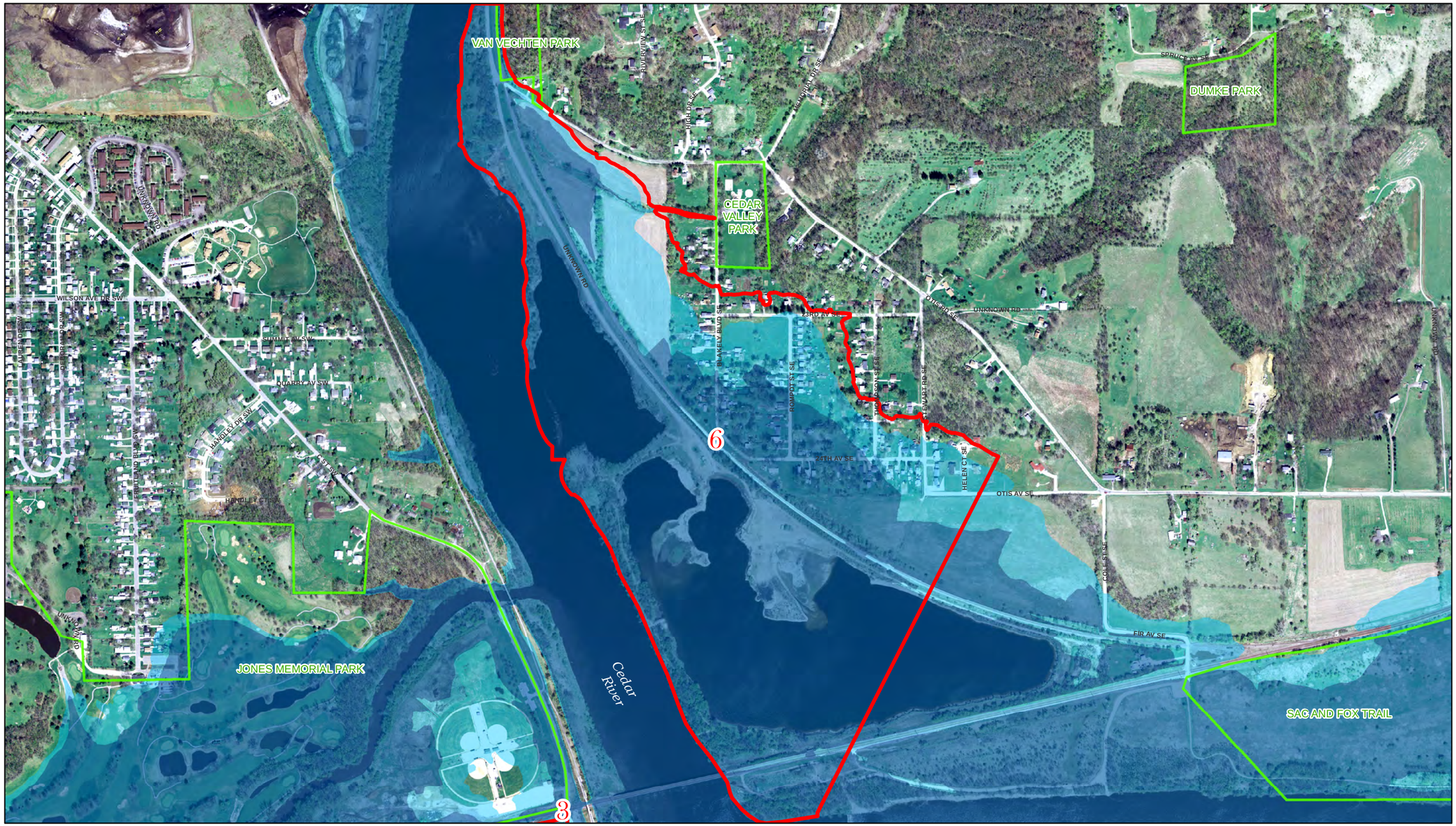
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 5C



LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 150 300 450 600 *Meters*

0 570 1,140 1,710 2,280 *Feet*

N S

US Army Corps of Engineers
Rock Island District

CRGIS

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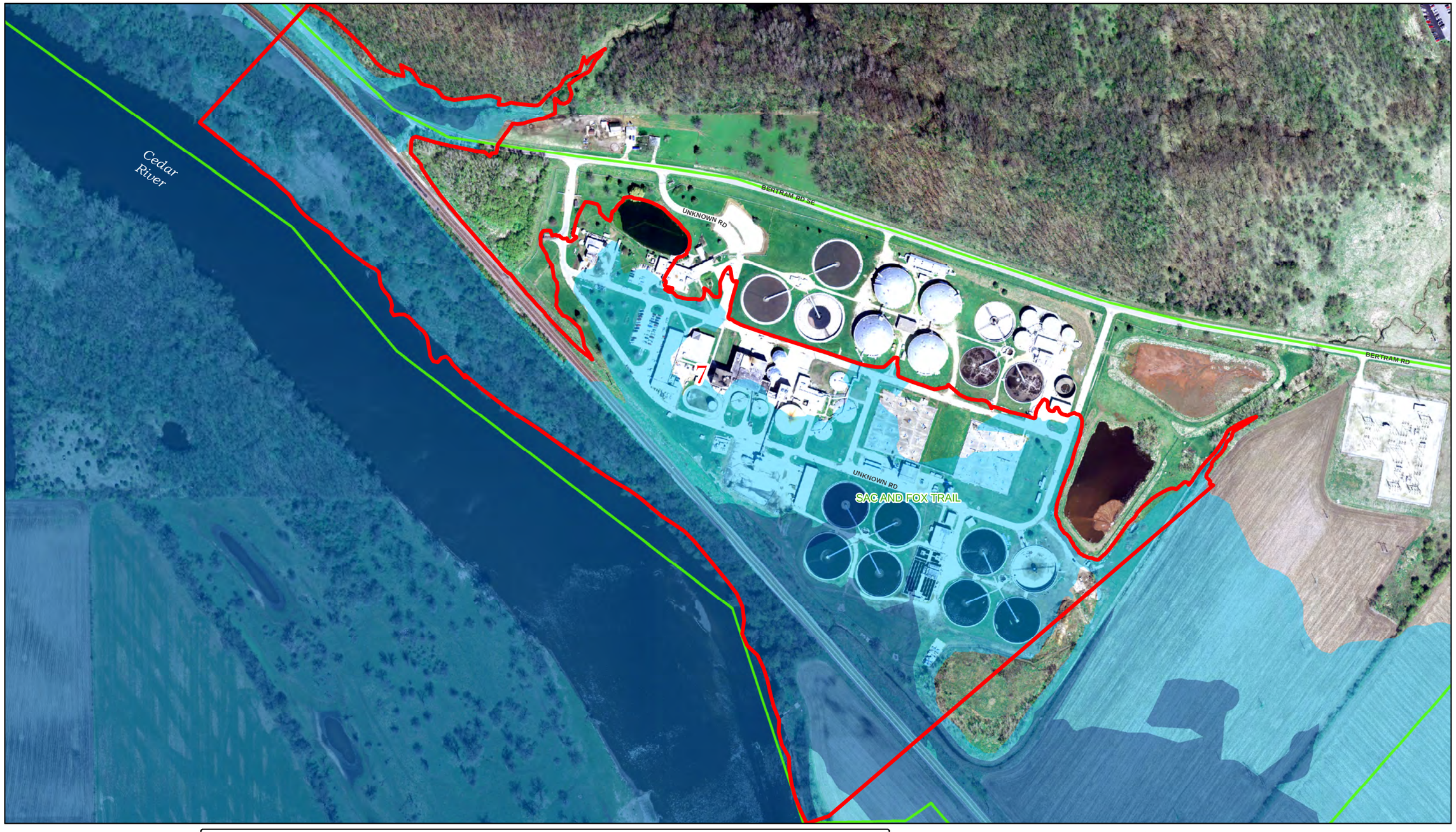
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 6



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 80 160 240 320 *Meters*

0 290 580 870 1,160 *Feet*

N S

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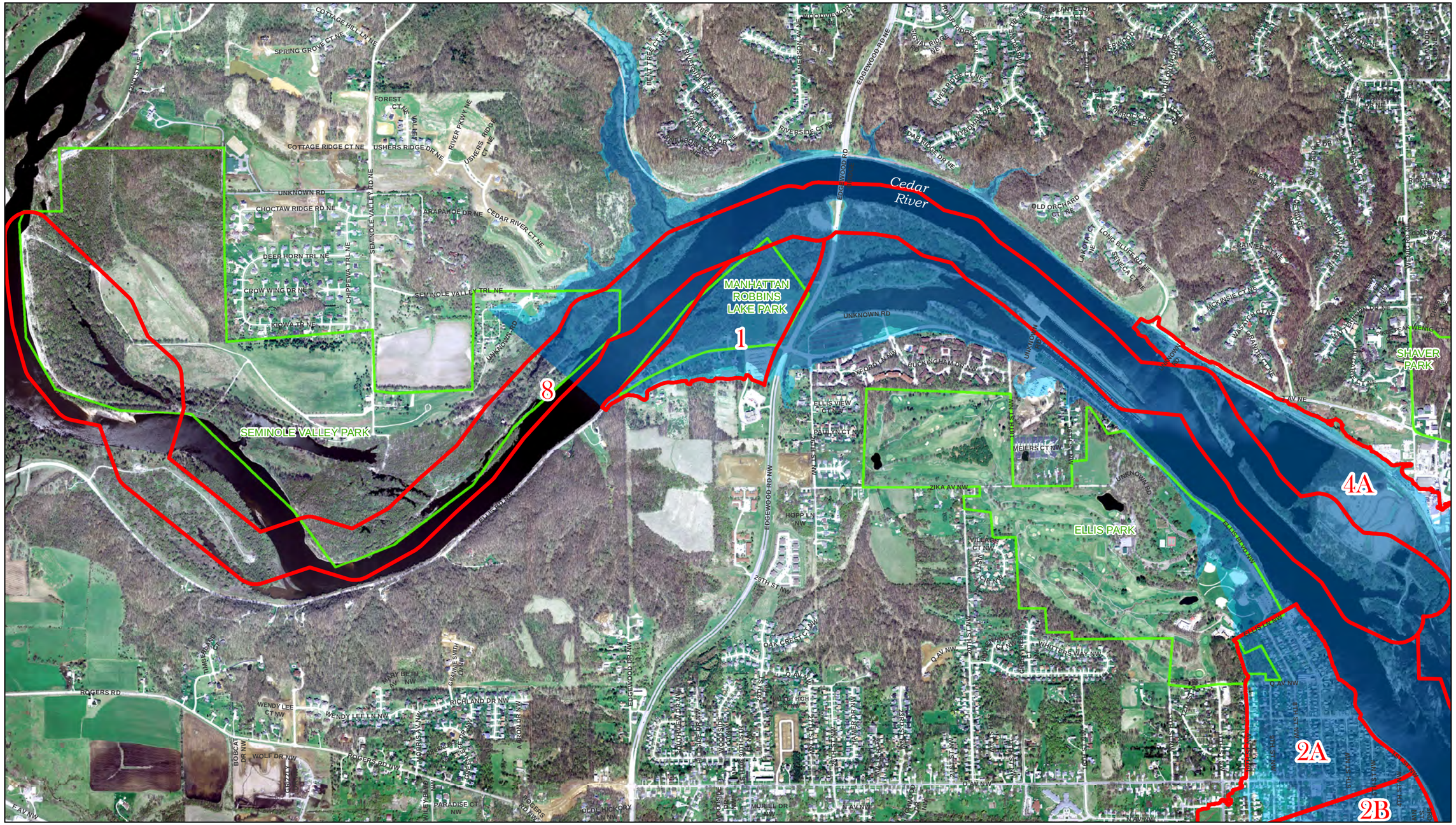
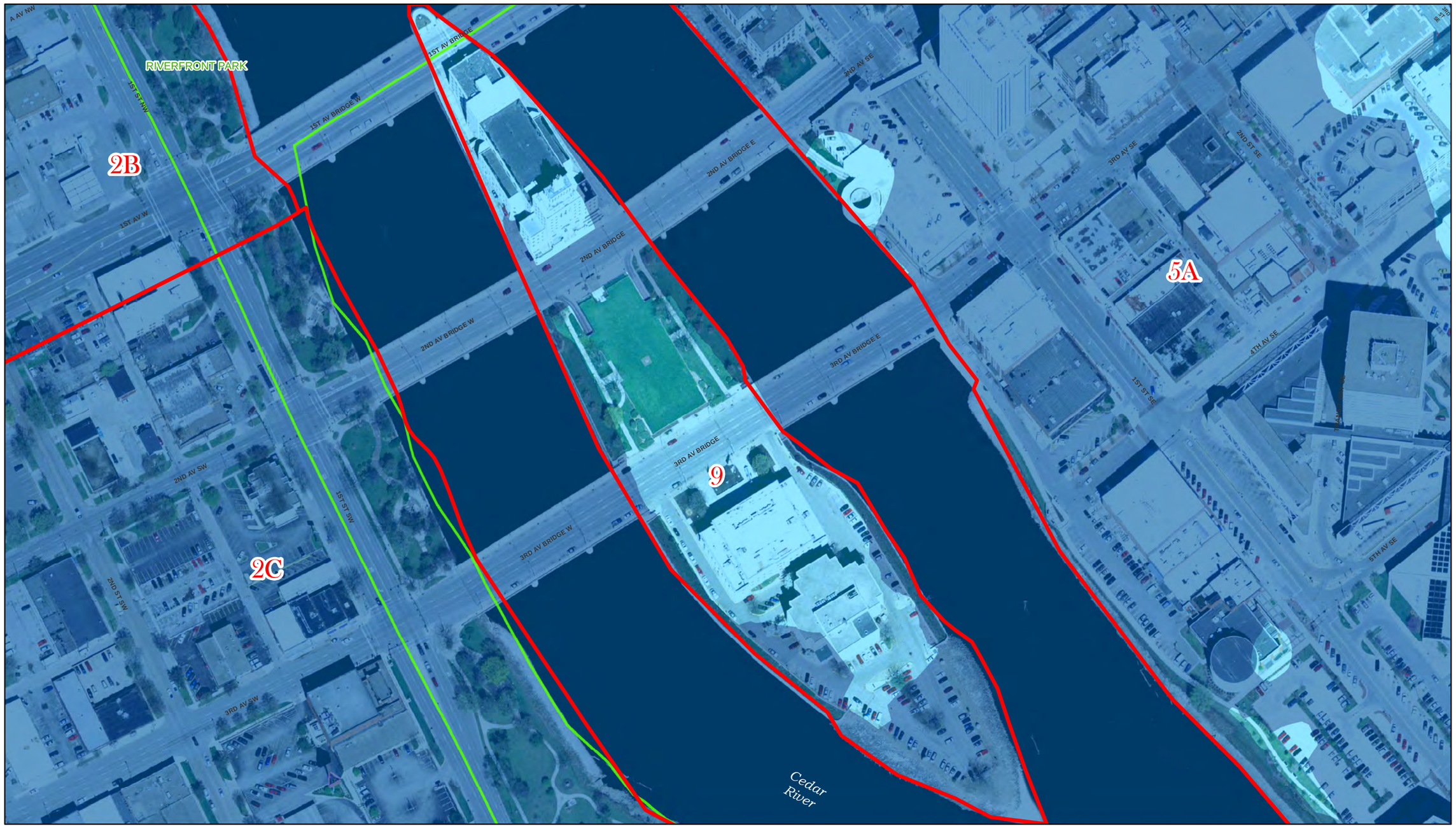
Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 7


Cedar River
MANHATTAN ROBBINS LAKE PARK
SEMINOLE VALLEY PARK
ELLIS PARK
SHAVER PARK
1
8
4A
2A
2B
COTTAGE HILL LN NE
SPRING GROVE CT NE
FOREST CT NE
VALLEY CT NE
COTTAGE RIDGE CT NE
USHERS RIDGE DR NE
RIVER PKWY NE
USHERS RIDGE CT NE
UNKNOWN RD
CHOCTAW RIDGE RD NE
ARAPAHOE DR NE
CEDAR RIVER CT NE
SEMINOLE VALLEY RD NE
DEER HORN TRL NE
CHIPPEWA TRL NE
CROW WING DR NE
IOWA TR NE
SEMINOLE VALLEY TRL NE
BENT TREE CT NE
RIVERSIDE DR NE
RIVERSIDE CT NE
WOODVIEW DR
EDGEWOOD RD NE
SIGNAL RIDGE NE
RIVER RIDGE DR NE
RIVER RIDGE CT NE
RIVERVIEW DR NE
RIVERVIEW CT NE
RIVERVIEW CIR NE
RIVERBLUFF DR NE
RIVERBLUFF CT NE
RIVERBEND DR NE
RIVERBEND CT NE
RIVERBEND CIR NE
RIVERBEND CT NE
RIVERBEND DR



US Army Corps of Engineers
Rock Island District

CRGIS

LEGEND

- Damage Reach
- Hospital
- Schools/Universities
- Parks

USACE Existing Condition Inundation Delineations

- 1% Probability
- .2% Probability

0 40 80 120 160 Meters

0 125 250 375 500 Feet

N S

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Economic Damage Reaches

Cedar River, Cedar Rapids, Iowa

FRM FS *26 March 2010*

REACH 9

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX C
PROGRAMMATIC AGREEMENT

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT

FINAL

APPENDIX C
PROGRAMMATIC AGREEMENT

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PROGRAMMATIC AGREEMENT AMONG THE UNITED STATES ARMY CORPS OF ENGINEERS, ROCK ISLAND DISTRICT, IOWA STATE HISTORIC PRESERVATION OFFICER, CITY OF CEDAR RAPIDS, AND ADVISORY COUNCIL ON HISTORIC PRESERVATION FOR ALTERNATIVE 4C IMPLEMENTED UNDER THE CEDAR RIVER, CEDAR RAPIDS, IOWA FLOOD RISK MANAGEMENT FEASIBILITY STUDY, LINN COUNTY, CEDAR RAPIDS, IOWA

WHEREAS, the United States Army Corps of Engineers Rock Island District (hereinafter Corps) and the City of Cedar Rapids, Iowa (hereinafter City) have commissioned the *Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa* (hereinafter, FRMFS), and proposed risk management (structural and nonstructural) measures in accordance with House Resolution Docket 2749 (General Investigations) adopted April 5, 2006, and Committee on Environment and Public Works U.S. Senate dated May 23, 2006; and,

WHEREAS, the Corps has identified Alternative 4C as described in the Cedar *River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment* as being the most fiscally prudent and viable alternative available under the FRMFS and has defined this alternative as the Undertaking for the purposes of this agreement; and,

WHEREAS, the Corps has determined that implementation of the Undertaking will result in activities that may affect properties listed on or eligible for listing on the National Register of Historic Places (hereinafter NRHP), and therefore has consulted with the Advisory Council on Historic Preservation (hereinafter ACHP), the Iowa State Historic Preservation Officer (hereinafter SHPO), the University of Iowa, Office of the State Archaeologist (hereinafter, OSA) and other interested parties hereinafter Parties, see Appendix A) pursuant to 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act [16 U.S.C. 470(f) and Section 110(f) of the same Act (16 U.S.C. 470h-2(f)]; and,

WHEREAS, the Corps recognizes the sovereignty of federally-recognized tribes and respects their expertise in identifying, interpreting, and assessing the religious and cultural significance of American Indian historic properties on and off of Tribal lands; and,

WHEREAS, in recognition of the unique government-to-government relationship between the federal government and the tribes, the Corps has notified the tribes (see Appendix A) of the Undertaking, and of the potential for effects that the Undertaking may have upon historic properties which may be of particular interest to them, and has invited the tribes to participate as concurring parties to this agreement, but none have responded; and,

WHEREAS, the Undertaking is complex in its scope and the Corps, in consultation with the SHPO, proposes a phased approach to identify and evaluate historic properties and to assess the magnitude of the Undertakings' effects upon them as allowed by 36 CFR 800.4(b)(2); and,

WHEREAS, the Corps has not fully determined the scope of activity and Areas of Potential Effects (hereinafter APE) for the Undertaking but will consult with the SHPO in a timely manner prior to implementation in order to determine the APE for all of the actions subject to the terms of this agreement, and shall document modifications to the APE throughout the duration of this agreement (Appendix B); and,

WHEREAS, the parties to this agreement have consulted to identify actions that have no effects to historic properties and upon defining qualifying criteria agree that no further consultation for these actions is necessary (Appendix C); and,

WHEREAS, the parties to this agreement have consulted to devise other streamlining procedures (Appendix C) that will allow the Undertaking authorized by this agreement to move forward in the most expeditious way as possible; and,

WHEREAS, the parties to this agreement have agreed to certain programmatic mitigation measures (Appendix D) but in so doing also recognize that not all effects can be mitigated programmatically and therefore have agreed to re-enter consultation in order to devise appropriate remedial measures when the need arises,

NOW, THEREFORE, the Corps, the SHPO, the City, and the ACHP agree that the Undertakings shall be implemented in accordance with the following stipulations of this Programmatic Agreement (PA) to satisfy the Corps' Section 106 responsibilities for the Undertaking.

STIPULATIONS

I. CORPS' AND CITY'S RESPONSIBILITIES

A. The Corps shall require the City by contract or permit requirement to follow the conditions set forth in this PA.

B. The Corps shall serve as the primary technical assistance contact for the City in matters concerning the interpretation of this agreement and the routine execution of its terms. The Corps, at its discretion, may consult directly with the SHPO and ACHP when issues of a complex nature arise.

C. The Corps and the City shall ensure that the procedures for project-specific consultation, historic properties identification and evaluation, assessment of effects, mitigation of adverse effects, and treatment of historic properties are implemented in accordance with procedures outlined in Appendices C and D.

D. The Corps and the City shall ensure that all historic properties investigations, evaluations, treatment plans, and data recovery efforts devised and conducted pursuant to this agreement shall be performed by or under the direct supervision of an individual that meets the Secretary of the Interior's Qualifications Standards (48 FR 44738-9, September 29, 1983); and, shall be performed in a manner that is consistent with Secretary of the Interior's Standards and the *Guidelines for Archaeological Investigations in Iowa*, and all other Federal or State standards as appropriate.

E. The Corps shall ensure that documentation submitted to SHPO for review meets or exceeds the standards outlined at 36 CFR 800.11. Pursuant to Section 304 of the Act (16 U.S.C. 470w-3) and Chapter 22 7(22) of the Iowa Code, the Corps and the City shall withhold from disclosure to the public information relating to the location or character of historic resources when it has been determined that disclosure of such information may create a substantial risk of harm, theft, or destruction to such resources or to the area or place where such resources are located.

F. The Corps and the City shall ensure that all archeological reports resulting from actions pursuant to this agreement shall be responsive to contemporary professional standards and to the Department of the Interior's Format Standards for Final Reports of Data Recovery Program (42 FR 5377-79). Precise location data should be provided only in a separate appendix if it appears that release of such data could jeopardize archeological deposits.

G. The Corps shall invite the participation of consulting parties in all activities authorized under this agreement as listed in Appendix C. (Note: The Corps must invite tribal consultation for all activities, even those excluded from SHPO review, unless a previous arrangement with individual or united tribes has been made). Parties that have a consultative role in the Section 106 process include, but are

not limited to, the following: federally-recognized Indian tribes; representatives of local governments; county and municipal historic preservation commissions including those established under the Certified Local Governments program; the Public; the National Trust for Historic Preservation; Preservation Iowa organization; and individuals and organizations who, due to the nature of their legal or economic relation to the Undertaking or their concern with the Undertaking's effects on historic properties, demonstrate a legitimate interest.

H. The Corps and the City shall ensure that all mitigation through archaeological data recovery is timed to occur *after* acquisition through purchase or condemnation at which time the Corps or the City will possesses free and clear title to archaeological material, records, and intellectual property that may be recovered.

I. The Corps shall ensure that artifacts, samples, and associated materials (ecofacts) recovered during data recovery mitigation from Federal lands, City-owned lands, and lands acquired through eminent domain shall be curated, along with all associated records, at a facility in the State of Iowa that meets or exceeds standards established at 36 CFR **§** 79. Artifacts recovered from private property belong to the property owner. The Corps and the City shall encourage landowners to donate items to an appropriate in-state institution for curation and/or exhibit.

II. THE IOWA STATE HISTORIC PRESERVATION OFFICER AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION RESPONSIBILITIES

A. The SHPO shall comment on all activities designated for its review in a timely and efficient manner and in accordance with procedures outlined in Appendix C.

B. The ACHP shall participate in cases in which dispute resolution among parties is required as indicated in Stipulation VI and in instances when the criteria for ACHP involvement in reviewing individual section 106 cases (36 CFR 800, Appendix A) are met.

III. UNANTICIPATED DISCOVERIES

A. Human Remains. Iowa law protects all human burials regardless of their historical age, sex, or cultural/ethnic affiliation. The Corps shall ensure that the following procedures are observed in the event that human remains are encountered during construction or archaeological investigations.

1. In the event that human remains or burials are encountered during archeological investigations or construction activities, work shall cease in the area, appropriate steps shall be taken to secure the site, and officials at the Corps, Burials Program at OSA and the SHPO shall be notified.

2. If the remains appear to be ancient (i.e., older than 150 years), the Burials Program at OSA shall have jurisdiction to ensure that the appropriate procedures in accordance with Chapter 263 of the Iowa Code are observed.

3. Human remains less than 150 years old are protected under Chapter 566 of the Iowa Code. In the event that human remains appearing less then 150 years in age are encountered, the Corps shall ensure that appropriate law enforcement authorities and the Iowa Department of Health be notified.

B. Archaeological Material (non-mortuary related). The Corps shall ensure that the following procedures are observed in the event that previously undetected non-mortuary-related archeological materials are encountered.

1. All activities in the area of the resource shall cease immediately, appropriate steps shall be implemented to secure the site, and the Corps and SHPO shall be notified of the discovery.

2. An archaeologist retained by the Corps or the City will inspect the work site and determine the extent of the affected archeological resource within 48 hours of its discovery. Construction work may then continue in the area outside the archeological resource as it is defined by the archaeologist in consultation with the SHPO.

3. Before work can resume in the area of any unanticipated discovery, the Corps must determine the NRHP eligibility of the archeological resource in consultation with the SHPO.

4. Upon a determination of eligibility, the Corps shall submit a plan for avoidance, protection, recovery of information, or destruction without data recovery to the SHPO for review and comment. The Corps will notify all consulting parties of the unanticipated discovery and provide the proposed treatment plan for their consideration. The SHPO and consulting parties will have seven (7) calendar days to provide comments on the proposed treatment plan upon receipt of the information. The Corps may implement the proposed treatment plan if SHPO fails to respond within the allotted timeframe.

5. Work in the affected area shall resume upon either:

a. The development and implementation of an appropriate data recovery plan, other recommended mitigation procedures, or agreement among the Corps and the SHPO that the site does not warrant mitigation; or,

b. Agreement by the SHPO and the Corps that the newly located archeological materials are not eligible for inclusion on the NRHP.

C. Adverse Effects upon Architectural Properties. The Corps and City shall ensure that the following procedures are observed in the event that post-review effects to historic buildings, objects, or districts are identified.

1. Work in the affected area shall cease and the Corps shall notify the SHPO of the discovery.

2. An architectural historian retained by the City or Corps will inspect the work site and determine the extent and magnitude of the effects upon the property within 48 hours of its discovery. The Corps shall provide its determination of effect and report of the consulting historian's findings to the SHPO who shall have seven (7) calendar days to provide comments.

3. Upon assessment of adverse effect, the Corps shall submit a plan for after-the-fact mitigation to the SHPO for review and comment. The Corps will notify all consulting parties of the unanticipated discovery and provide the mitigation proposal for their consideration. The SHPO and consulting parties will have seven (7) calendar days to provide comments on the mitigation proposal upon its receipt. The Corps may implement the proposed mitigation plan if SHPO fails to respond within the allotted timeframe.

4. Work in the affected area shall resume upon either upon:

a. Agreement by the Corps and the SHPO that the effects are not adverse; or,

b. The development and implementation of an appropriate mitigation plan, or agreement among the Corps and the SHPO that the site does not warrant mitigation.

IV. DISPUTE RESOLUTION

Should any signatory to this Agreement object to any action carried out or proposed by the Corps with respect to the implementation of this Agreement, the Corps shall consult with that signatory party to resolve the objection. If the Corps, after initiating such consultation determines that the objection cannot be resolved, the Corps shall forward documentation relevant to the objection to the ACHP, including the Corps' proposed response to the objection. Within forty-five (45) calendar days after receipt of all pertinent documentation, the ACHP shall exercise one of the following options:

A. Advise the Corps that the ACHP concurs with the Corps' proposed final decision, whereupon the Corps shall respond accordingly; or

B. Provide the Corps with recommendations, which the Corps shall take into account in reaching a final decision regarding its response to the objection; or

C. Notify the Corps that the objection will be referred to the ACHP for formal comment and proceed to refer the objection and comment within forty-five (45) days. The resulting comment shall be taken into account by the Corps in accordance with 36 CFR § 800.7(c)(4).

D. If the Corps and the SHPO (and, as appropriate, the THPOs/Tribes) do not agree on NRHP eligibility, or if the ACHP or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the NRHP, National Park Service, whose determination shall be final. Should the ACHP not exercise option A, B, or C within forty-five (45) calendar days after receipt of all pertinent documentation, the Corps may assume the ACHP's concurrence with its proposed response to its objections. The Corps shall take into account any ACHP recommendation or comment provided in accordance with this stipulation with reference to the subject of the objection; the Corps' responsibility to carry out all actions under this Agreement that are not the subjects of the objection shall remain unchanged.

V. DURATION

This agreement will become void if its terms are not carried out within ten (10) years from the date of its execution. Prior to such time, the Corps may consult with the other signatories to reconsider the terms of the agreement and amend it in accordance with Stipulation VII. The terms of this Agreement shall remain in-force for a period of ten (10) years commencing at the date of its execution. At the end of this period the Corps shall review the necessity of this Agreement in order to determine whether it should be reissued or allowed to expire. If the Agreement requires reissue, the Corps shall consult with the SHPO in order to ensure compliance with the most current version of the federal regulations (36 CFR Part 800) implementing Sections 106 and 110(f) of the Act.

VI. TERMINATION

Any of the signatories to this PA may request a reconsideration of its terms or revoke the agreement upon written notification to the other signatories by providing 30 days notice to the other Parties, provided that the Parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR § 800.3 through § 800.7 with regard to individual actions covered by this Programmatic Agreement.

VII. AMENDMENTS

Any of the signatories to this PA may request that any or all of its articles be amended subsequent to the PA's execution, whereupon the other signatories will consult in accordance with 36 CFR Part 800.13, to consider such amendment. The Corps must notify the ACHP of its intent to amend the Agreement and invite the ACHP's review and comment. The amendment will be effective on the date a copy signed by all of the signatories is filed with the ACHP. The Corps shall ensure that copies of the amended Agreement are provided to all of the signatories. Revisions to the appendices shall not require notification of and review by the ACHP. However Corps shall ensure that the ACHP is provided file copies of finalized versions that reflect all revisions. The Corps shall follow the above procedures for amendment in the event that the Undertaking is redefined by the selection of a different alternative or through the adoption of multiple alternatives. Revisions to the appendices shall not require notification of and review by the Council. The Appendices to the PA can be changed with co-concurrence by the Corps, the City of Cedar Rapids and the SHPO. However, the Corps shall ensure that the Council is provided file copies of finalized versions that reflect all revisions.

VIII. PERIODIC REVIEW

The Corps will provide the SHPO, City, CRHPC, OSA, and ACHP with evidence of compliance with this PA by letter on January 30, 2011, and once every year thereafter. This letter shall contain the name of the Undertaking; title of the documents which contained the PA; historic properties identified; determinations of effect; avoidance procedures; and level of investigation(s) and/or mitigation(s) conducted with titles of all reports related to such investigation(s) and/or mitigation(s) which have been completed. Nothing in this PA is intended to prevent the Corps from consulting more frequently with the signatories or other consulting parties concerning any questions that may arise or on the progress of any actions falling under or executed by this agreement.

IX. EXECUTION OF THE AGREEMENT

Execution of this agreement by the U.S. Army Corps of Engineers, Rock Island District; the Iowa State Historic Preservation Officer; the City of Cedar Rapids; and the Advisory Council on Historic Preservation and the implementation of its terms evidence that the Corps has taken into account program effects on historic properties and has afforded the Advisory Council on Historic Preservation an opportunity to comment.

PRINCIPAL SIGNATORIES

ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS

BY: _____ Date: 10 OCT 10

Shawn P. McGinley
Colonel, US Army
Commander and District Engineer

IOWA STATE HISTORIC PRESERVATION OFFICER

BY: Barbara A. Mitchell Date: 4 Oct 2010

Ms. Barbara A. Mitchell
Deputy Iowa State Historic Preservation Officer
State Historical Society of Iowa

CITY OF CEDAR RAPIDS

BY: _____ Date: 10-5-2010

The Honorable, Ron Corbett, Mayor
City of Cedar Rapids and City Council

As attested by:

_____ Date: 10/5/10

~~Mr. Casey Drew~~
~~City Finance Director~~ Jeffrey Pomeranz
City Manager

ADVISORY COUNCIL ON HISTORIC PRESERVATION

BY: John M. Fowler Date: 10/12/10

Mr. John M. Fowler
Executive Director
Advisory Council on Historic Preservation

CONCURRING SIGNATORIES

THE UNIVERSITY OF IOWA

BY: _____ Date: 10-4-2010

Mr. John F. Doershuk, Ph.D, RPA
State Archaeologist
Office of the State Archaeologist

CITY OF CEDAR RAPIDS

BY: _____ Date: 10/5/10

Ms. Maura Pilcher
Chair
Historic Preservation Commission

APPENDIX A

INTERESTED AND CONSULTING PARTIES LIST

Pursuant to 36 CFR § 800.2(d), § 800.3, § 800.5(c), and § 800.6(a)(2), § 800.8(c)(1)(iv) of the NHPA and to meet the responsibilities under the National Environmental Policy Act of 1969 Act (NEPA) (42 U.S.C. 4321-4335) , the Corps and the City have developed an Interested and Consulting Parties List comprised of 28 individuals from government organizations or agencies, 14 THPOs/Tribes, and 4 other interested parties The Corps will comply with any requests to be removed from, or added to, the Interested and Consulting Parties List and will continue to develop and maintain the following Interested and Consulting Parties List:

AGENCIES , SOCIETIES, AND INDIVIDUALS

Ms. June Strand
ATTN: Review and Compliance Program
State Historical Society of Iowa
Capitol Complex
Des Moines, IA 50319

Mr. Thomas McCullouch
c/o Mr. Don L. Klima, Director
Eastern Office of Project Review
Old Post Office Building
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NW. Suite 809
Washington, DC 20004

Mr. Jerome Thompson
Administrator and SHPO
State Historical Society of Iowa
600 East Locust Street
Des Moines, IA 50319-0290

Mr. Tim Weitzel
Historic Preservation Specialist
Community Development Division
Iowa Department of Economic Development
PO Box 686
Iowa City, IA 52244-0686

Ms. Sylvia Rose Augustus
Regional Historic Preservation Officer
General Services Administration
1500 East Bannister Road, #2135
Kansas City, MO 64131

Mr. Daniel Higginbottom, Archeologist
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Mr. Jeff Carr
Lead Historic Preservation Specialist
FEMA, Iowa Recovery Center
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Urbandale, IA 50323-2317

Mr. Mike Smith, Assistant General Counsel
Midwest Office National Trust for Historic Preservation
53 W. Jackson Boulevard, Suite 350
Chicago, IL 60604

Ms. Jennifer Sandy
Midwest Office
National Trust for Historic Preservation
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University of Iowa
Iowa City, IA 52242-1030

Ms. Lois Coulter
Crew Leader, Special Considerations (Historical)
FEMA Historic Preservation Specialist
FEMA Iowa Recovery Center
4149 - 120th Street
Urbandale, IA 50323

Ms. Gail Naughton, President/CEO
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One Research Plaza
Marion, IA 52302

Ms. Robyn Rieckhoff
Executive Director of the Czech Village/
New Bohemia Main Street District
101 16th Avenue SW
Cedar Rapids, IA 52404

Mr. Thomas Moore, Executive Director
African American Museum of Iowa
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Cedar Rapids, IA 52402

Mr. Peter Jorgensen
Silos & Smokestacks National Heritage Area
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Waterloo, IA 50704-2845

Mr. Adam Lindenlaub
Long-Range Planning Coordinator
Corridor MPO
Cedar Rapids' Department of Community Development
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Cedar Rapids, IA 52402

Ms. Maura Pilcher, Chair
Cedar Rapids Historic Preservation Commission
Department of Community Development
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Cedar Rapids, IA 52402-3851

Mr. Rod Scott, President
Preservation Iowa
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Cedar Rapids, IA 52401

Mr. Ken DeKeyser
PE CPESC
Cedar Rapids Public Works Department
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Cedar Rapid, IA 52404

Ms. Rita Rasmussen
Real Estate
1201 6th Street SW.
Cedar Rapid, IA 52404

Mr. Stephen J. Krug, ASLA
Cedar Rapids Parks & Recreation Department
Landscape Architect
3601 42nd Street NE
Cedar Rapids, IA 52402

Mr. Daniel Gibbins, City Arborist
Cedar Rapids Public Works Department
3601 42nd Street NE
Cedar Rapids, IA 52402

Mr. Dave Smith
Parks and Recreation
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Cedar Rapids, IA 52402

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Historic Preservation Specialist
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US Department of Homeland Security
FEMA Region VII
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Dr. David Benn
Bear Creek Archeology, Inc.
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Cresco, IA 52136

Ms. Pay Cargin
Cedar Rapids Preservation Com
Cedar Rapids, IA 52403

Mr. Joe Thompson
Bear Creek Archeology
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Mr. Adrain Stroupe
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Ms. Jennifer Pratt
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Mr. Jack Porter-Preservation Consultant
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National Trust for Historic Preservation
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Mr. Benton Quade
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Architectural Historian for Disaster Relief Efforts
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Des Moines, IA 50319

Mr. Richard Luther
Cultural and Historical
City of Cedar Rapids
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Ms. Barbara Wyatt
National Register of Historic Places
National Park Service
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Washington, D.C. 20005

Ms. Justine Christianson, Historian
Historic American Engineering Record
1201 Eye Street NW. 2270
Washington, DC 20005

Ms. Kristen O'Connell
National Park Service
Historic American Engineering Record
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Washington, DC 20005

Mr. Dana Lockett, Architectural Project Manager
National Park Service
Historic American Engineering Record
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Washington, DC 20005

Ms. Peggy Whitworth
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Ms. Sandi Fowler, Assistant to the City Manager
City of Cedar Rapids
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Cedar Rapids, IA 52402

Mr. Patrick Roberts
Flood Assistance Team
Community Development
Iowa Department of Economic Development
200 East Grand Avenue
Des Moines, IA 50309

TRIBES

Iowa Tribe of Kansas and Nebraska

Mr. Leon Campbell, Chairman
Iowa Tribe of Kansas
3345 Thrasher Road # 8
White Cloud, KS 66094

Mr. Alan Kelly
Iowa Tribe of Kansas and Nebraska
204 South Buckeye
Salina, KS 67410

Iowa Tribe of Oklahoma

Ms. Christie Modlin, Chairwoman
Iowa Tribe of Oklahoma
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Perkins, OK 74059

Menominee

Mr. David J. Grignon, Tribal Historic Preservation Officer
Menominee Indian Tribe of Wisconsin
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Keshena, WI 54135-0910

Sac and Fox of Oklahoma

Mr. George Thurman, Principal Chief
Sac & Fox Nation of Oklahoma
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Stroud, OK 74079

Ms. Sandra Massey
Sac & Fox Nation of Oklahoma
Route 2, Box 246
Stroud, OK 74030

Sac and Fox of Missouri

Mr. Twen Barton, Chairman
Sac & Fox Nation of Missouri
305 North Main Street
Reserve, KS 66434

Mr. Edmore Green
Sac & Fox Nation of Missouri
305 North Main Street
Hiawatha, KS 66434

Sac and Fox of Iowa

Mr. Adrian Pushetonequa, Chairman
Sac & Fox Tribe of Mississippi in Iowa
349 Meskwaki Road
Tama, IA 52339

Mr. Jonathan Buffalo
Sac & Fox of the Mississippi
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Tama, IA 52339

Ho Chunk Nation of Wisconsin

Mr. Wilfrid Cleveland, President
Ho-Chunk Nation
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Black River Falls, WI 54675

Mr. Larry Garvin
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
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Black River Falls, WI 54615

Mr. William Quackenbush
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
P.O. Box 667
Black River Falls, WI 54615

Winnebago

Mr. John Blackhawk, Chairman
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, NE 68071

Mr. Charles Aldrich
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, NE 68071

Otoe-Missouria Tribe of Oklahoma

Mr. Charles Michael Harwell, Chairman
Otoe-Missouria Tribe of Oklahoma
8151 Highway 177
Rock Road, OK 74651

Ms. Mildred Hudson
Otoe-Missouria Tribe of Oklahoma
8151 Highway 177
Rock Road, OK 74651

Yankton Sioux

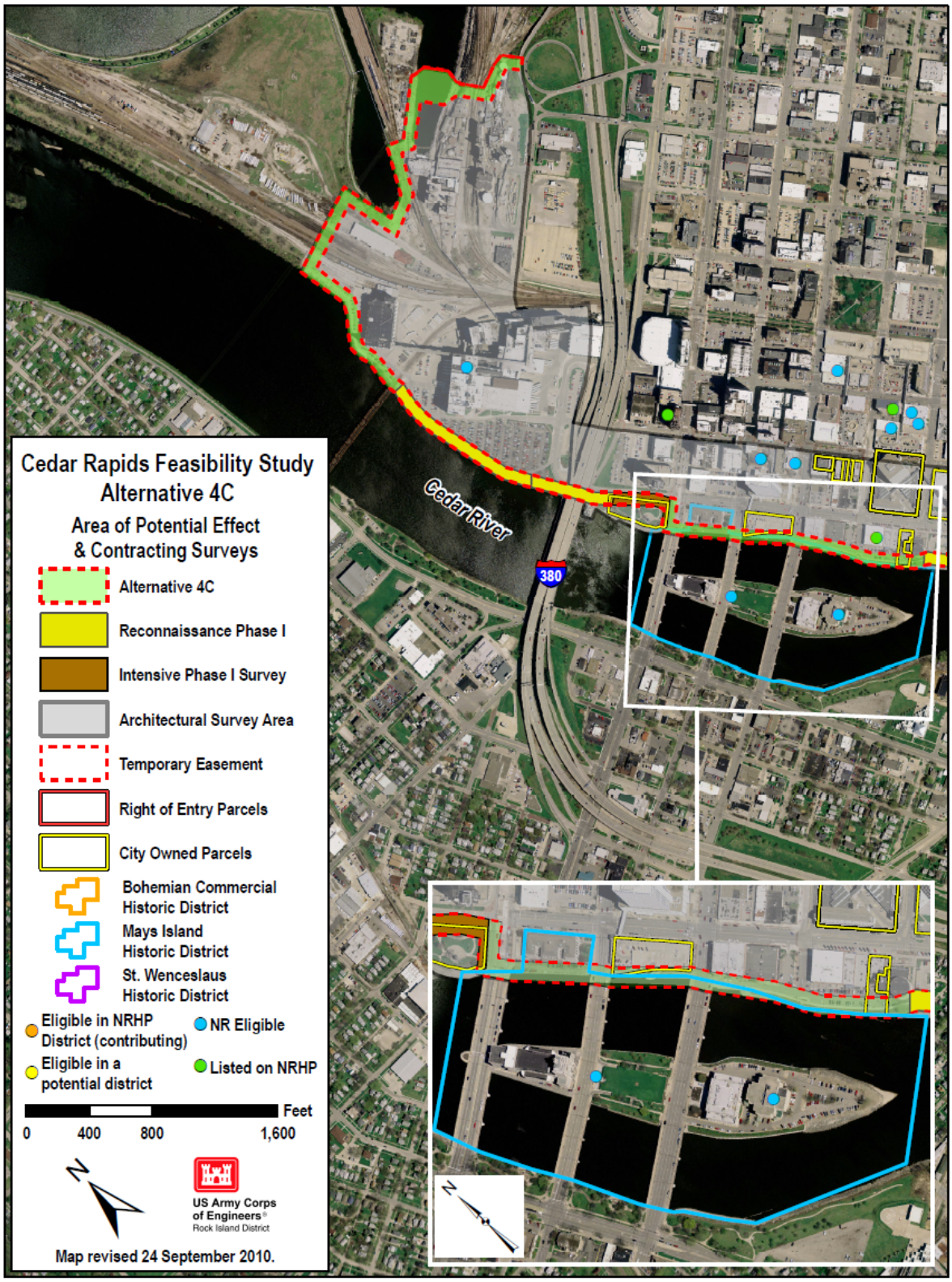
Ms. Lana M. Gravatt
Yankton Sioux Tribal Historic Preservation Office
Box 248
Marty, SD 57361

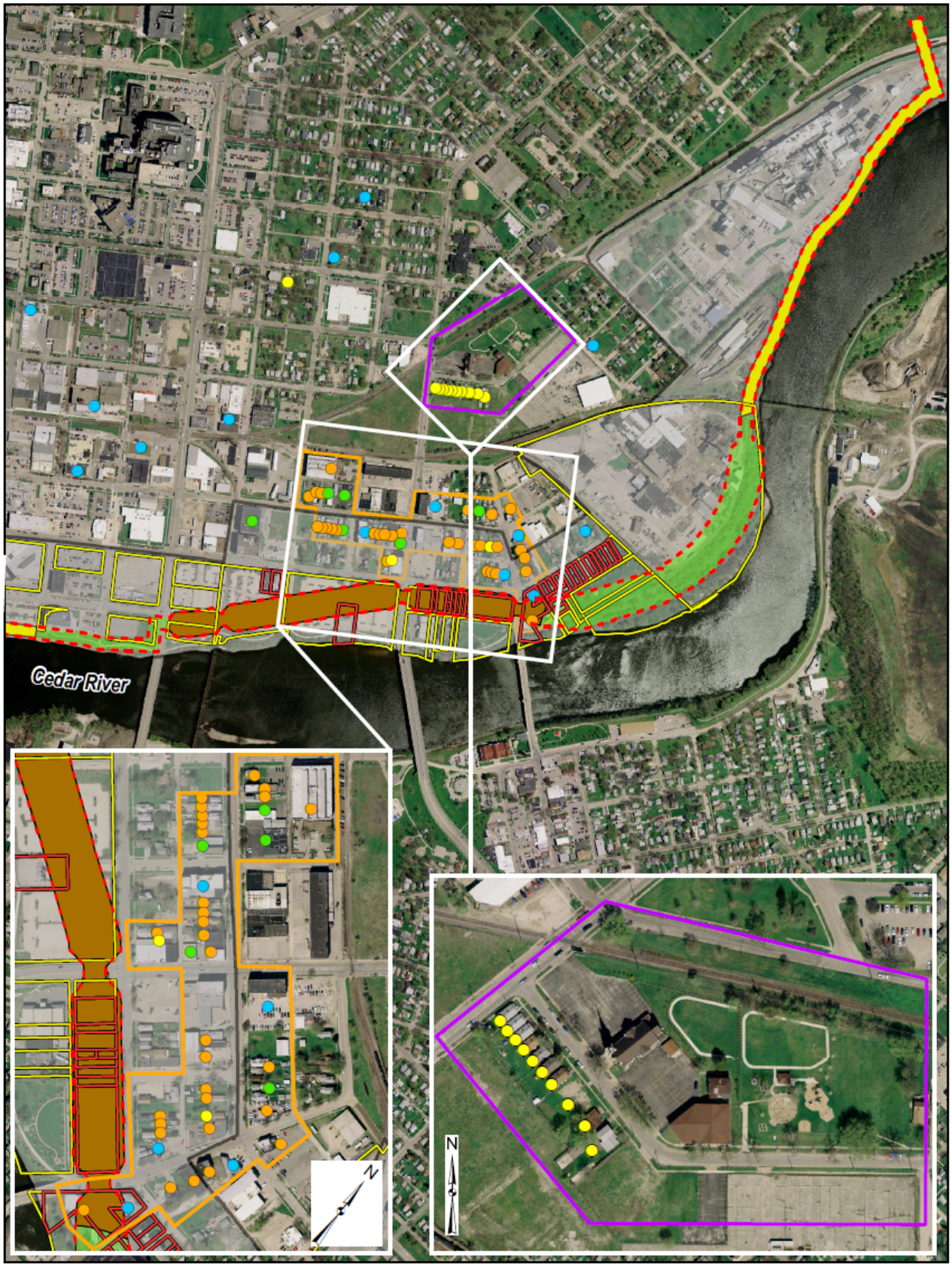
Mr. Robert Cournoyer, Chairman
Yankton Sioux
P.O. Box 248
Marty, SD 57361

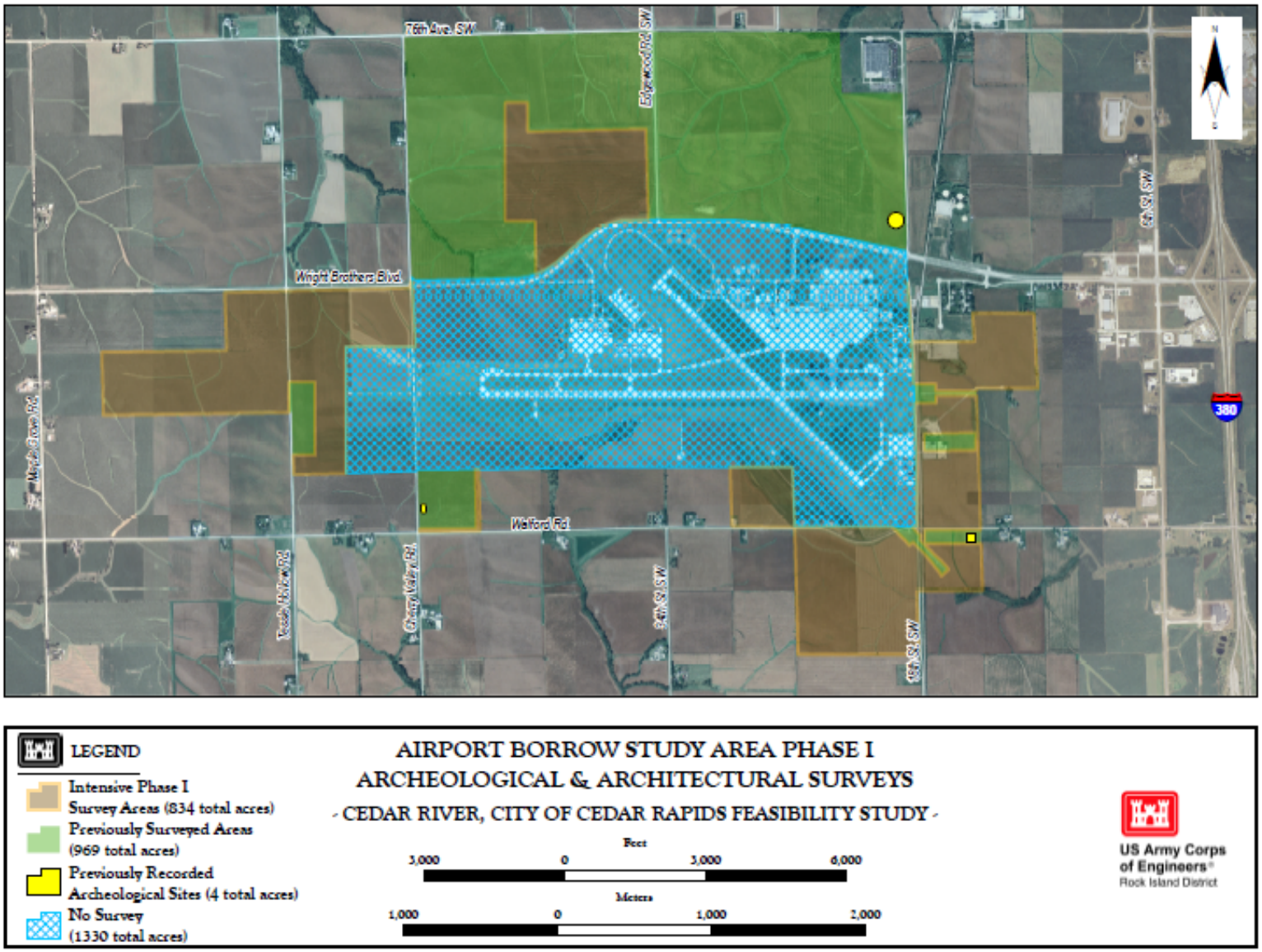
Mr. Francis Berney
Yankton Sioux
P.O. Box 248
Marty, SD 57361

APPENDIX B

AREA OF POTENTIAL EFFECT




Cedar River
N
N


76th Ave. SW
Edgewood Rd. SW
Wright Brothers Blvd
Walford Rd
Maple Grove Rd
Teeple Hollow Rd
Cherry Valley Rd
94th St. SW
15th St. SW
6th St. SW
380
LEGEND
Intensive Phase I Survey Areas (834 total acres)
Previously Surveyed Areas (969 total acres)
Previously Recorded Archeological Sites (4 total acres)
No Survey (1330 total acres)
AIRPORT BORROW STUDY AREA PHASE I
ARCHEOLOGICAL & ARCHITECTURAL SURVEYS
- CEDAR RIVER, CITY OF CEDAR RAPIDS FEASIBILITY STUDY -
Feet
3,000 0 3,000 6,000
Meters
1,000 0 1,000 2,000
US Army Corps of Engineers
Rock Island District

APPENDIX C

HISTORIC PROPERTIES IDENTIFICATION AND PROCEDURES FOR PROJECT REVIEW

I. HISTORIC PROPERTY SURVEYS AND TESTING

The Corps will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for inclusion in the NRHP, including but not limited to burials, cemeteries, or sites likely to contain human skeletal remains, artifacts, or objects associated with interments or religious activities, and provide this information, and associated studies or reports to the OSA and SHPO through the implementation of historic property surveys and testing, and agreed upon treatments of historic properties. The Corps will ensure that the following measures are implemented:

A. The Corps will provide scholarly evidence of stewardship in the recordation, protection, and management of historic properties within the City through systemic research and studies which have been finalized and approved, then placed in the permanent files of the SHPO as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 C.F.R. Part 800: "Protection of Historic Properties." Furthermore, the Corps will make a reasonable and good faith effort to carry out appropriate identification efforts under § 800.4(b)(1).

B. Unless non-historic, profound ground surface disturbances can be documented, the Corps will conduct necessary surveys on all areas indirectly and directly affected by construction, use, maintenance, and operation of all flood protection management measures (flood proofing, as well as structural measures that modify flood behavior, such as dams, reservoirs, levees, walls, diversion channels, bridge modifications, channel alterations, pumping, and land treatment) for the reduction or elimination of flood damages during the implementation of the FRMFS preferred alternative along with the project related activities. The Corps will evaluate historic properties relative to past surveys and reports and properties deemed ineligible based upon the evaluation of the most recent survey within the last five years will not be reevaluated. If a survey results in the identification of properties that are eligible to the NRHP, the Corps, in consultation with the SHPO, Tribe(s), THPO(s), and/or Parties, shall develop and implement plans for the appropriate treatment of historic properties.

C. All surveys will be conducted in a manner consistent with the Secretary of the Interior's *Standards and Guidelines for Identification and Evaluation* (48 FR 44720-23) and take into account the National Park Service publication *The Archaeological Survey: Methods and Uses* (1978) and any extant or most recent version of the *Guidelines for Archaeological Investigations in Iowa* (1999). The reconnaissance surveys and subsurface testing will be implemented by the Corps, reported, and the reports will be provided to the SHPO for review and comment.

D. In consultation with the SHPO, and, as appropriate, the THPOs/Tribes, the Corps shall evaluate for eligibility all properties by applying the NRHP criteria (36 CFR **§** 60.4).

1. For those properties that the Corps and the SHPO (and, as appropriate, the THPOs/Tribes) agree are not eligible for nomination to or inclusion in the NRHP, no further historic properties investigations will be required, and the project may proceed in those areas.

2. If the survey results in the identification of properties that the Corps and the SHPO (and, as appropriate, the THPOs/Tribes) agree are eligible for inclusion on the NRHP, such properties shall be treated in accordance with Stipulation II. *Treatment of Historic Properties*.

II. TREATMENT OF HISTORIC PROPERTIES

The Corps will adhere to the following guidelines when dealing with historic properties in the APE.

A. Avoidance. The preferred treatment for all archeological, historical, and architectural historic properties is avoidance of direct and indirect effects resulting from the Undertaking. The Corps shall, to the extent feasible, avoid historic properties either through project design changes, use of temporary fences or barricades during construction, realignments, landscaping, or other measures that SHPO agrees will adequately protect historic properties in both the short and long-term.

B. Reduction of Effects on Properties Preserved in Place. When the Corps determines that complete avoidance of historic properties is not feasible, the Corps shall explore ways to reduce the extent of the adverse effects on the properties. Exploration of ways to reduce adverse effects will include the consideration of preservation of historic properties or the protection of historic properties against impacts by project-related activities in close proximity to the property.

C. Alteration/Floodproofing. The Corps shall ensure that alterations to historic buildings or structures required for floodproofing (a combination of changes and/or adjustments incorporated in the design and/or construction and alteration of individual buildings, structures or properties subject to flooding primarily for the reduction or elimination of flood damages) adhere to the recommended approaches in the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitation*. The floodproofing shall also meet the applicable City ordinances, standards, and regulations. The Corps shall coordinate proposed floodproofing plans with the SHPO, City, CRHPC, and Parties and take their comments and recommendations into consideration when deciding on the treatment plan.

D. Mitigation Plans. When the Corps, in consultation with the SHPO (and, as appropriate, the THPOs/Tribes), determines that project activities will have an adverse effect on buildings, structures, sites, districts, or objects, and that avoidance or in-place preservation is not feasible, the Corps shall ensure that a mitigation plan is developed for these properties in accordance with Appendix D of this PA.

E. Treatment Plans. Unless the SHPO (and, as appropriate, the THPOs/Tribes) objects within 30 days of receipt of any plan, the Corps shall ensure that the treatment plans are implemented by the Corps or its representative(s). The Corps shall revise treatment plans to address comments and recommendations provided by the SHPO and THPOs/Tribes so long as the Corps, SHPO, and THPOs/Tribes can agree that they are technically feasible and economically prudent. Should the Corps and SHPO not agree, the Corps will request the ACHP's comments in accordance with Stipulation IV, *Dispute Resolution* of this PA.

F. Buildings and Structures. When avoidance or in-place preservation is not feasible, treatment plans for NRHP listed or eligible buildings and structures shall adhere to the following guidelines:

1. Acquisition

a. The buildings or structures located within the proposed levee and floodwall construction corridors shall be acquired by the City as part of their obligations under this flood protection Project Partnership Agreement.

b. Once an historic building or structure has been acquired by the City and prior to any further actions on the building, the Corps will document the building or structure in accordance with Appendix D Section C.1 of this PA with the understanding that documentation may not represent the only mitigation measure employed in resolving the adverse effect.

2. Relocation. The Corps shall determine, in consultation with the SHPO, City, CRHPC, and Parties, whether it is feasible and prudent to move the historic building or structure to a new location where it can be preserved. Adverse effects upon a structure or building contributing to a Historic District will include consideration of effects to the structure or building, as well as to the entire Historic District.

3. Property Transfer/Marketing. Any sale and removal/demolition of an historic structure that is leveraged by the Undertaking becomes part of the Undertaking and is subject to the terms of this agreement. Any purchase agreement between the City and a perspective buyer must stipulate preservation and maintenance of those qualities that make the structure historic.

4. Demolition. If relocation is not feasible or if there are no offers for the historic building or structure and no other prudent and feasible creative alternatives present themselves, the Corps will notify the SHPO and shall document the building or structure in accordance with Stipulation IV. *Mitigation of Adverse Effects to Historic Properties*, Section C.1.

5. Levee/Floodwall Construction. Construction proposed for the flood protection management measures on or adjacent to a significant historic property or historic district (including those properties deemed eligible to be, or listed on the NRHP), the Corps shall ensure that the design and specifications for new construction are developed in consultation with the SHPO and CRHPC and are submitted to the SHPO for final approval. The Corps shall ensure that the project design for new construction is technically feasible and economically prudent; is compatible with the historic and architectural qualities of the historic property or district in question in terms of style, scale, massing, color, and materials; and is responsive to the recommended approaches to new construction set forth in the *Secretary of the Interior's Standards for Rehabilitation* (National Park Service 1983). The Corps acknowledges that the flood protection management measures of Alternative 4C have not been fully finalized and may change or be modified since economical, operational, engineering, and environmental studies are ongoing. The Corps will therefore determine effects as directed under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 C.F.R. Part 800: "Protection of Historic Properties." Also, the Corps will:

a. consider the Undertakings direct and indirect effects within the APE, such as all construction areas, including the construction zones of footprints of the proposed levees, floodwalls, and/or any other flood protection management measures, plus road raises, tieback levees, drainage diversions, reservoirs, municipality modifications, borrow areas and any other project-related features and ancillary features proposed.

b. consider and coordinate with the SHPO, areas with the potential for containing submerged historic properties.

c. consider areas where the City selects flood risk management measures or betterments to the Corps' proposed flood risk management measures (National Economic Development Plan), and if those alternatives or betterments become part of the Undertaking, that they will be included under this PA.

H. Archeological Data Recovery. The Corps and the City shall ensure that any significant archaeological site whose preservation in place is not feasible and that is eligible to the NRHP is subject to data recovery, based on a data recovery plan developed in consultation with the ACHP, SHPO, and THPOs/Tribes and subject to a 30-day review and comment period. All data recovery

plans shall be consistent with the *Secretary of the Interior's Standards and Guidelines for Archeological Documentation* (48 FR 44734-37), the *Guidelines for Archaeological Investigations in Iowa* (1999), and take into account the ACHP's publication: *Treatment of Archeological Properties.* Each data recovery plan shall specify, at a minimum

1. the property, properties, or portions of properties where data recovery is to be carried out;

2. the research questions to be addressed through the data recovery, with an explanation of their relevance and importance;

3. the methods to be used, with an explanation of their relevance to the research questions;

4. the methods to be used in analysis, data management, and dissemination of data, including a schedule;

5. the proposed disposition of recovered materials and records in accordance with Stipulation I.I;

6. proposed methods for involving the interested public in the data recovery; and

7. a proposed schedule for the submission of progress reports to the Iowa SHPO, the ACHP, and, where applicable, concerned Tribes and Parties.

I. Historic Properties of Traditional Religious and Cultural Significance

1. If a property of traditional religious and cultural significance to Tribes to Tribes and/or any other groups, or societies is identified within the APE, the Corps shall develop a treatment plan for that property in consultation with the Tribe or Parties that could be affected by Corps proposed activity at the specific historic site or property involved. The plan will cover analysis of treatment options and selection of a recommended treatment for the property and the measures which will be undertaken by the Corps to ensure that the plan is implemented.

2. The Corps shall submit the final plan to the SHPO and to the affected Tribe or Parties and shall implement the plan in accordance with the procedures outlined in the plan, if formal objections are not received within 30 days following its distribution.

3. Should a formal objection to the final plan be submitted within 30 days following its distribution, the Corps, the SHPO, and the affected Tribe(s) shall attempt to resolve the objection. If the Corps, the SHPO, and the affected Tribe(s) have not resolved the objection within 90 days, the Corps shall request the comments of the ACHP in accordance with Stipulation X., *Dispute Resolution*.

APPENDIX D

PROGRAMMATIC MITIGATION OF EFFECTS

PROCEDURES

A. The Corps shall provide the SHPO, THPOS/Tribes, and Parties with letter reports summarizing the alternatives considered to avoid, minimize, or mitigate adverse effects to affected properties. The SHPO and Parties may request that the Corps consider other alternatives to avoid, minimize or mitigate adverse effects.

B. After the Corps, SHPO, and other Parties as appropriate agree on a proposed alternative to mitigate adverse effects, the Corps, in consultation with the SHPO will develop a Mitigation Agreement to memorialize the mutually agreed upon strategy. Once the Corps and these parties have finalized the Mitigation Agreement in letter format and received concurrence from the SHPO, and, as appropriate, the THPOs/Tribes, a copy will be filed with the ACHP and CRHPC. The Corps shall ensure that all provisions set forth in each Mitigation Agreement will be carried out.

C. Standard mitigation measures to be considered include, but are not limited to, the following (arranged in order of preference):

1. Transfer or Conveyance with Preservation Covenants. Should a NRHP property determined to be a candidate for conveyance; signatories shall consult with the SHPO for the appropriate treatment to ensure preservation of the property.

The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the NRHP, sources of funding for historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation of historic properties, the Corps and the City, in consultation with the SHPO and the CRHPC, shall develop a plan to transfer and convey the historic property with a covenant. The Corps and the City shall submit the covenant to the SHPO and CRHPC for review, comment, and execution. If the appropriate preservation is deemed to be permanent, the City will provide and enforce a preservation easement.

2. Documentation

a. The Corps shall consult with the SHPO regarding the appropriate level of documentation prior to the substantial alteration, relocation, or demolition of any historic building or structure. Documentation shall be consistent with the *Secretary of the Interior's Standards for Architectural and Engineering Documentation* and the *Secretary of the Interior's Standards for Historical Documentation*.

b. Unless otherwise agreed to by the SHPO in a Mitigation Agreement, the Corps shall ensure that all documentation is completed and accepted by the SHPO prior to the demolition, alteration, or relocation of the historic building or structure.

c. The Corps will provide copies of the documentation to the SHPO, THPOs/Tribes, and CRHPC, and other local, county, or state organizations in which the SHPO and CRHPC designate.

3. Transfer or Conveyance Without Preservation Covenants. In instances where the historic properties will not be conveyed or transferred with preservation covenants, the Corps shall record these properties to Historic American Building Survey standards or to a level agreed upon with the SHPO. The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the

NRHP, sources of funding for significant historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation of historic properties, the Corps and the City, in consultation with the SHPO and CRHPC, shall develop a plan to transfer and convey significant historic property without covenants. Preservation Iowa and the CRHPC shall be included as consultation parties involving the preservation in place, removal, demolition of any historic structure.

4. Mitigation for Archeological Sites Eligible Other than or in Addition to Criterion D. If preservation in place is not feasible, the Corps shall consult with the SHPO, THPOs/Tribes, and Parties to develop a mitigation plan for any archeological site that is eligible to the NRHP under criteria other than, or in addition to, criterion D of 36 C.F.R. Part 60. The Corps shall submit the plan to the SHPO and THPOs/Tribes for review and comment.

5. Off-Site Mitigation for the Loss of a Historic Property. The Corps may preserve similar property types or sites outside APE as mitigation for properties that cannot be preserved in place due to requirements of flood risk management measures. The Corps, THPOs/Tribes, and the SHPO will consult to determine if off-site preservation is suitable mitigation and to develop appropriate easements, covenants and other legal instruments for the protection of such off-site properties, if off-site preservation is undertaken. Prior to the demolition of historic properties within the APE, the Corps, in consultation with the SHPO, THPOs/Tribes, and Parties, shall consider the appropriateness of developing an off-site mitigation plan to compensate for the loss of historic properties. The Corps shall submit the plans to the SHPO for review and comment.

6. Alteration and Flood Risk Management Measures Not Adhering to the Standards. The Corps shall consult with the SHPO to develop alternate treatment or mitigation plans for those features which cannot meet the *Secretary of the Interior's Standards for Rehabilitation*. The Corps shall submit these plans to the SHPO for review and comment.

7. Other Mitigation Strategies. The Corps, SHPO, THPOs/Tribes, City, CRHPC, and Parties shall consult to devise other mitigation strategies in instances where those included in this agreement do not satisfactorily mitigate adverse effects to historic properties. It may be necessary to develop separate Mitigation Agreements of effects on specific historic properties.

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX D
U.S. FISH AND WILDLIFE SERVICE
COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
1511 47th Avenue
Moline, Illinois 61265
Phone: (309) 757-5800 Fax: (309) 757-5807

IN REPLY REFER TO:
FWS/RIFO

May 18, 2010

Colonel Shawn McGinley
District Engineer
U.S. Army Engineer Corps of Engineers
Rock Island District
Attn: Mr. Ken Barr (PM-A)
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel McGinley:

This letter constitutes the Draft Fish and Wildlife Coordination Act (FWCA) report for the Cedar Rapids Flood Risk Management Feasibility Study, Cedar Rapids, Iowa. It has been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C. 661 et seq.) and Endangered Species Act of 1973, as amended.

The authority for this study is House Resolution Docket 2749 adopted April 5, 2006, and Committee on Environment and Public Works U.S. Senate dated May 23, 2006. The purpose of this study is to develop a solution to increasing flood risk in the City of Cedar Rapids. In order to respond to the immediate needs of the urban-industrial river interface, or river corridor, the agency has been asked to complete a feasibility-level analysis within a highly compressed timeframe, thus limiting this analysis to structural flood control measures on the downtown river corridor. It is anticipated that a parallel but longer term basin-scale study will allow the analysis of a full suite of structural and non-structural flood risk reduction measures to address potential climatic events affecting both the Cedar and Iowa River floodplains.

PROJECT OBJECTIVES

This study has been authorized to determine "...whether any modifications....are advisable in the interest of flood damage reduction, ecosystem restoration, recreation and related purposes along

the Cedar River in Cedar Rapids, Iowa." The immediate objective is to prevent additional damage and reduce future flood risk in the Cedar Rapids area impacted by the 2008 flood.

DESCRIPTION OF THE PROPOSED PROJECT

Proposed project features include levee construction, flood walls, and removable wall or gate sections at road and railroad crossings. These features have been examined in several alternative forms, and finally combined into three main alternatives. The primary differences among alternatives are the spatial extent of protection provided on the east or left descending bankline. Please see the Feasibility Report for plates of each alternative.

Alternative 1

Areas Protected: This alternative protects the east and west sides of the Cedar River corridor of Cedar Rapids. The neighborhoods protected on the east side are (proceeding north to south): Cedar Lake Area, Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. The west side alignment protects from north to south the Time Check/Northwest neighborhood, Cedar Rapids Downtown-west/Taylor neighborhood, and the Czech neighborhood.

Description of Alignment: The east side alignment starts in the north with a tie-back levee along McCloud's Run and proceeds to the Cedar River, then turns south and runs parallel between the railroad tracks and the river. The alignment then turns south and runs parallel along the riverside of the downtown buildings. The alignment then turns east at 8th Street where it creates greenway between the alignment and the river through City owned properties to 12th Street. From 12th Street, the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

The west side alignment starts with a tie-back north of Ellis Lane and runs south between Ellis Boulevard NW and the Cedar River and then turns just north of O Avenue NW. At O Avenue NW and 4th Street NW, the alignment turns south and follows just west of 4th Street NW until K Avenue NW where it turns east to the railroad bridge. At the railroad bridge, the alignment turns south and follows 1st Street NW until 4th Avenue SW where it turns southeast in front of the Police Station. The alignment then precedes south following the Cedar River, aligning with A Street SW and tying into high ground at the terminus of A Street SW.

Alternative 1A

Areas Protected: This alternative protects the east and west sides of the Cedar River corridor of Cedar Rapids. The neighborhoods protected on the east side are (proceeding north to south): southern Cedar Lake Area (Alliant Energy, Cargill, and Quaker Oats facilities), Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. The

west side alignment protects from north to south the Time Check/Northwest neighborhood, Cedar Rapids Downtown-west/Taylor neighborhood, and the Czech neighborhood.

Description of Alignment: The east side alignment starts in the north with a tie-back levee protecting the southern Cedar Lake area. The alignment then turns south and runs parallel along the riverside of the downtown buildings. The alignment then turns east at 8th Street where it creates greenway between the alignment and the river through City owned properties to 12th Street. From 12th Street, the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.
The west side alignment is the same as in Alternative 1.

Alternative 4

Areas Protected: This alternative protects only the east side of the Cedar River corridor of Cedar Rapids. The neighborhoods protected are (proceeding north to south): southern Cedar Lake Area (Alliant Energy, Cargill, and Quaker Oats facilities), Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood.

Description of Alignment: The east side alignment starts in the north with a tie-back levee protecting the southern Cedar Lake area. The alignment then turns south and runs parallel along the riverside of the downtown buildings. It then turns landward at 8th Street where it creates greenway through City owned properties to 12th Street. From 12th Street the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

Description of Alignment: The alignment starts in the northeast with the levee alignment, protecting the backside of the three facilities from Cedar Lake. The alignment then generally runs east to west then turns south along the Cedar River. The final tie-back portion of the levee to the south is under Interstate 380.

For each alternative, borrow for levee construction is proposed to be obtained from agricultural property around the municpal airport.

DESCRIPTION OF THE PROJECT AREA

The project is located within the City of Cedar Rapids, Iowa, along or near the right and left descending banklines of the Cedar River. Maps of the project area and the borrow site may be found in the Feasibility Report. Wildlife habitat in the construction alignment is limited to discontinuous narrow strips of early successional forest with a few larger mature silver maple and cottonwood specimens interspersed, scrub-shrub, untended landscaping in abandoned areas, and mowed grass. Elsewhere a group of small islands and bottomland forest are present at the confluence of McCloud Run and the Cedar River. The proposed borrow areas are located

adjacent to the municipal airport and vegetative cover is limited to grassed waterways within an existing actively cultivated area. Aquatic habitat in the project area consists of the mainstem Cedar River, McCloud Run, and Cedar Lake.

METHODOLOGY

An inter-agency team (Team) with representatives from the Corps of Engineers (Corps), the Iowa Department of Natural Resources (IDNR), and the U.S. Fish and Wildlife Service (Service) evaluated the project area. The Team determined that given the highly urbanized condition of the construction alignment and the active cultivation of the borrow area, it was not necessary to conduct detailed habitat or species-based analyses to quantify effects of the proposed project. Further, as alternative construction alignments presented no significant relative difference in resource impacts, no incremental differences would be detectable using current habitat or species based methodologies such as the Service's Habitat Evaluation Procedures, the Corps' Expert Habitat Evaluation Procedure, or the Wildlife Habitat Appraisal Guide. No alternative has been presented that involves significant modification of aquatic habitat. Therefore, similar methodologies developed for analyses of aquatic systems were also not applied. Habitat analyses were strictly qualitative.

THREATENED AND ENDANGERED SPECIES

To facilitate compliance with Section 7c of the Endangered Species Act of 1973, as amended, Federal agencies are required to obtain from the Service information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed action. Therefore, we are furnishing you the following list of species which may be present in Linn County.

Classification	Common Name	Scientific Name	Habitat
Threatened	Prairie bush clover	*Lespedeza leptostachya*	Dry to mesic prairie with gravel soils
Threatened	Western prairie fringed orhcid	*Platanthera praeclara*	Wet to mesic grasslands

The **prairie bush clover** is listed as threatened and considered to potentially occur statewide in Iowa based on historical records and habitat distribution, although we have no record of occurrences in Linn County. It occupies dry to mesic prairies with gravelly soil. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity

involving this species or the destruction, malicious damage, or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The **western prairie fringed orchid** is listed as threatened and considered to potentially occur statewide in Iowa based on historical records and habitat distribution, although we have no record of occurrences in Linn County. It occupies wet to mesic grassland habitats. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage, or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever wet prairie remnants are encountered.

Prior to construction, the Corps will need to determine the effect, if any, on the above listed species. A no effect determination will preclude the need for further consultation on a species unless the project is modified or new information indicates endangered species may be affected. Any determination other than "no effect" will require additional coordination with the Service as required by Section 7 of the Endangered Species Act of 1973, as amended.

EXISTING FISH AND WILDLIFE RESOURCES

At the locations currently proposed, both the construction alignment and borrow area provide marginal habitat for wildlife. The island and McCloud Run confluence area provide suitable habitats for waterfowl, neotropical migrant birds, and wading birds. Mallards and Canada geese nest in the project area along with many nongame and neotropical migrant bird species like catbirds (*Dumetella carolinensis*) and warblers. Dominant tree species along the levee alignment around Cedar Lake would typically include silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), cottonwood (*Populus deltoides*), box elder (*Acer negundo*), and willow (*Salix* sp.). Understory tree species include willow, silver maple, green ash, box elder, hackberry (*Celtis occidentalis*), and false indigo (*Amorpha fruticosa*) along the river's edge. Herbaceous species include *Leersia* sp., *Scirpus* sp., cattails (*Typha* sp.), sedges (*Carex* sp.), reed canary grass (*Phalaris arundinacea*), and mixed cool season domestic lawn species. Typical resident mammals of such habitats include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), opossum (*Didelphis marsupialis*), mink (*Mustela vison*), and muskrat (*Ondatra zibethicus*).

No longer federally endangered, the bald eagle (*Halieetus leucocephalus*) remains protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA). Bald eagles breed along the Cedar River and two nests were observed on islands near the McLoud Run confluence. Under the BGEPA, it is illegal to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb the eagles. Because the bald eagle is known to nest near the project area, it is possible that your project may require an eagle take permit. This office should be consulted to further discuss the likelihood of taking an eagle and appropriate mitigation measures. For more information on bald and golden eagles go to our website: http://www.fws.gov/midwest/eagle/guidelines/index.html

Although listed as an impaired water, Cedar Lake provides a sport fishery dominated by common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), freshwater drum (*Aplodinatus grunniens*), and buffalo (*Ictiobus*) species. A mercury advisory is in place for carp and channel catfish taken from the lake. While the river fishery is consistent with other Iowa river fish populations, the 5-in-1 Dam in downtown Cedar Rapids is the first impassable dam under a normal hydrograph and is just over 100 river miles upstream of the Mississippi River. As such, the river in this area holds large concentrations of many potadromous species. Iowa species of greatest conservation need such as shovelnose sturgeon (*Scaphirynchus platorynchus*), paddlefish (*Polyodon spathula*), and blue sucker (*Cycleptus elongatus*) migrate upriver (many from the Mississippi River) every spring to spawn, making the Cedar River below Cedar Rapids important spawning habitat for these species. Tagged shovelnose sturgeon have been recaptured as far downstream as navigation Pools 17 and 18 of the Mississippi River. Additionally, in 2009 an adult lake sturgeon was sampled near Palisades-Kepler State Park. This area has also been the site of Higgins eye pearlymussel releases, although none have been relocated during sampling in 2009.

IDNR staff report that most shovelnose sturgeon recaptures in this area are from Mississippi River navigation Pool 18, and that 33-46% of the fish handled during spring sampling are gravid females, indicating that this area is important for sturgeon recruitment to populations in the Mississippi River. IDNR staff also note a distinct chronology in spawning habitat utilization by blue suckers, paddlefish, and shovelnose sturgeon. Other migratory species encountered include sauger, white bass, and redhorse.

FUTURE WITHOUT PROJECT

The No Federal Action alternative is considered the future without the project condition. With no project, the fate of abandoned properties in residential neighborhoods and industrial sites is unknown, as is the potential for greenspace development in these areas. In the absence of human habitation and maintenance, these properties may shelter nuisance wildlife and become a source of undesirable invasive plants. Proposed borrow areas would remain in current land use, primarily agriculture.

FUTURE WITH PROJECT

Project construction will impact approximately 35.29 acres of urban, industrial, residential, and partially landscaped habitats. About 0.85 of an acre of Cedar Lake will be included in the levee footprint. Another 0.15 acre will be temporarily disturbed during levee construction. Levee fill will be obtained from agricultural lands surrounding the municipal airport. Up to two thousand acres are currently available for borrow. However, further geotechnical analyses are anticipated to determine the locations of the most suitable material, and we anticipate that a much smaller acreage will ulitmately be affected.

CONCLUSIONS AND RECOMMENDATIONS

The implementation of the proposed project as discussed will have neglible negative effects on terrestrial, wetland, or aquatic resources in the project area. Typical borrow site operation involves removing productive upper soil horizons for stockpiling until borrow excavation is completed, and then replacing those soil layers for continued agricultural production or other use. Given the proximity of the borrow area to the municipal airport and the need for wildlife collision safety, it is unlikely that any cover of substantial value to wildlife will be established and no net change in wildlife value will result.

We support pursuit of the preferred alternative, but are concerned about the lack of proposed protection for the Water Pollution Control Facilities, given the potential effects of untreated discharges on the aquatic ecosystem of the Cedar River. We recommend that investigations continue regarding protecting or relocating such critical infrastructure. Completion of the levee segment through the former residential neighborhood (Time Check) could provide an opportunity for greenspace and establishment of landscaping beneficial to wildlife, particularly to neotropical migrant birds. Abandoned properties may continue to harbor hazardous materials and provide a source for invasive exotic plant species or undesirable wildlife. However as no protection for this area is currently included in the preferred alternative, plans for management of

abandoned properties should be included in the final Detailed Project Report for this study. Disturbance of sediment in Cedar Lake should be minimized to reduce resuspension and availability of contaminants in the aquatic food web.

We appreciate the opportunity to provide these comments and look forward to continued coordination on this project. If you have any questions, please contact Mr. Bob Clevenstine of my staff at (309) 757-5800, extension 205.

Sincerely,

Richard C. Nelson
Field Supervisor

cc: IDNR (Schwake, Stone)

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CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

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REAL ESTATE PLAN

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APPENDIX E
REAL ESTATE PLAN

I. PURPOSE

The Purpose of this Real Estate Plan is to support the *Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study With Integrated Environmental Assessment* (Study). This Study was authorized by House Resolution adopted April 5, 2006 by the Committee on Transportation and Infrastructure of the U. S. House of Representatives. This report is for Alternative 4c which protects the east side of the Cedar River corridor of the City of Cedar Rapids, Iowa (City). The protected areas from north to south are: the Cedar Lake area; Iowa Electric Light and Power Company; railroads; Cargill; Quaker Oats facilities; Cedar Rapids main business district; the Oakhill Jackson neighborhood; the new Bohemia area; and the Sinclair-Cargill neighborhood. This Study will extend approximately 3 miles and starts at the north with a tie-back levee protecting the area south of Cedar Lake. The alignment then turns southerly and runs parallel along the riverside of the main business district. It then turns landward at 8th Avenue where it creates greenway through City-owned property to 12th Avenue. From 12th Avenue, the alignment continues southeasterly between 1st Street SE and 2nd Street SE and proceeds downstream with a tie-back levee in a City park north of Otis Road SE**.** There are no other Real Estate Plans that support this Study.

II. DESCRIPTION OF THE LANDS, EASEMENTS, AND RIGHTS-OF-WAY REQUIRED FOR CONSTRUCTION, OPERATION AND MAINTENANCE

A map of the Study area is included as Exhibit A. This map is not a surveyed Right-of-Way map; rather, it is an aerial photograph with the Study area overlaid on it showing the various types of protection that will be used in the Study. It also divides the Study area into reaches, designated as: 4B, 5A, 5B and 5C. Also attached, as Exhibit B, is a seven-page map that shows the Study area in greater detail. Exhibit B contains map pages G-103-4C-T and C-101 through 106. The centerline is shown in black. The permanent takings necessary are shown by the solid red line and the temporary easements are shown by the red dashed line. The individual parcels that make up the Study area are shown in yellow. The recreational portions of the Study area are shown by colored lines marked appropriately. Exhibit C attached hereto is a map of the Eastern Iowa Airport properties available for the borrow site necessary for the project.

The Project will consist of floodwalls, earthen levees, gates of various types, removable walls, and recreational trails. There will be a 15-foot permanent taking on the river side and a 30- foot permanent taking on the dry side of the Study area for operation, maintenance and moving of utilities, if necessary. Whether this 30-foot taking will be fee or permanent easement depends on whether the flood protection wall or levee at that point has a recreational feature associated with it. There will also be a 15-foot temporary easement outside of the permanent taking areas for construction operations. The exact widths of these estates will vary according to the requirements of each individual parcel, which will be determined during plans and specifications.

The Study area, starting from the north end, reach 4B in Exhibit A, ties in at high ground at an off ramp for I-380. It then proceeds northerly and westerly across railroad tracks, Cedar Lake and industrial properties. The railroad tracks will be crossed by removable flood gates. The lake will be crossed with an earthen levee. The remainder of the flood protection in this reach will be by floodwall. When the Study area reaches the left descending bank of the Cedar River, it turns southerly following the river bank. At the southern end of this reach, the flood wall goes through more industrial property.

Cedar Lake is owned by the City and is currently listed as an Impaired Water site, by the Iowa Department of Natural Resources (IADNR) in its 2008 Integrated Report to the U. S. Environmental Protection Agency, dated April 30, 2009. It is listed as not meeting the Iowa water quality standards because of the presence of known pollutants, in this case, PCBs.

Reach 5A continues southerly across the F Avenue Bridge, beneath the Interstate 380 Bridge, with a removable wall and along the Cedar Rapids main business district with a flood wall. In this reach, the flood wall crosses the following properties: a City park; a City-owned, non-used parking ramp; a privately-owned furniture store; a vacant Science Station Museum whose ownership is uncertain; a City-owned parking lot; and a privately-owned, multi-story office.

Near the southern portion of this reach, the Study area joins and follows a City-owned recreational trail. At the Study area's intersection with 8th Avenue, it turns easterly away from the river. There are four roadways that will be protected with gates in this reach.

Reach 5B is protected by an earthen levee, two roadway gates, and one railroad gate. It no longer follows the City recreational trail. It passes through a City parking lot, a City-owned temporary bus terminal, and a privately-owned vacant building. It then passes inland through a residential area containing seven small older houses and another privately-owned building. At the Project's intersection with 16th Avenue, it rejoins the City recreational trail. It then passes through a City park and south of a City-owned former industrial site. Near the eastern edge of this site, the earthen levee ends and a floodwall begins, which then continues easterly to where it intersects with railroad property containing a single unused railroad line.

Reach 5C continues easterly, close to the river, with a flood wall. It passes through another City-owned unused industrial site. It then passes between an electrical power substation that services an adjacent industrial plant and the river. The floodwall then passes along the southern edge of this industrial site along the river bank.

The floodwall continues easterly until it reaches the eastern end of the industrial site. There it turns northerly and crosses Otis Road two times and a railroad line with gates. Immediately north of Otis Road SE, the floodwall will tie-in to high ground in a City-owned Park.

NECESSARY ESTATES

There are four standard estate interests which may be used for this Study. The following standard estates as set forth in ER 405-1-12 will be used, and there will be no non standard estates necessary**:**

FEE

The fee simple title to (the land described in Schedule A) (Tracts Nos. __, __ and __), subject , however, to existing easements for public roads and highways, public utilities, railroads and pipelines. The Fee interests are outlined in purple on attached Exhibit A, and contain 29.2 acres

TEMPORARY WORK AREA EASEMENT

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. __, __ and __), for a period not to exceed three years, beginning with the date of possession of the land is granted to the United States, for use by the United States, its representative, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structure on the land and to perform any other work necessary and incident to the construction of the Study, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

The temporary work areas have been designated as 15 feet adjacent to and outside of the permanent takings along the Study footprint, and the easements therefore will be for a 3-year period.

FLOOD PROTECTION LEVEE EASEMENT

A perpetual and assignable right and easement in (the land described in Schedule A) to construct, maintain, repair, operate, patrol and replace a flood protection levee, including all appurtenances thereto; reserving, however, to the owners their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject; however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

BORROW EASEMENT

A perpetual and assignable right and easement to clear, borrow, excavate and remove soil, dirt, and other materials from (the land described n Schedule A)(Tracts Nos._____, _____, and _____); subject, however to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges in said land as may be used without interfering with or abridging the rights and easements hereby acquired.

The borrow area necessary for this Study is shown on attached Exhibit C. The exact tract to be used has not been identified, but sufficient suitable sites exist at the airport site to meet Study needs.

There will be no mitigation necessary for this Study.

The Study area will be physically accessed from existing public roads and through temporary construction easements along the Project footprint. Contractor staging areas will be within the temporary construction easements shown on Exhibit B.

III. NON-FEDERAL SPONSOR-OWNED LANDS, EASEMENT, RIGHTS-OF-WAY

The NFS recognizes the responsibility to provide all Lands, Easements, Rights of Way, Relocations, and Disposals (LEERDs) required for the project. The City owns 15 parcels of real estate that are identified with parcel numbers in their records. In addition, the City owns 19 parcels that are not identified with parcel numbers. These non-identified parcels are typically streets, parking lots, sidewalks, bridges, recreational type trails, and other public improvement type parcels. There are 11 non-identified parcels whose ownership is not known. The City may in fact own some or all of these parcels, but that ownership could not be ascertained at this point in the Study process.

IV. EXISTING FEDERAL PROJECTS AND FEDERALLY-OWNED LANDS

There is one federally-owned parcel in the Study footprint. It is not known which Federal entity is the record titleholder to this property. The present Study footprint and plans do not include any takings from this federally-owned real estate.

V. NAVIGATION SERVITUDE

There are no additional lands, easements, and rights-of-way (ROW) required for this Study area which lie below the Ordinary High Water Mark or Mean High Water Mark of the Cedar River. The Cedar River is not recognized as a commercial navigation waterway.

VI. INDUCED FLOODING

This real estate plan does not include any costs for induced flooding as a result of the construction of the project. Minimal flooding on the west bank is expected during high water events. The induced flooding is expected to be infrequent and minimal based on hydraulic modeling (see table 17 in the main report). If subsequent engineering during design phase determines changes in the hydraulic data, this issue will be revisited.

VII. BASELINE COST ESTIMATE

The following extraordinary assumptions were made in placing a value on the real estate needed for the Study:

A. Real estate parcels remaining on the wet side of the floodwalls or levee would not be affected by the Study.

B. Because of the extent and scope of this valuation, assessment values will be used as the primary source of value to simulate pre flood values where the total property is being acquired.

C. All properties were owned by the present owners for 90 days prior to the flood.

D. The City is in the process of purchasing properties in the areas flooded during 2008 with Federal funds. It is unknown if the properties in the footprint of this Project alignment will be purchased or not. In this valuation properties are assumed to not be purchased by the City. Should the City acquire any properties in the footprint of this Study, they will receive bare land value for them.

E. The City has fee interest in all streets, alleys and bridges within the Project footprint and will be acquired as a permanent easement for 50 percent of the surrounding property fee values. Any City-owned land not purchased with Federal funds will be acquired as permanent easements at 80 percent of the surrounding fee value. Temporary easements are given 10 percent per year fee value for the surrounding property values. It is estimated that construction will take approximately 3 years.

F. The City has fee ownership of the recreational trail through the downtown area. The City has stated such ownership, but has produced no supporting documentation. Any recreational trail that will be impacted by the Study will be replaced, and additional recreational features may be added to the Study as Study enhancements.

G. Study plans indicate that construction/staging areas will be located within the temporary and permanent easement areas next to the actual floodwall or levee on City-owned property.

H. Any necessary utility relocations will be done within the 30-foot dry side easement areas. At this time, no utility relocations have been identified and no Attorney's Opinion of Compensability issued.

I. All construction work can be performed within the Project limits for purposes of this report, although indications suggest that this may have to be revisited during the next stage and corrected by appropriate engineering solutions.

J. The Project alignment will have no effect on the property on the wet side and those properties have not been assigned a value.

K. Any potential impact on normal operations of commercial/industrial sites will be resolved out on a mutually agreeable basis and have not been assigned a value.

L. Acquisition cost differential and relocation payments have been included in the overall estimate as required by Public Law 91-646.

M. The proposed borrow and spoil sites at the Airport will be adequate for this Study.

N. The present plans have no provisions for access to the maintenance building near the roller dams under the Interstate 380 Bridge or for the City-owned park adjacent to the building. It was assumed that access will be provided in the final plans.

O. City-owned property on the wet side of the flood protection will be provided walkways and maintenance vehicle access. The City has indicated that it will use these areas for recreational river front parks.

P. A 15-foot permanent easement is assumed on the river side with a 30-foot permanent taking on the land side of the floodwall or levee and an additional 15-foot temporary construction easement will be outside the permanent takings. The exact distance will vary due to the specific situation of each parcel, but the assumption is that this average will adequately cover all needed real estate to include construction staging areas. No separate construction staging areas outside the Project footprint have been identified and included in the real estate cost estimate.

The Study will require a total acquisition of 89 parcels covering approximately 59.29 acres of land, which includes a 24-acre borrow site. Of those 89 parcels, 54 are identifiable as to ownership by specific designations from City government offices. Sixteen of these designated parcels are owned by the City; 35 are privately-owned; and 3 are owned by the Science Center. It is not known if the City owns these three properties or if the Science Center is a private entity. Of the remaining 35 undesignated parcels, 19 are assumed to be owned by the City; 4 are owned by railroads; 1 is owned by the Iowa Department of Transportation (the I-380 tie-in); and there are 11 parcels whose ownership is unknown. The City may own some or all of these unknown parcels. The City-owned undesignated parcels are typical publically-owned improvements and comprise streets, parking areas, recreational paths, bridges, etc. There are five businesses that are within the Project footprint. The estimated value of acquiring these 89 parcels and estates, determined by a gross appraisal conducted by a qualified Corps Appraiser, rounded to the nearest $1,000.00 is $11,700,000.00.

The real estate incremental cost was estimated at 45 percent. This was based on a number of factors:

- the nature of the properties included in the Study, i.e. residential, commercial, industrial, and public. It was based also on the nature of the property owners involved i.e. large corporations, railroads, and business owners, all of whom will be inconvenienced by the construction.

- the suspected HTRW conditions at several of the large sites such as Alliant Energy, Quaker Oats, Cargill, and the City-owned sites to include the former railroad car repair facility and the former meat packing site

- the lack of a definite ROW map showing specific lands to be acquired and easements to be obtained.

The 11 unidentified parcels will present possible time delays and increased acquisition costs because of difficulties in obtaining ownership information and possible condemnations to acquire these tracts. Additional factors include an unknown start date; aggressive City actions to revitalize the area; the perceived threat of additional flooding; the necessity of the City supplying clean project-ready land;

the possibility that stated City plans might not occur; and the potential for the market values of the real estate to be acquired increasing substantially with an improved economy.

VIII. VALUATION SUMMARY

	Non-Federal	Federal	Total
Lands and Damages			
Total Lands, Easements, and ROW	$ 9,807,200		
PL 91-646 (URA)			
Differential Housing/Relocation (Residential. & Business)	$ 1,160,000		
Incidental Acquisition Costs	$ 412,500	$320,300	
	$11,379,700	$320,300	**$11,700,000**

IX. RELOCATION ASSISTANCE BENEFITS

There will be seven residential properties and five businesses that will have to be relocated as a result of this Study. This level of study and report permits utilizing estimates of value supported by public records, such as assessor records, for improved properties where personal inspection and owner information is not available. Since these properties have been damaged by the 2008 Flood it is assumed that the properties will be rehabilitated to at least the same pre-flood condition and value at the time of acquisition. These values are also being used as the estimated acquisition cost to be compared to the cost of replacement housing or business relocation, with the difference representing differential housing costs. All relocations will be done in accordance with PL 91-646. Relocation costs, including differential payments, have been included in the acquisition costs discussed in paragraph VII, B.

X. MINERAL ACTIVITY

There are no known mineral considerations in the Study vicinity which might affect construction or Operation, Maintenance, Repair, Rehabilitation, and Replacement of the Study.

XI. NON-FEDERAL SPONSOR ASSESSMENT

The City has professional staff responsible for the development, acquisition and disposal of city owned real estate. The City has condemnation authority, and is ready to use it if necessary in the acquisition of the real estate needed for the construction of this Project. The City does not have "Quick Take" authority. The City will provide the Right of Entry and Attorney's Certificate to the Corps for the real estate interests identified above. The City has been informed and is aware that they will not receive any credit for real estate purchased with Federal funds, unless the funding agency has approved such credits. Attached as Exhibit D is the checklist for *Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability.*

XII. ZONING

No application or enactment of zoning ordinances is proposed in lieu of, or to facilitate, acquisition in connection with this Study.

XIII. SCHEDULE

After a Project Partnership Agreement (PPA) is executed between the City, acting as the non-Federal Sponsor (NFS), and the Corps, the process and schedule for obtaining the required real estate will be as follows:

Corps

- prepares and sends an ROW map – 60 days

NFS

- prepares tract ownership data; determines legal descriptions of parcels in the ROW map – 120 days
- verifies title to parcels – 90 days
- provides appraisals of each separate tract; said appraisal is reviewed and approved by the Corps -120 days
- negotiates acquisition of parcels with owners – 120 days
- obtains ownership of parcels through closings with owners – 90 days
- if negotiations with parcel owner(s) are unsuccessful, initiates condemnation proceedings and obtains title – 4 to 8 months after filing of action
- relocates seven residences with suitable replacement housing; relocates five businesses - up to 18 months
- prepares and delivers an Attorney's Certificate and Authorization for Entry to the Corps – 45 days

It is estimated that, provided no condemnations are required, it will take approximately 18 months for the NFS to obtain the necessary real estate from the time of the signing of the PPA. If condemnation is required, that estimate becomes 22 to 26 months. This schedule has been coordinated with and concurred by the City.

XIV. FACILITY OR UTILITY RELOCATIONS

There have been no relocations identified for any utilities for this Study. No such relocation has been given to Office of Counsel, and no Opinion of Compensability has been prepared for this Study. The compressed time frame for this Study has not permitted the usual relocation identifications and evaluations. No opinions have been requested or received from Office of Counsel . Office of Counsel will complete an Opinion of Compensability for any and all utility relocation once identified. The results of the study will be implemented in the final ROW requirements.

XV. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE ENVIRONMENTAL CONSIDERATION

Hazardous, Toxic, and Radioactive Waste **(**HTRW) recommendations are not complete based on the schedule restrictions imposed by the PDT. As stated above, the Study will run through properties suspected of contamination of some type based on their historical uses. It is unlikely the HTRW sites can be avoided with this Project's alignment. The City has acknowledged that it will provide real estate necessary for the Study free from any HTRW considerations.

XVI. LANDOWNER ATTITUDE

This Study is being undertaken by the City to provide flood protection for the citizens of Cedar Rapids and the downtown and east bank areas. It is expected that the citizens from the west bank will be unhappy that they are not being protected. Also, the City may run into challenges when dealing with the large corporations along the Study footprint. The City wants to leave the access to and unobstructed views of the river as open as possible, and has suggested the use of removable flood walls through the downtown/business district, which would be more costly.

XVII. RISK NOTIFICATION

By letter to then Mayor Kay Halloran dated March 9, 2009, the City has been notified concerning the risks of acquiring LER before the execution of the PPA. In addition, the City has also been notified of these risks numerous times verbally at meetings. Should any "Draft" ROW maps be provided prior to a signed PPA, additional risk letters will be sent to the City.

XVIII. OTHER RELEVANT REAL ESTATE ISSUES

There will of necessity be on-site engineering solutions required during construction. Issues of access to facilities left on the wet side of the flood protection, realignments to avoid unnecessary takings, access during construction to existing businesses, parking that will be temporarily or permanently displaced, and determining recreational features along the Study area will need to be addressed.

XIX. CHECKLIST

A Quality Control Plan Checklist is attached hereto, as Exhibit E.

I have prepared and thoroughly reviewed the REP and all information, as required by Section 12-16 of ER 405-1-12, is contained in the Plan

Dated 6 Nov 2010 Signed: _____

Ron Williams
Chief, Real Estate Partnership and Appraisal Branch
US Army Corps of Engineers Rock Island District
Rock Island District

Dated 6 NOV 2010 Concurred: _____

Stuart P. Jackson
Chief, Real Estate Division
U.S. Army Corps of Engineers
Rock Island District

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CEDAR RAPIDS, IOWA

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Prepared by:
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EXECUTIVE SUMMARY

A. Background. This report summarizes the Phase I Hazardous, Toxic, and Radioactive Waste (HTRW) Environmental Site Assessments (ESA) for the *Cedar River, Cedar Rapids Iowa Flood Risk Management Feasibility Study* (Study). The Phase I ESA was completed in accordance with Engineering Regulation (ER) 1165-2-132, HTRW Guidance for Civil Works Projects; (ER) 405-1-12, Real Estate Handbook; and ASTM Practice E 1527-05. This HTRW Documentation Report does not provide complete documentation as required by ER 1165-2-132 for feasibility level studies.

B. Conclusions. The HTRW Study Area of Interest (Study Area) is comprised of 843 parcels of property. Four Alternative alignments (1C, 1A-C, 4C and 10E) were reviewed in regard to the parcels the alignments affected. The alignment for Alternative 1C comprises 787 parcels and Alternative 1A-C comprises 782 parcels. The alignment for Alternative 4C comprises 99 parcels. Alternative 10E comprises 85 parcels.

Of the 843, 89 parcels were identified as having recognized environmental conditions (REC). These 89 parcels are distributed throughout the Study Area, the majority of which are located on the west side of the Cedar River. 48 parcels along the Alternatives 1C and 1A-C alignments, 15 parcels along the Alternative 4C alignment, and 12 parcels along the Alternative 10E alignment required Phase II Environmental Site Assessments (ESA). Twenty-two parcels along the Alternatives 1C and 1A-C alignment, and four parcels along the Alternative 10E alignment have RECs that require further action, such as disposal of 55-gallon drums or abandoning a cistern, but do not require further investigation (such as Phase II ESAs).

Hazardous, Toxic, and Radioactive Waste soil sampling was completed for the Cedar Rapids Airport potential borrow area. Seventeen soil borings were installed, for a total of 34 soil samples. The samples were analyzed for the presence of Volatiles; Semi-Volatiles; Polychlorinated Biphenyls; pesticides; herbicides; Toxic Characteristic Leaching Procedure Metals; and Total Metals. Three soil sample locations indicate chemical and/or metal concentrations above the Iowa DNR Statewide Standards for soil. The samples were collected from the 0-5 foot depth. Therefore, no soil from the Airport boring locations B1, B11 and B13 in the range of 0 to 5 feet depth can be used as borrow material. The remaining areas that were proposed for borrow material from the airport property may be utilized.

Hazardous, Toxic, and Radioactive Waste sampling was also completed along Alignment 4C on nine parcels of concern in conjunction with geotechnical investigations. There are six parcels (two Cargill facilities, two Alliant Energy facilities and two Midwest Railroad facilities) where access was not granted. Sample results indicate five parcels sample locations exceed the statewide soil standards for benzo(a)pyrene, and one parcel exceeds for benzo(a)pyrene, benzo(a)anthracene, benzo(p)flourene, and dibenzo(a,h)anthracene. Contaminant concentrations are low to moderate in magnitude, and are fairly consistent throughout the Study Area. It is anticipated that contaminant concentrations on parcels where sampling access was not granted will be similar to those already observed. If the type and magnitude of contaminants remains the same, HTRW remedial activities are not anticipated to be detrimental to project schedule, scope and proposed construction methods.

Due to the nature of the project, modifying the Alternatives footprints to avoid any parcels with HTRW concerns is not feasible. Movement to avoid parcels such as the Rescar Facility, Cargill or the former Sinclair Meatpacking Plant would result in subjecting those parcels to the wet side of the flood protection measure, thus defeating the purpose of the flood protection,

As the full extent of HTRW concerns has not been discerned due to lack of access to all parcels, risk associated with HTRW issues was addressed in the Project Cost and Schedule Risk Analysis Report, located in Appendix I-A. HTRW implications for project cost and schedule were assigned a High Risk rating, which was incorporated into the final contingency value of 20%.

Given current HTRW conditions, a lack of response on the sponsor's part would result in the hindrance of Real Estate activities; likely pose additional risk during construction activities to construction workers and the general public, and complicate material movement and disposal during construction activities.

C. Recommendations. Based on the Phase 1 ESAs, it is recommended that Phase II ESAs be completed on the parcels of concern within the alignment for the preferred Alternative. The number of remaining Phase II ESA's required are as follows: Alternatives 1C and 1A-C at least 40, Alternative 4C at least 6, and Alternative 10E at least 8. These Phase II ESAs will determine if some form of contamination is present in the subsurface of the parcels, and will identify those areas where the City would be required to conduct further assessment and remediation. In addition, it is recommended that the City address the non-Phase II RECs present in each Alternative alignment's parcels that are City-owned or owned by individuals.

Design engineers shall coordinate with the District's Environmental Engineering and Geotechnical Section to determine what areas of the proposed Airport Borrow Site are suitable. Most of the proposed area is suitable for utilization.

A majority of the parcels of concern affected by the Alternative 4C footprint have been investigated with a Phase I ESA, a Phase II ESA or both. Thus far, HTRW concerns are present but appear minimal. Nevertheless there are three main concerns with the type and magnitude of contamination observed.

First, as contamination is present, easements for construction and operations and maintenance cannot be procured for those parcels in question until the City can provide documentation from a state or federal agency (Iowa DNR or Region 7 US EPA) that the risks associated with the contamination have been mitigated. The City has committed to pursuing such documentation in an HTRW Letter of Intent located in Appendix F-F.

Second, the contamination currently observed exceeds the Iowa Statewide soil standards for dermal contact and ingestion. These two exposure pathways are present during construction activities. Any remaining risks posed to construction workers by these contaminants must be addressed in the design phase by the City and the Corps.

Third, existing soils might be removed as part of project construction. Further sampling and analysis will need to be incorporated in the design phase and construction phase to identify the proper disposal process for soils removed off construction work limits.

D. Limitations. No ESA can wholly eliminate uncertainty regarding the existence of recognized environmental conditions concerning a property. This assessment is intended to reduce, but not eliminate, uncertainty regarding the existence of recognized environmental conditions in connection with a property with reasonable limits of time and cost. Continuing the Environmental Due Diligence Audit process beyond these ESAs may reduce uncertainty, or reveal unidentified environmental liabilities. If any previously unaddressed recognized environmental condition should arise, this report will be revisited.

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I. GENERAL

A. Authority. The authority for the *Cedar River Cedar Rapids Iowa Flood Risk Management Feasibility Study* (Study) derives from a "resolution dated May 23, 2006, the Committee on Environment and Public Works, U.S. Senate has requested a review of the report of the Chief of Engineers on the Iowa and Cedar Rivers, Iowa and Minnesota, published as House Document 166, 89th Congress, 1st Session, and other pertinent reports with a view to determining whether any modifications to the recommendations contained therein are advisable in the interest of flood damage reduction, ecosystem restoration, recreation, and related purposes along the Cedar River in Cedar Rapids, Iowa."

B. Guidance and Policy. The Corps' Engineering Regulation (ER) providing guidance for the conduct of Civil Works Planning Studies is contained in ER 1105-2-100. The policies and authorities outlined in ER 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects, and ER 405-1-12, Real Estate Handbook, were developed to facilitate the early identification and appropriate consideration of HTRW issues in all of the various phases of a water resources study or project. Division Regulation (DIVR) 1165-2-132 provides divisional guidance for HTRW assessment for Civil Works projects. American Society for Testing and Materials (ASTM) Standards E1527-05 and E1528-06 provide a comprehensive guide for conducting Phase I Environmental Site Assessments (ESA). ASTM Standard E1903-97(2002) provides guidance for Phase II ESAs. These references provide information on what considerations are to be factored into project planning and implementation. The policy of the Corps is to avoid construction of Civil Works projects when HTRW is located within project boundaries or may affect or be affected by such projects.

II. INTRODUCTION

A. Purpose and Scope. The specific purpose of an HTRW Documentation Report (HDR) is to adequately document an appropriate inquiry into HTRW activities on potential project lands. The scope of this report documents the HTRW investigation for the Cedar River's flood risk management project. The goal of the Study is to reduce flooding by either raising or extending the existing levee system, improving closures, non structural alternatives, and addressing other penetration concerns. Any project modification must result in improved flood prevention.

This HTRW inquiry is required in order to minimize and prevent Federal liability under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and to reduce any threats to project workers and avoid costly delays associated with environmental abatement activities. Appendix A contains a list of acronyms used in this report. A list of documents and records reviewed or referenced is contained in Appendix F-B.

The District contracted Phase I Environmental Site Assessments for the Study Area (not including the Cedar Rapids Airport potential borrow area) with Foth Infrastructure & Environment (Foth), LLC, 7500 North Harker Drive, Peoria, Illinois 61615, under DACW912EK-09-D-D0008, Delivery Order 0001 on July 21, 2009. A modification was approved on March 3, 2010 to conduct Phase I ESAs on 71 additional parcels not included in the original Area footprint. While there was only one contract, 13 reports were issued summarizing Phase I Activities. Copies of these reports are available from CEMVR-EC-DN.

B. Limiting Conditions and Methodologies Used. The techniques used to assess HTRW contamination within and adjacent to a project area consisted of contracts with various Architectural and Engineering firms to conduct Phase I and Phase II ESAs. The scope of inquiry was limited to investigating onsite HTRW potential within the project boundaries as well as offsite HTRW potential within a reasonable distance from the project.

C. Site Safety. Phase I ESA contracts required site safety plans for all site visits performed by District contractors. Therefore, a District site safety plan was not developed, as District contractors conducted all HTRW site visits.

III. SITE DESCRIPTION

A. Location. The Study Area comprises a large part of central Cedar Rapids, Iowa (City) on the east and west sides of the Cedar River. Due to the size of the Study Area, each area is discussed individually for ease of location and understanding. It should be noted that at the time of the writing of the Scope of Work for the Phase I ESAs, the Study Area had not yet been broken down into damage reaches. The Scope of Work for Phase I ESAs broke the Study Area down into 13 Sections. This is how the Architectural and Engineering Firm submitted each Phase I ESA, per Corps direction. Maps of the Sections are included in Appendix F-C.

In addition, the Cedar Rapids Airport was investigated as a potential borrow site for levee material. A map of the potential borrow area is included in Appendix F-D.

Section 1. Section 1 runs along the East Bank of the Cedar River from the intersection of Wenig Road NE and J Avenue NE south to the F Avenue NW Bridge (Interstate 380). Section 1 is comprised of 19 parcels. The parcels consist of commercial and industrial properties, a section of a railyard, a few residences, and vacant areas (woodland and cleared). Section 1 runs along the Cedar River East Bank. Section 1 does not include Cedar Lake and the area immediately surrounding Cedar Lake. Section 1 also only includes the extreme western border of the Quaker Oaks facility.

Section 2. Section 2 runs along the East Bank of the Cedar River from the F Avenue NW Bridge south to the 8th Avenue SE Bridge. Section 2 is comprised of 16 parcels. The parcels consist of commercial properties, parking lots, parking garage, and a park. A Federal courthouse is currently being constructed at the southern end of this section.

Section 3. Section 3 runs along the East Bank from the 8th Avenue SE Bridge south to the 16th Avenue SW Bridge. Section 3 is comprised of 23 parcels. The parcels consist of single family residences, commercial properties, a park, museum, bus transfer station, parking lots.

Section 4. Section 4 runs along the East Bank from the 16th Avenue SW Bridge south to the intersection of 15th Avenue SE and the extension of 19th Street. Section 4 is comprised of 28 parcels. The parcels consist of single family residences, commercial and industrial properties, and a park. The Brownfield site Sinclair Meatpacking plant and Cargill Inc. facility are located in this section.

Section 5. Section 5 runs along the West Bank from the intersection of Ellis Boulevard NW and Ellis Lane NW south to M Avenue NW. Section 5 is comprised of 262 parcels. The parcels consist of primarily single family residences and some commercial properties.

Section 6. Section 6 runs along the West Bank from M Avenue NW south to the F Avenue NW Bridge. Section 6 is comprised of 198 parcels. The parcels consist of primarily single family residences and some commercial, industrial and City-owned properties.

Section 7. Section 7 runs along the West Bank from the F Avenue NW Bridge south to the 8th Avenue SE Bridge. Section 7 is comprised of 123 parcels. The parcels consist of single family residences, apartments, commercial, industrial and City-owned properties.

Section 8. Section 8 runs along the West Bank from the 8th Avenue SE Bridge to an area 50 feet southeast of the intersection of 22nd Avenue SW and A Street SW. Section 8 is comprised of 100 parcels. The parcels consist of single family residences, commercial, industrial and City-owned properties.

Section 9. Section 9 is the Cedar Rapids Water Pollution Control Facility. Section 9 is comprised of two parcels. The parcels consist of an Alliant Energy electrical substation, and the Cedar Rapids Water Pollution Control Facility. Section 9 runs along the East Bank of the Cedar River.

Section 10. Section 10 is the Alliant Energy Prairie Creek Generating Station. Section 10 is comprised of two parcels. The parcels consist of the Alliant Energy Prairie Creek Generating Station. Section 10 is located near the West Bank of the Cedar River at its intersection with Prairie Creek.

Section 11. Section 11 runs along the south bank of Cedar Lake. Section 11 is comprised of 13 parcels. The parcels consist of a rail yard, Iowa Electric Light and Power, a portion of Cedar Lake and other industrial properties.

Section 12. Section 12 runs along the south right of way of Interstate 380 from 1st Street NE northeast to 5th Street NE. Section 12 is comprised of six parcels. The parcels consist of A Avenue, Iowa DOT right of way and commercial properties.

Section 13. Section 13 runs from the Cargill Facility near Otis Road SE west along a railroad spur to 12th Avenue SE, then northeast along 12th Avenue SE to 10th Street SE, south along 10th Street SE, to Otis Road SE, then west along Otis Road SE back to 12th Avenue SE. Section 13 is comprised of 51 parcels. The parcels consist of industrial, commercial, residential and City-owned properties. Section 13 is located near the Sinclair Meatpacking Plant brownfield site and Viola Gibson Park.

Potential Borrow Area. The area is comprised of 11 individual parcels totaling 2,144 acres. The parcels are located immediately surrounding the airport.

B. Proposed Flood Protection Alternative Alignments. Four Alternatives were chosen for further analysis. Alternatives 1C, 1A-C 4C and 10E each correspond to different Study Area sections.

Alternative 1A-C. This Alternative is the Locally Preferred Option and runs along the east and west side of the Cedar River, and along the southern edge of Cedar Lake. The Alternative 1A-C alignment corresponds to Study Area Sections 1, 2, 3, 4, 5, 6, 7, 8, and 11

Alternative 1C. This Alternative and runs along the east and west side of the Cedar River and the northern edge of Cedar Lake. The Alternative 1C alignment corresponds to Study Area Sections 1, 2, 3, 4, 5, 6, 7, 8, and 11

Alternative 4C. This Alternative runs along the east side of the Cedar River and the southern edge of Cedar Lake. The Alternative 4C alignment corresponds to Study Area Sections, 1, 2, 3, 4 and 11.

Alternative 10E. This Alternative runs along the east side of the Cedar River and surrounds the Quaker Oats Facility north of Interstate 380 and the Cargill Facility located in the southeastern part of the City. The Alternative 4C alignment corresponds to Study Area Sections, 4, 12 and 13.

IV. ENVIRONMENTAL SITE ASSESSMENTS

This section of the report serves to summarize the contents of the each Section's ESA completed by Foth in Fall 2009/Winter 2010 and Terracon Consultants (geotechnical subcontractor) in Spring/Summer 2010.

Section 1 (Alternatives 1C, 1A-C and 4C). Section 1 has five areas of concern, one within the section Study Area and four outside the Study Area.

- Quaker Manufacturing Inc, 418 2nd Street NE, (Industrial). The RECs are historical releases of 2-Furan carboxaldehyde, acetic acid, and formaldehyde. Recommended Phase II ESA characterizing soil and groundwater from historical release areas. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Borings B7, B8, B9, and B10) was conducted along the section of the Alternative 4 alignment that coincides with this

parcel. Based on the HTRW soil sampling, the chemicals of concern do not exceed state and federal standards. No further assessment is necessary.

- 1119 Wenig Road NE, (Undeveloped-adjacent to Study Area). The Recognized Environmental Concern (REC) is soil piles located on vacant part of parcel. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for the Alternatives and no further action is necessary.
- Vacant Land, Parcel # 1417402002, (Undeveloped-adjacent to Study Area). The RECs are a waste pile of white sludge and a pool of turbid white water. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for the Alternatives, and no further action is necessary.
- CNW North Rail Yard, 800 Stickle Drive NE, (Industrial-adjacent to Study Area). The REC is a gasoline UST release. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for the Alternatives, and no further action is necessary.
- 218 2nd Street NE, (Commercial-adjacent to Study Area). The REC is a 750 gallon diesel release that occurred during the 2008 Flood. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for the Alternatives, and no further action is necessary.

Section 2 (Alternatives 1C, 1A-C and 4C). Section 2 has no areas of concern, either within or adjacent to the Study Area.

Section 3 (Alternatives 1C, 1A-C and 4C). Section 3 has five areas of concern within the Study Area, and no concerns adjacent to the Study Area.

- 917/925 - 2nd Street SE, (Commercial). The REC is the presence of a former tannery at this location. Recommended Phase II ESA characterizing soil and groundwater. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Boring B17) has been conducted along the section of the Alternative 4 alignment that coincides with this parcel. Based on the HTRW soil sampling, benzo(a)pyrene concentrations exceed the state standard. The sponsor will be required to address this contamination prior to any construction activities.
- 1001 - 2nd Street, (City-owned). The RECs are three corroded transformers, a bus depot and electrical substation. Recommended Phase II ESA characterizing soil and groundwater. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Borings B17 and B18) has been conducted along the section of the Alternative 4 alignment that coincides with this parcel. Based on the HTRW soil sampling, benzo(a)pyrene concentrations exceed the state standard. The sponsor will be required to address this contamination prior to any construction activities.
- Iowa Electric Light and Power Company, Parcel # 1428403002 (Industrial). The RECs are a 55-gallon unlabeled drum, and corroded non-operating electrical equipment. Recommended Phase II ESA characterizing soil and groundwater. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Boring B18) was conducted along the

section of the Alternative 4 alignment that coincides with this parcel. Based on the HTRW soil sampling, the chemicals of concern do not exceed state and federal standards. No further assessment is necessary.

- 1221 - 1st Street SE, (City-owned). The REC is a capped pipe and rectangular depression in parking lot. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for Alternative 4, and no further action is necessary.
- 8th Avenue & 1st Street SE, Parcel # 1428157001, (City Owned). The REC is the presence of coal tar odor encountered during drilling operations for geotechnical analysis. Subsequently, an HTRW soil sample was collected from geotechnical boring B16 to satisfy the requirements for a Phase II ESA. Based on the HTRW soil sampling, benzo(a)pyrene concentrations exceed the state standard. The sponsor will be required to address this contamination prior to any construction activities.

Section 4 (Alternatives 1C, 1A-C, 4C and 10E). Section 4 has four areas of concern within the Study Area, and no concerns adjacent to the Study Area.

- 1437 - 2nd Street SE, (Commercial). The RECs are soil staining near a former used oil/solvent AST; a gasoline UST and piping removed in the mid 1970s; and storage oil in a shop. Recommended a Phase II ESA characterizing soil and groundwater and characterizing and proper disposal of oil. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Boring B22) has been conducted along the section of the Alternative 4 alignment that coincides with this parcel. Boring B22 was installed downgradient of the subject site in Osborn Park (Parcel # 1427331020). Benzo(a)pyrene concentrations exceed the state standard. The sponsor will need to address the contamination prior to any construction activities.
- Former Sinclair Meat Packing Facility, 1600 - 3rd Street SE, (Industrial). The RECs are the site is in Brownfield Cooperative Agreement with the U.S. Environmental Protection Agency (USEPA), unused water wells; presence of an aboveground storage tank; unlabeled chemical containers in tipped over semi-trailer; stagnate water ponds; asbestos containing materials and Polychlorinated Biphenyl containing ballasts in Building 5; waste oil drum in Building 4; stained soil pile west of Building 1; presence of monitoring wells near Building 3. Recommend Phase II ESA comprised of the following: determine status and scope of Brownfield Cleanup Grant; properly abandon water wells; remove AST; characterize and dispose of chemicals in semi-trailer; remove and dispose stagnate water; dispose of asbestos containing materials and PCB ballasts; remove and dispose of waste oil drum; characterize soil pile and dispose if necessary; and abandon monitoring wells if not needed.

  In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Borings B23 and B24) has been conducted along the section of the Alternative 4 alignment that coincides with this parcel. In addition, the sponsor has conducted Phase II soil and groundwater sampling near the Alignment 4 alignment footprint.

  Based on a review of the HTRW soil sampling and sponsor Phase II sampling, benzo(a)pyrene, benzo(a)anthracene, benzo(b)flouranthene and dibenzo(a,h)anthracene

concentrations exceed the state soil standards, and benzo(a)anthracene concentrations exceed the state groundwater standards. The sponsor will need to address the contamination prior to any construction activities.

- Former Rescar Facility, 1800 - 10th Street SE, (Industrial). The RECs are a former facility for railcar maintenance and painting, stained soil, a former storage area for paint and hazardous waste, and a former dump and fill area. Foth recommended a Phase II ESA characterizing the soil at the railcar maintained facility, the stained soil area, the former paint and hazardous waste storage areas, and the former dump and fill area.

  The sponsor has conducted Phase II soil and groundwater sampling near the Alternative 4 alignment footprint. Based on a review of the sponsor Phase II sampling, benzo(a)pyrene concentrations exceed the state soil standards, and total extractable hydrocarbon concentrations exceed the state groundwater standards. The sponsor will need to address the contamination prior to any construction activities.

- Cargill Inc, 1710 16th Street SE, (Industrial). The REC is site's designation as a hazardous waste generator, presence of a 10,000 gallon 'hazardous' UST, location in a historical industrial area , and the presence of an electrical substation on the south side of the property. Recommended a Phase II ESA characterizing soil and groundwater. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Borings B27, B28 and B29) was proposed along the section of the Alternative 4 alignment that coincides with this parcel. Due to access issues, the sampling was not completed. Further analysis must be conducted prior to completion of design phase. Based on sample results from nearby areas, and the Phase I ESA, the likelihood of finding some form of contamination is moderate, but the likelihood that the contamination would be of the magnitude and type that would hinder future real estate acquisition and construction activities is low.

Section 5 (Alternatives 1C and 1A-C). Section 5 has eight areas of concern within the Study Area, and no concerns adjacent to the Study Area.

- 1915 Ellis Blvd NW, (Residential). The REC is the presence of three unlabeled 55-gallon drums. Recommend characterization and proper disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 1848 - 8th Street NW, (Residential). The REC is the presence of one unlabeled 55-gallon drum. Recommend characterization and proper disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 1856 - 8th Street NW, (Residential). The REC is the presence of three unlabeled 55-gallon drums. Recommend characterization and proper disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 604 Penn Avenue NW, (Residential). The REC is the presence of one unlabeled poly tank. Recommend characterization and proper disposal of tank contents if further action on Alternative 1C or 1A-C is pursued.

- 590 Penn Avenue NW, (Residential). The REC is the presence of 14 unlabeled 55-gallon drums. Recommend characterization and proper disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 600 Penn Avenue NW, (Residential). The REC is the presence of two unlabeled poly tanks. Recommend characterization and proper disposal of tank content if further action on Alternative 1C or 1A-C is pursued.
- 1617 - 6th Street NW, (Residential). The RECs are a sand pit well and fuel oil 55-gallon drum. Recommend proper abandonment of sand pit well and disposal of fuel oil drum if further action on Alternative 1C or 1A-C is pursued.
- 1520 - 4th Street NW, (Residential). The REC is sinkhole that possibly contains an underground storage tank. Recommend a Phase II ESA to determine presence of UST and soil/groundwater characterization if needed if further action on Alternative 1C or 1A-C is pursued.

Section 6 (Alternatives 1C and 1A-C). Section 6 has eleven areas of concern within the Study Area, and no concerns adjacent to the Study Area.

- 1247 - 3rd Street NW, (Residential). The REC is a former appliance repair shop. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 1215 - 2nd Street NW, (Commercial). The RECs are a former auto repair shop, a cistern, and two hydraulic lifts. Recommend a Phase II ESA characterizing soil and groundwater and proper abandonment of cistern if further action on Alternative 1C or 1A-C is pursued.
- 1131 - 4th Street NW (Commercial). The REC is the former auto repair garage. Recommend a Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- Hubbard Industrial Park, 1124 - 1st Street NW, (Industrial). The RECs are three deep water wells; oil stains; 41 5-gallon cans of latex paint; 13 5-gallon containers of hydraulic oil; five 55-gallon drums of motor oil; 2000-gallon heating oil UST, and LUST incidents in November 1989 and November 1995. Recommend Phase II ESA characterizing soil and groundwater from heating oil UST, former LUST incidents, and oil spill locations; abandon water wells, characterize and dispose of paint, hydraulic oil and motor oil if further action on Alternative 1C or 1A-C is pursued.
- 1250 1st Street NW, (Commercial). The REC is historical use of chemicals associated with motor freight and truck repair facility. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 100 F Avenue NW, (Commercial). The REC is the historical use of the site for auto repair. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- Cedar Rapids Tent and Awning Co., 1208 First Street NW, (Commercial). The RECs are two temporarily closed 1000 gallon USTs. Recommend Phase II ESA characterizing soil and

groundwater, and removal of USTs if not used if further action on Alternative 1C or 1A-C is pursued.

- Lehman, Allsop and Evans, 1010 - 1st Street NW, (Industrial). The RECs are two unlabeled 55- gallon drums (with spillage); oil seeps along building west wall; floor drains with unknown discharge locations; car batteries; 200-gallon used motor oil AST; and reports of mercury spill in 1996. Recommend Phase II ESA characterizing soil and groundwater from petroleum and chemical spills, and mercury spill if further action on Alternative 1C or 1A-C is pursued.
- 407 Avenue NW, (Residential). The REC is a large pile of home contents, electronics and municipal solid waste. Recommend proper disposal of waste if further action on Alternative 1C or 1A-C is pursued.
- 1011 5th Avenue NW, (Residential). The REC is a very large pile of demolition debris. Recommend proper disposal of waste if further action on Alternative 1C or 1A-C is pursued.
- 305 G Avenue NW, (Residential). The RECs are multiple containers of used oil; open buckets of oily water; miscellaneous debris; and old roof shingles. Recommend Phase II ESA characterizing soil and groundwater, and proper disposal of debris and waste if further action on Alternative 1C or 1A-C is pursued.

Section 7 (Alternatives 1C and 1A-C). Section 7 has twenty areas of concern within the Study area, and one concern adjacent to the Study area.

- 613 - 4th Street NW, (Residential). The REC is an unlabeled 55-gallon drum. Recommend characterization and disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 612 - 3rd Street NW, (Residential). The REC is an unlabeled tank in the basement of the residence. Recommend characterization and disposal of tank contents if further action on Alternative 1C or 1A-C is pursued.
- Jiffy Mart, 120 - 1st Avenue NW, (Commercial). The REC is the properties designation as a LUST site. Recommend investigation into LUST remediation status, and collecting groundwater samples from existing monitoring wells if further action on Alternative 1C or 1A-C is pursued.
- Iowa Lube Inc, 116 - 1st Avenue NW, (Commercial). The RECs are the designation as a former LUST site and use of the site as an auto lubrication business. Recommend determining LUST remediation status if further action on Alternative 1C or 1A-C is pursued.
- Dhalilwal's Bulk Stations, 100 - 1st Avenue NW, (Commercial). The designation as a former LUST site, and the reporting of inspection violations. Recommend further research into LUST status and violations if further action on Alternative 1C or 1A-C is pursued.
- Swiss Valley Farms Co, 133 F Avenue NW, (Commercial). The RECs are the designation as a former LUST site; unlabeled 55-gallon drums; AST's; and a water well. Recommend further investigation into LUST remediation status, abandon water well, and review record of chemical disposal if further action on Alternative 1C or 1A-C is pursued.

- 222 3rd Street NW, (City owned). The RECs are 250-gallon diesel and 250-gallon gasoline ASTs; a 100-gallon hydraulic fluid container; and use of facility as vehicle maintenance facility. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- Fire Training Center, Parcel # 1428227001, (City owned). The RECs are unlabeled 55-gallon drums. Recommend charactering and disposing of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 200 1st Street SW, (Commercial). The RECs are floor drains with unknown connections. Recommend further investigation into floor drain layout if further action on Alternative 1C or 1A-C is pursued.
- 415 2nd Street SW, (Commercial). The REC is the use of the facility as an auto repair shop. Recommend Phase II ESA of soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 419 2nd Street SW, (Commercial). The REC is the presence of three unlabeled 55-gallon drums. Recommend characterization and disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.423 2nd Street SW, (Commercial). The REC is the use of the facility as an auto repair shop. Recommend Phase II ESA of soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 116 5th Ave SW, (Commercial). The REC is the use of the facility as an auto repair shop. Recommend Phase II ESA of soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 108 5th Avenue SW, (Commercial). The REC is a 30-gallon waste oil barrel. Recommend characterizing and disposing of barrel contents if further action on Alternative 1C or 1A-C is pursued.
- 418 1st Street SW, (Commercial). The REC is the presence of PCB containing transformers. Recommend Phase II ESA of soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 406 1st Street SW, (Commercial). The REC is an unlabeled 55-gallon drum. Recommend characterizing and disposing of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 525 H Street SW, (Commercial). The REC is the use of the facility as a scrap yard. Recommend Phase II ESA charactering soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 529 H Street SW, (Commercial). The REC is the use of the facility as a scrap yard. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 533 H Street SW, (Commercial). The REC is the use of the facility as a scrap yard. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.

- Police Station, 505 1st Street SW, (City owned). The RECs are two gasoline USTs. Recommend further investigation for possible releases if further action on Alternative 1C or 1A-C is pursued.
- Clark Retail #2337, 502 East Avenue, (Commercial-adjacent to Study Area). The REC is designation as LUST Site. Recommend further investigation into LUST remediation status and Phase II ESA characterizing soil and groundwater if needed if further action on Alternative 1C or 1A-C is pursued.

Section 8 (Alternatives 1C and 1A-C). Section 8 has seventeen areas of concern within the Study area, and no concerns adjacent to the Study area.

- 2210 A Street SW, (Commercial). The RECs are the designation as a small quantity hazardous waste generator, a landfill adjacent to the property, a former 6000-gallon gasoline UST and an unlabeled 30-gallon drum. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- P Lang Construction, 2204 A Street SW, (Commercial). The REC is the presence of a landfill adjacent to the property. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- Cedar Rapids Transmission, 20 22nd Avenue SW, (Commercial). The RECs are the use of the facility as a transmission repair shop and the removal of one 1000 -gallon diesel, one 1000-gallon gasoline and one 3000 gallon diesel USTs. Recommend investigation into UST removal documentation and Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 35 - 21st Avenue SW, (Residential). The REC is the historical use as an auto repair shop. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 103 - 8th Avenue SW, (Commercial). The REC is the historical use as a gas station. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 825 - 1st Street SW, (Commercial). The REC is the historical use of the property as a gas station. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- Penford Company, 1001 - 1st Street SW, 75 8th Avenue SW, (Industrial). The RECs are designation as small quantity hazardous waste generator; three 2100-gallon and one 6000-gallon AST's; reports of releases of ethylene oxide; sulfur dioxide; chlorine; chloroform; butadiene and PCBs; presence of ethylene oxide AST and railroad tank car; two AST's with unknown contents; a large AST with unknown contents and three water wells. Recommend a Phase II ESA characterizing soil and groundwater, further investigation into water wells and abandonment if not utilized if further action on Alternative 1C or 1A-C is pursued.

- 1115 C Street SW, (City owned). The REC is the historical use of the property as a gas station. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 1100 C Street SW, (City owned). The REC is the historical use of the property as a gas station. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 1805 A Street SW, (City owned). The RECs are a used oil drain; diesel and gasoline AST's; and use as a maintenance facility. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- Sokol Park, Parcel # 1428476002, (City-owned). The REC is the historical use of the property as a coal shed and auto junk yard. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 28 - 16th Avenue SW, (City owned). The RECs are the status a as an RCRA non-hazardous generator, former presence of one 10,000-gallon gasoline; three 4000-gallon gasoline; and one 4000-gallon diesel USTs, and designation as LUST release. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 41 - 16th Avenue SW, (Commercial). The REC is the historical use of the property as an auto sales/service and repair shop. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 50 -16th Avenue SW (Commercial). The REC is the historical use of the property as an auto repair shop. Recommend Phase II ESA characterizing soil and groundwater if further action on Alternative 1C or 1A-C is pursued.
- 45 - 17th Avenue SW, (Residential). The REC is a potential septic tank. Recommend further investigation into septic tank presence if further action on Alternative 1C or 1A-C is pursued.
- 46 - 18th Avenue SW, (Residential). The RECs are oil stains on a driveway, and an unlabeled 30 gallon drum. Recommend proper disposal of drum contents if further action on Alternative 1C or 1A-C is pursued.
- 2250 A Street SW, (Landfill). The RECs are use as a landfill; former presence of a 10,000-gallon diesel UST; presence of monitoring wells; and an unlabeled 200-gallon poly tank. Recommend further investigation into UST removal, and conducting Phase II ESA, characterizing soil and groundwater if necessary; characterize and dispose of contents in poly tank if further action on Alternative 1C or 1A-C is pursued.

Section 9 (Not included in Alternatives). Section 9 has one area of concern within the Study area, and no concerns adjacent to the Study area.

- **Cedar Rapids Water Pollution Control Facility,** 7525 Bertram Road SE, (City owned). The RECs are an inactive water well; oil leaks from storage shed; gasoline leak from storage container; a 170,000 -gallon #2 fuel oil AST; and use as an ash lagoon operation, electrical substation, and waste water treatment facility. Recommend Phase II ESA characterizing soil and groundwater and proper abandonment of inactive water well if further action is pursued.

Section 10 (Not included in Alternatives). Section 10 has one area of concern within the Study area, and no concerns adjacent to the Study area.

- **Alliant Energy Prairie Creek Generating Station,** 3300 C Street SW (Industrial). The presence of a coal fired power plant and the presence of coal piles, coal ash piles, transformers and lagoons. Recommend Phase II ESA characterizing soil and groundwater if further action is pursued.

Section 11 (Alternatives 1C, 1A-C and 4C). Section 11 has two areas of concern within the Study Area, and four concerns adjacent to the Study Area.

- Vacant Land, Midwestern Railroad Property (Parcel # 1421301003), (Industrial). The REC is the presence of two monitoring wells on the northeast portion of the parcel and the location of the parcel in a historical industrial area. Recommend determining the purpose of two monitoring wells. In conjunction with geotechnical exploration for Alternative 4C, HTRW soil sampling (Boring B4) is proposed along the section of the Alternative 4C alignment that coincides with this parcel. Due to access issues, the sampling was not completed. Further analysis must be conducted prior to completion of design phase. Based on sample results from nearby areas, and the Phase I ESA, the likelihood of finding some form of contamination is moderate, but the likelihood that the contamination would be of the magnitude and type that would hinder future real estate acquisition and construction activities is low.

- Cargill Inc, 704 Dewey Avenue NE (Industrial). The REC is the presence of large USTs and AST's and the location of the parcel in a historical industrial area. The USTs are utilized for hazardous liquid storage. Recommend evaluating management of ASTs and USTs to assure environmental impact of any release is minimized. In conjunction with geotechnical exploration for Alternative 4C, HTRW soil sampling (Boring B1) was proposed along the section of the Alternative 4C alignment that coincides with this parcel. Due to access issues, the sampling was not completed. Further analysis must be conducted prior to completion of design phase. Based on sample results from nearby areas, and the Phase I ESA, the likelihood of finding some form of contamination is moderate, but the likelihood that the contamination would be of the magnitude and type that would hinder future real estate acquisition and construction activities is low.
- Electro-Coatings Inc, 911 Shaver Road NE (Industrial-adjacent to Study Area). The REC is the property's listing in the National Priorities Listing database for release of chromic acid to Cedar Lake. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for Alternative 4C, and no further action is necessary.
- CNW North Railyard, 800 Stickle Drive NE (Industrial-adjacent to Study Area). The REC is property listed as a leaking underground storage tank site Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for Alternative 4C, and no further action is necessary.
- Quaker Manufacturing LLC, 418 2nd Street NW (Industrial-adjacent to Study Area). The RECs are historical releases of 2-Furan carboxaldehyde, acetic acid, and formaldehyde.

Recommended Phase II ESA characterizing soil from historical release areas. In conjunction with geotechnical exploration for Alternative 4, HTRW soil sampling (Borings B7, B8, B9 and B10) was conducted along the section of the Alternative 4C alignment that coincides with this parcel. Based on the HTRW soil sampling, the chemicals of concern do not exceed state and Federal standards. No further assessment is necessary.

- 218 2nd Street NE (adjacent to study area), (Commercial). The REC is a 750 gallon diesel release that occurred during the 2008 Flood. Foth recommended a Phase II ESA for the parcel, but further analysis indicates this parcel is outside the range of influence for Alternative 4, and no further action is necessary.
- Alliant Energy, Parcel # 1421201001, (Industrial). The REC's are proximity to the contaminated Cedar Lake, hazardous waste generator status, industrial history and presence of fly ash piles adjacent to property. In conjunction with geotechnical exploration for Alternative 4C, HTRW soil sampling (Borings B2 and B3) is was proposed along the section of the Alternative 4 alignment that coincides with this parcel. Due to access issues, the sampling was not completed. Further analysis must be conducted prior to completion of design phase. Based on sample results from nearby areas, and the Phase I ESA, the likelihood of finding some form of contamination is moderate, but the likelihood that the contamination would be of the magnitude and type that would hinder future real estate acquisition and construction activities is low.

Section 12 (Alternative 10E). Section 12 has five areas of concern within the Study Area, and no concerns adjacent to the Study Area.

- Armstrong Race Realty, 120 2nd Street NE (Commercial). The REC is the former presence of a gasoline service station. Recommend Phase II ESA characterizing soil and groundwater if Alternative 10E is pursued.
- Vacant Land, (Parcel #1421455002), (City owned). The REC is former use of property as an auto repair shop. Recommend Phase II ESA characterizing soil and groundwater if Alternative 10E is pursued.
- Vacant Land, Brenton Bank and Trust Company (Parcel # 1421379002), (Commercial). The REC is the former use of the property as a gasoline service station. Recommend Phase II ESA characterizing soil and groundwater if Alternative 10E is pursued.
- NW and NW corners of the A Avenue NE and 2nd Street NE intersection. The REC is the former use of the property as a gasoline service station. Recommend Phase II ESA characterizing soil and groundwater if Alternative 10E is pursued.
- NW and NW corners of the A Avenue NE and 3rd Street NE intersection. The REC is the former use of the property as a gasoline service station. Recommend Phase II ESA characterizing soil and groundwater if Alternative 10E is pursued.

Section 13 (Alternative 10E). Section 13 has eight areas of concern within the Study Area, and no concerns adjacent to the Study Area.

- City Park/Indoor Pool, 940 14th Avenue SE (City owned). The RECs are the presence hazardous chemicals and capped fill pipes for an unknown storage unit. Recommend verification of proper chemical storage, determine if any releases have occurred, and determine nature of fill pipes if Alternative 10E is pursued.
- 629 12th Avenue SE, (Commercial). The REC is the presence of a hoist oil tank. Recommend Phase II ESA characterizing soil if Alternative 10E is pursued.
- Vacant lot, 400 12th Avenue SE, (Industrial). The REC is the classification of the property as a LUST site. Recommend evaluation of site documents to determine if Phase II ESA is necessary if Alternative 10E is pursued.
- Vacant lot, 415 12th Avenue SE, (Industrial). The REC is the former use of property as a cannery and oil house, presence of open pipes and monitoring wells. Recommend abandoning monitoring wells if not needed, elevation of site documents to determine if Phase II ESA is necessary and plugging open pipes if Alternative 10E is pursued.
- 705 16th Avenue SE, (Industrial). The RECs are the presence of a tunnel, eight 55-gallon drums containing 'used screw oil" or ethylene glycol. Recommend investigation of nature and integrity of tunnel, and characterizing and disposing of drum contents if Alternative 10E is pursued.
- Former Rescar Facility, 1800 - 10th Street SE, (Industrial). The RECs are a former facility for railcar maintenance and painting, stained soil, a former storage area for paint and hazardous waste, and a former dump and fill area. Foth recommended a Phase II ESA characterizing the soil at the railcar maintained facility, the stained soil area, the former paint and hazardous waste storage areas, and the former dump and fill area.

  The sponsor has conducted Phase II soil and groundwater sampling near the Alternative 4C alignment footprint. Based on a review of the sponsor Phase II sampling, benzo(a)pyrene concentrations exceed the state soil standards, and total extractable hydrocarbon concentrations exceed the state groundwater standards. The sponsor will need to address the contamination prior to any construction activities.
- 1525 16th Avenue SE, (Industrial). The REC is the presence of several monitoring wells. Recommend investigation into nature of monitoring wells and abandonment if wells are no longer needed. In conjunction with geotechnical exploration for Alternative 4C, HTRW soil sampling has been conducted along the section of the Alternative 4C alignment that coincides with this parcel.
- Cargill Inc, 704 Dewey Avenue NE (Industrial). The REC is the presence of large USTs and AST's and the location of the parcel in a historical industrial area. The USTs are utilized for hazardous liquid storage. Recommend evaluating management of ASTs and USTs to assure environmental impact of any release is minimized. In conjunction with geotechnical exploration for Alternative 4C, HTRW soil sampling (Boring B1) was proposed along the section of the Alternative 4C alignment that coincides with this parcel. Due to access issues, the sampling was not completed. Further analysis must be conducted prior to completion of design phase. Based on sample results from nearby areas, and the Phase I ESA, the likelihood of finding some form of contamination is moderate, but the likelihood that the contamination

would be of the magnitude and type that would hinder future real estate acquisition and construction activities is low.

V. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE SOIL SAMPLING

A. Airport Borrow Area. The HTRW soil sampling was completed on March 18 and 19, 2010 for the Cedar Rapids Airport potential borrow area. Seventeen soil borings were installed, for a total of 34 soil samples. Two samples were collected from each boring. At each selected boring a composite sample was collected from the 0 to 5 feet depth range, and a discrete sample at 14 to 16 feet below grade. The samples were analyzed for the presence of Volatiles (VOCS); Semi-Volatiles (SVOCs); Polychlorinated Biphenyls (PCBs); pesticides; herbicides; Toxic Characteristic Leaching Procedure (TCLP) Metals; and Total Metals Review of the sample results indicates that two samples (B11 0-5', and B13 0-5') had bis(2-ethylhexyl)phthalate concentrations above the Iowa DNR Statewide Standards for Soil. One sample (B1 0-5') had cobalt concentrations above the Iowa DNR Statewide Standards for Soil. A map of the proposed borrow area is included in Appendix F-D.

B. Geotechnical/HTRW Alignment Borings Soil borings were installed as part of a geotechnical investigation along the proposed alignments for Alternatives 4C, 5 and 7. Twenty six borings were selected for HTRW. These borings were selected based on previous information from the Foth Phase I ESAs and information gathered by the Corps. For the sake of efficiency and timeliness, parcels that had indications of HTRW concerns that were going to have geotechnical drilling were also selected for collection of HTRW samples. Two samples were collected from each boring. At each selected boring a composite sample was collected from the 0 to 5 feet depth range, and a discrete sample at 15 feet below grade. Soil samples collected for the Phase II were analyzed for the presence of VOCs; SVOCs; PCBs; pesticides; herbicides; TCLP Metals; and Total Metals. . Due to access issues, only borings B5, B7, B8, B9, B10, B16, B17, B18, B22, B23, B24 and B37 were installed and sampled. A map of the borings locations in included in Appendix F-E.

VI. CONCLUSIONS

A. Alternatives 1C and 1A-C. The Phase I ESAs indicated there are at least 68 parcels on which RECs were identified along the alignments for Alternatives 1C and 1A-C. Of these 68 parcels, 48 indicate RECs requiring a Phase II ESA that would entail characterization of soil and groundwater. The remaining 20 parcels had RECs that would not require a Phase II ESA, but required additional action, such as disposing of 55-gallon drums, abandoning a cistern or disposal of flood related debris.

The 48 parcels requiring Phase II ESAs are scattered throughout the Study Area, with the highest concentrations in Sections 6, 7 and 8. The current list of Phase II parcel RECs range from small auto repair shops to large industries. As such, the Phase II ESAs would range in size and scope. It is anticipated that the Phase II ESAs would consist of one to five soil borings per parcel.
Each Phase II ESA would be tailored to the individual parcel RECs, but it can be assumed that each soil and groundwater assessment will analyze one or more of the following parameters: TAL metals, VOCs, SVOCs, PCBs, pesticides, and herbicides. An estimated cost to complete the 48 Phase II ESAs

is $150,000.00. Phase II ESA's (in conjunction with geotechnical exploration) have been conducted on eight of the 48 parcels of concern.

Addressing the RECs at the remaining parcels would be the responsibility of the City of Cedar Rapids, working with the individual parcel owners or the City's representatives on City-owned property. There is the possibility that some of these parcels, after further investigation as recommended, would require a Phase II ESA.

B. Alternative 4C. The Phase I ESAs indicated there are 15 parcels on which RECs were identified along the alignment for Alternative 4C. The RECs require a Phase II ESA that will entail characterization of soil and groundwater.

The 15 parcels requiring Phase II ESAs are concentrated near the northern and southern ends of the alignment. The current list of Phase II parcels RECs range from leaking USTs to abandoned industrial lots and large industries. In conjunction with geotechnical exploration for Alternative 4C, HTRW soil sampling was conducted along the section of the Alternative 4C alignment that coincides with nine of these parcels.

C. Alternative 10E. The Phase I ESAs indicated there are 16 parcels on which RECs were identified along the alignment for Alternative 10E. Of these 16 parcels, 12 indicate RECs that required a Phase II ESA that will entail characterization of soil and groundwater. The remaining four parcels had RECs that would not require a Phase II ESA, but required additional action, such as disposing of 55-gallon drums, abandoning a cistern or disposal of flood related debris.

The current list of Phase II RECs range from leaking USTs to abandoned industrial lots and large industries. As such, the Phase II ESAs would range in size and scope. It is anticipated that the Phase II ESAs would consist of one to five soil borings per parcel

Each Phase II ESA would be tailored to the individual parcel RECs, but it can be assumed that each soil and groundwater assessment will analyze one or more of the following parameters: TAL metals, VOCs, SVOCs, PCBs, pesticides and herbicides. An estimated cost to complete the 12 Phase II ESAs is $80,000.00. Phase II ESA's (in conjunction with geotechnical exploration) have been conducted on four of the 12 parcels of concern.

Addressing the RECs at the remaining four parcels would be the responsibility of the City of Cedar Rapids, working with the individual parcel owners or the City's representatives on City-owned property. There is the possibility that two or three of these parcels, after further investigation as recommended, would require a Phase II ESA.

D. Airport Borrow HTRW Sampling. Three soil sample locations (B1, B11, and B13) indicate chemical or metal concentrations above the Iowa DNR Statewide Standards for soil. The samples were collected from the 0-5 foot depth. Therefore no soil from the boring locations B1, B11 and B13 in the range of 0 to 5 feet depth can be used as borrow material. The remaining areas that were proposed for borrow material from the airport property may be utilized.

E. Alignment 1C, 1A-C and 4C HTRW Sampling. Sampling was completed on nine parcels of concern. There are six parcels (two Cargill facilities, two Alliant Energy facilities and two Midwest Railroad facilities) where access was not granted. Sample results indicate five parcels sample locations exceed the statewide soil standards for benzo(a)pyrene, and one parcel exceeds for benzo(a)pyrene, benzo(a)anthracene, benzo(p)flourene, and dibenzo(a,h)anthracene. Contaminant concentrations are low to moderate in magnitude, and are fairly consistent throughout the Study Area. It is anticipated that contaminant concentrations on parcels where sampling access was not granted will be similar to those already observed. If the type and magnitude of contaminants remains the same, HTRW remedial activities are not anticipated to be detrimental to project schedule, scope and proposed construction methods.

F. Project Considerations. Due to the nature of the project, modifying the Alternatives footprints to avoid any parcels with HTRW concerns is not feasible. Movement to avoid parcels such as the Rescar Facility, Cargill or the former Sinclair Meatpacking Plant would result in subjecting those parcels to the wet side of the flood protection measure, and also result in loss of protection benefits which would have negative impacts on project justification,

As the full extent of HTRW concerns has not been discerned due to lack of access to all parcels, risk associated with HTRW issues was addressed in the Project Cost and Schedule Risk Analysis Report, located in Appendix I-A. HTRW implications for project cost and schedule were assigned a High Risk rating, which was incorporated into the final contingency value of 20%.

Given current HTRW conditions, a lack of response on the sponsor's part would result in the hindrance of Real Estate activities; likely pose additional risk during construction activities to construction workers and the general public, and complicate material movement and disposal during construction activities.

VII. RECOMMENDATIONS

A. Additional Investigation. Based on the Phase 1 ESAs, it is recommended that Phase II ESAs be completed on the parcels of concern within the alignment for the preferred Alternative. The number of remaining Phase II ESA's required are as follows: Alternatives 1C and 1A-C, at least 40 and Alternative 4C, at least 6, Alternative 10E at least 8.

These Phase II ESAs will determine if some form of contamination is present in the subsurface of the parcels, and will identify those areas where the City would be required to conduct further assessment and remediation. In addition, it is recommended that the City address the non-Phase II RECs present in each Alternative alignment's parcels that are City-owned or owned by individuals

B. Airport Borrow. Future planners and designers shall coordinate with the District's Environmental Engineering and Geotechnical Section to determine what areas are suitable for borrow material. Most of the proposed area is suitable for utilization.

C. Project Considerations. A majority of the parcels of concern affected by Alternative 4C have been investigated with a Phase I ESA, a Phase II ESA or both. Thus far, HTRW concerns are present but appear minimal. Nevertheless there are three main concerns with the type and magnitude of contamination observed.

First, as contamination is present, easements for construction and operations and maintenance cannot be procured for those parcels in question until the City can provide documentation from a state or federal agency (Iowa DNR or Region 7 US EPA) that the risks associated with the contamination have been mitigated. The City has committed to pursuing such documentation in an HTRW Letter of Intent located in Appendix F-F.

Second, the contamination currently observed exceeds the Iowa Statewide soil standards for dermal contact and ingestion. These two exposure pathways are present during construction activities. Any remaining risks posed to construction workers by these contaminants must be addressed in the design phase by the City and the Corps.

Third, existing soils might be removed as part of project construction. Further sampling and analysis will need to be incorporated in the design phase and construction phase to identify the proper disposal process for soils removed off construction work limits.

VIII. LIMITATIONS

No ESA can wholly eliminate uncertainty regarding the existence for recognized environmental conditions concerning a property. This assessment is intended to reduce, but not eliminate, uncertainty regarding the existence of recognized environmental conditions in connection with a property with reasonable limits of time and cost. If any previously unaddressed recognized environmental condition should arise, this HDR will be revisited. Title searches and research into environmental liens were not conducted for this report, but will be required prior to construction phase of the preferred alternative.

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

APPENDIX F-A
ACRONYMS

AIRS/AFS	Aerometric Information Retrieval System/AIRS Facility Subsystem
AST	Above-ground Storage Tank
ASTM	American Society for Testing and Materials
BRS	Biennial Reporting System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CEMVR	Corps of Engineers, Mississippi Valley Division, Rock Island District
DIVR	Division Regulation
DOD	Department of Defense
ED-DN	Engineering Division - Environmental Engineering Section
EM	Engineering Manual
EMCI	EnviroFacts Master Chemical Integrator
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Environmental Site Assessment
FII	Facility Identification Initiative
GI	General Investigation
GICS	Grants Information and Control System
GIS	Geographic Information System
HDR	HTRW Documentation Report
HTRW	Hazardous, Toxic, and Radioactive Waste
ICR	Information Collection Rule
ILEPA	Illinois Environmental Protection Agency
LUST	Leaking Underground Storage Tanks
LRP	Land Recycling Program
NFRAP	No Further Action Planned (Certificate)
NCOD	National Contaminant Occurrence Database
NPL	National Priorities List
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PNA	Polynuclear Aromatic Compound
PCS	Permit Compliance System

RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Information System
SDWIS	Safe Drinking Water Information System
SEIDS	Site Environmental Information Data System
SSHP	Site Specific Safety and Health Plan
TCLP	Toxic Characteristic Leaching Procedure
TRIS	Toxic Release Inventory System
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

CEDAR RIVER
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FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

APPENDIX F-B
REFERENCES AND ABSTRACTS

Foth Infrastructure & Environment LLC, Phase I Environmental Site Assessment, Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 - Cedar Rapids, Iowa, February 2010 and Sections 11, 12 and 13, April, 2010.

ASTM E 1527-05, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.

ASTM E 1528-06, Standard Practice for Environmental Site Assessments: Transaction Screen Process

ASTM, Standard E-1903-97 (2002)-Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process. ASTM, Philadelphia, PA, 1997

USACE, ER 1165-2-132, Water Resources Policies and Authorities - Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects, June 26, 1992,http://www.hnd.usace.army.mil/techinfo/engpubs.htm
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USACE, ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste, Appendix B, March 18, 1994, http://www.hnd.usace.army.mil/techinfo/engpubs.htm

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USACE, EM 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans, February 1, 2001. http://www.hnd.usace.army.mil/techinfo/engpubs.htm

USACE, Policy Guidance Letter ER 1105-2-100 No. 34, CECW-PA, Non-CERCLA Regulated Contaminated Materials at Civil Works Projects, 5 May 1992

USACE, ER 405-1-12, Real Estate Handbook, Chapter 8

USACE, ER 500-1-1, Natural Disaster Procedures

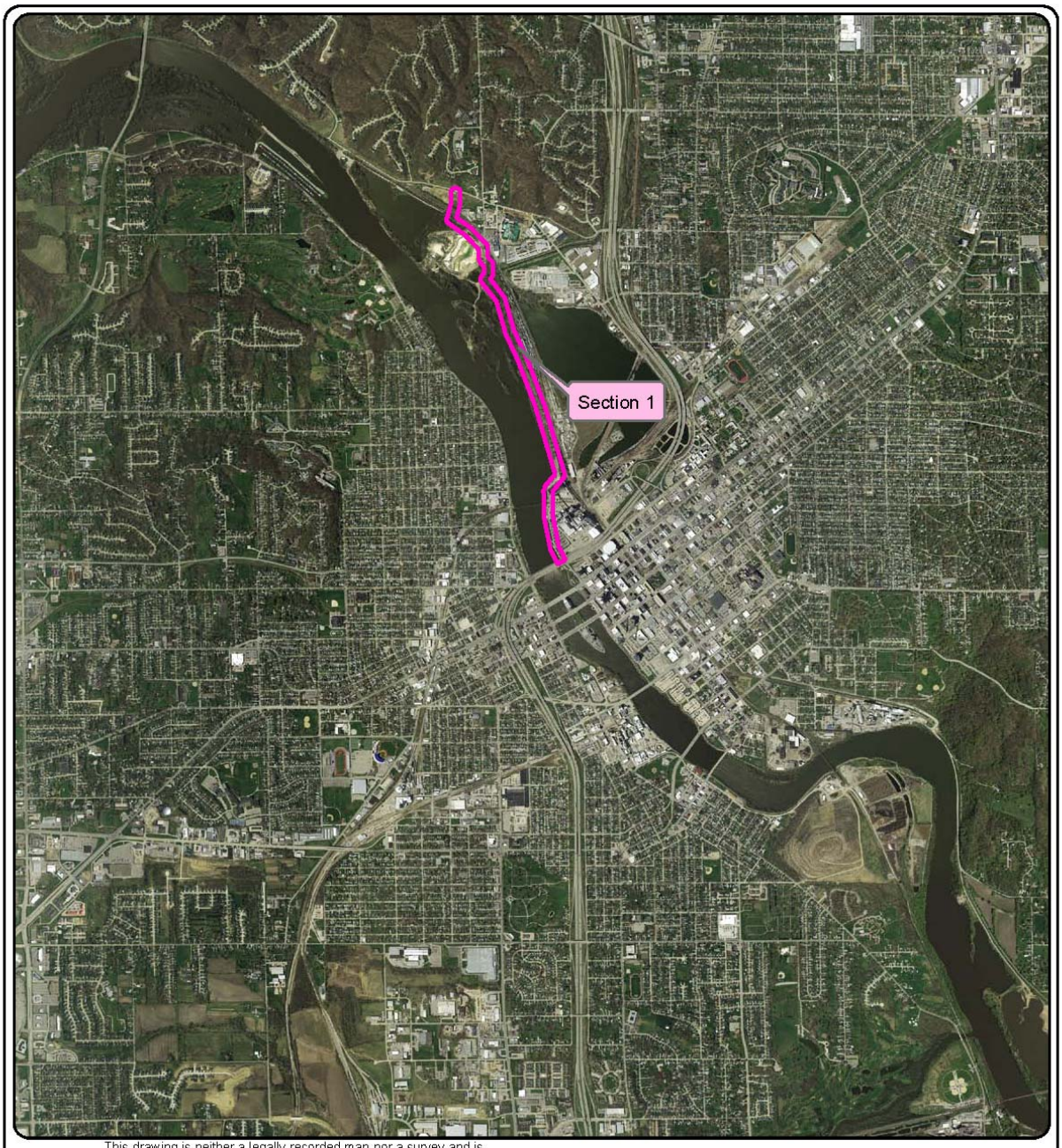
CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

APPENDIX F-C
SECTION OVERVIEW MAPS



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Section 1

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SECTION 1
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

DATE: 05-12-2010
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CHECKED BY: MRO

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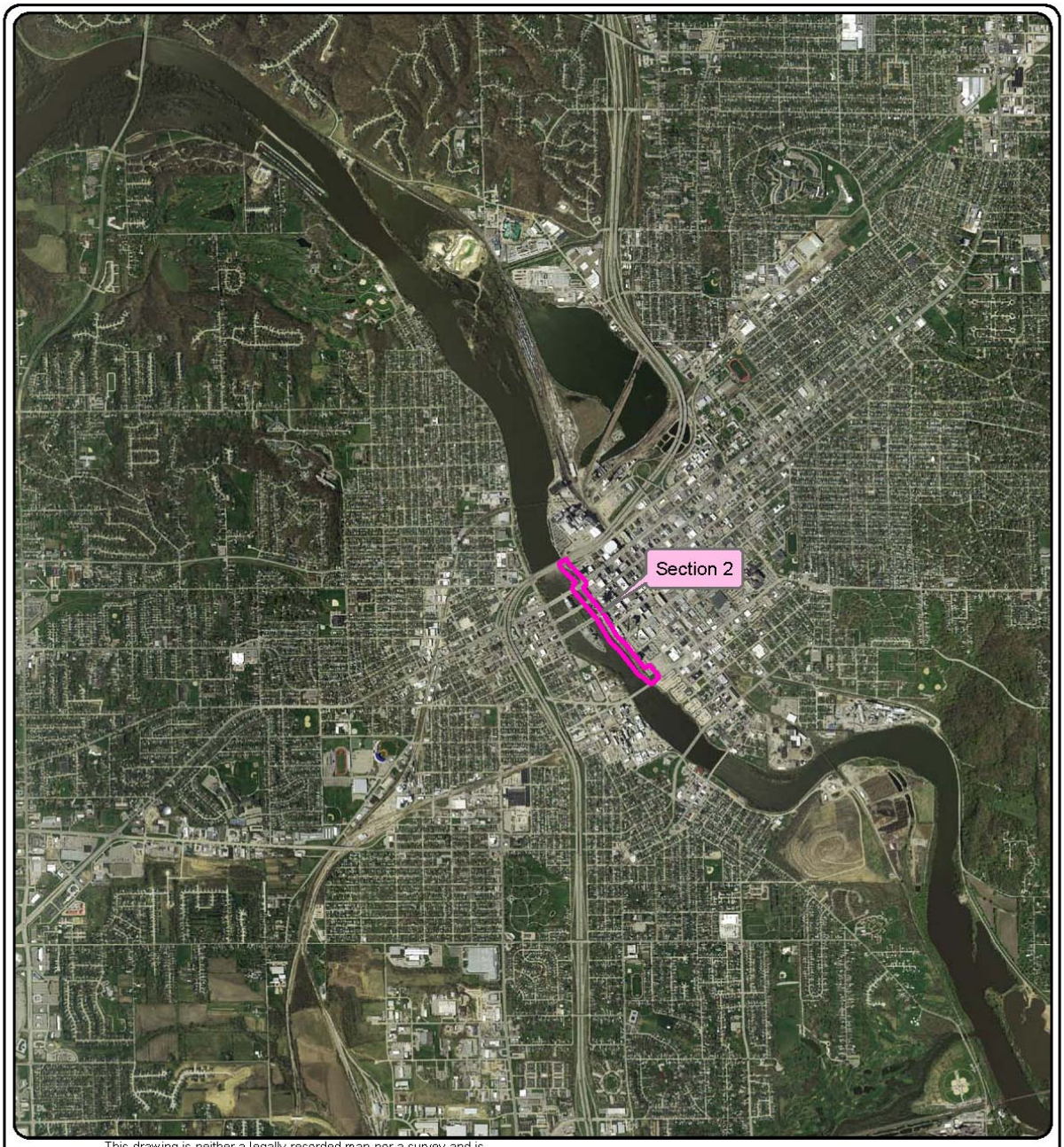

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Section 2

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FLOOD RISK MANAGEMENT FEASIBILITY STUDY
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CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

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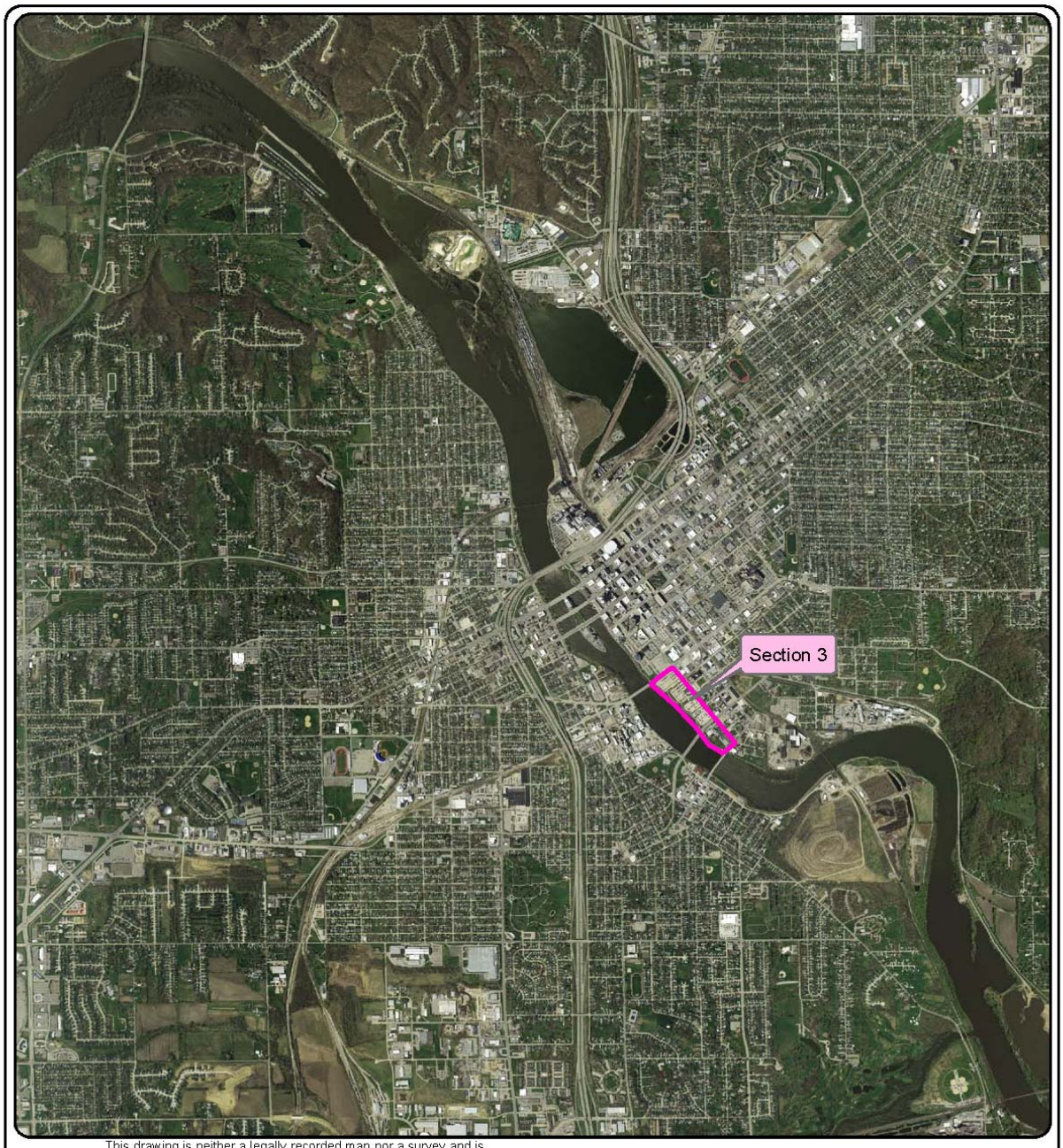

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Section 3

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FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

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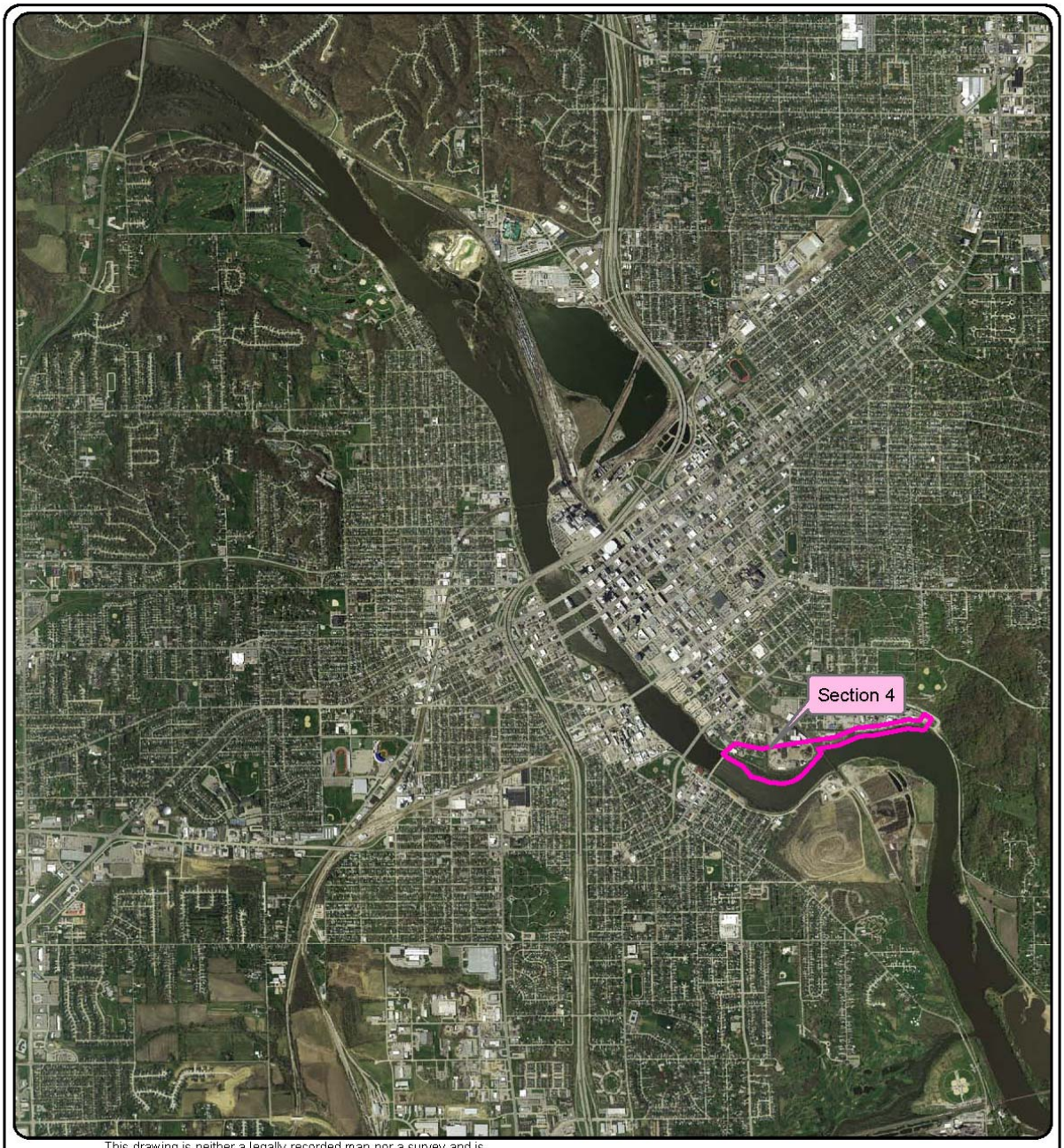

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Section 4

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FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

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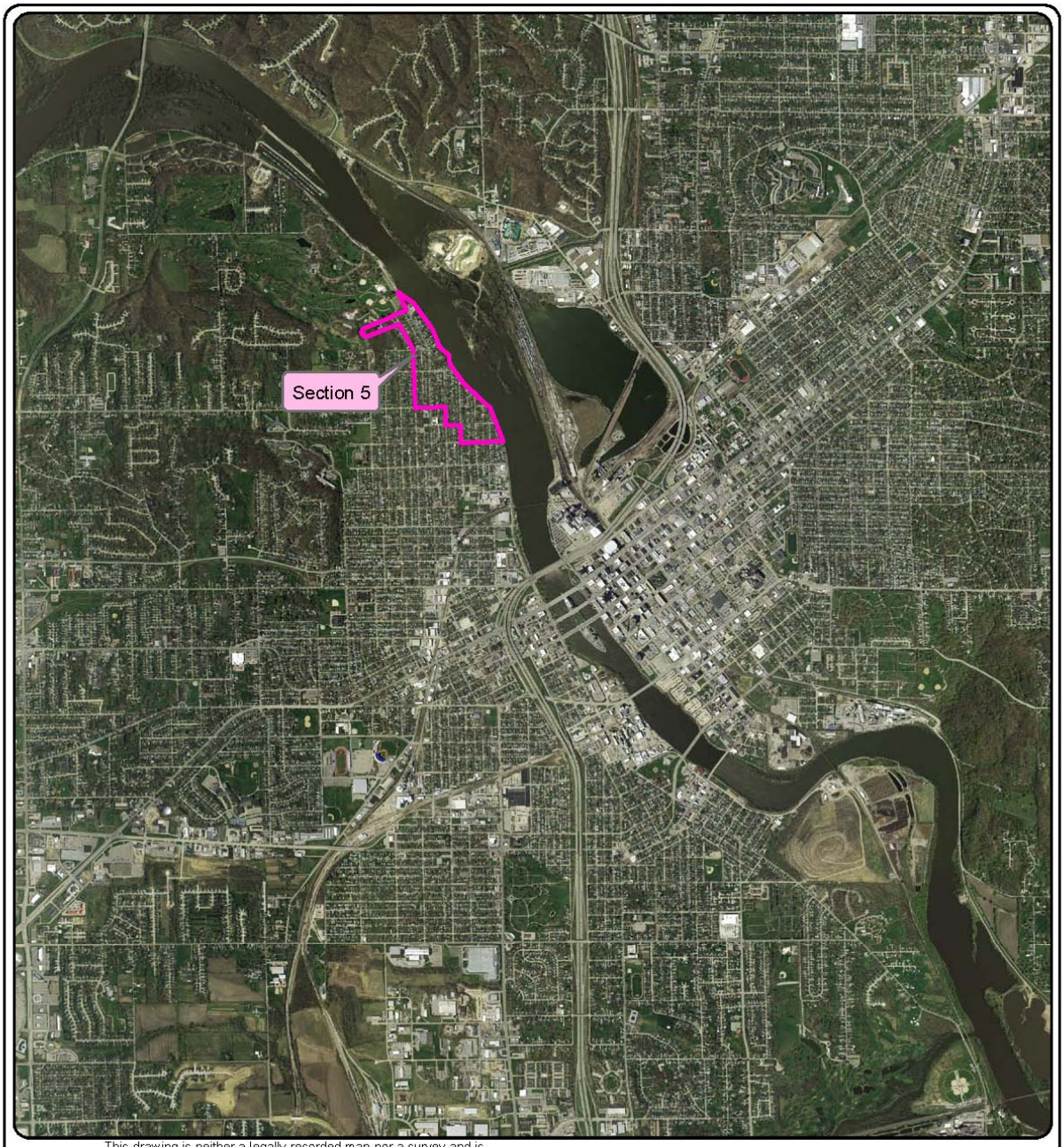

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Section 5

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SECTION 5
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

DATE: 05-12-2010
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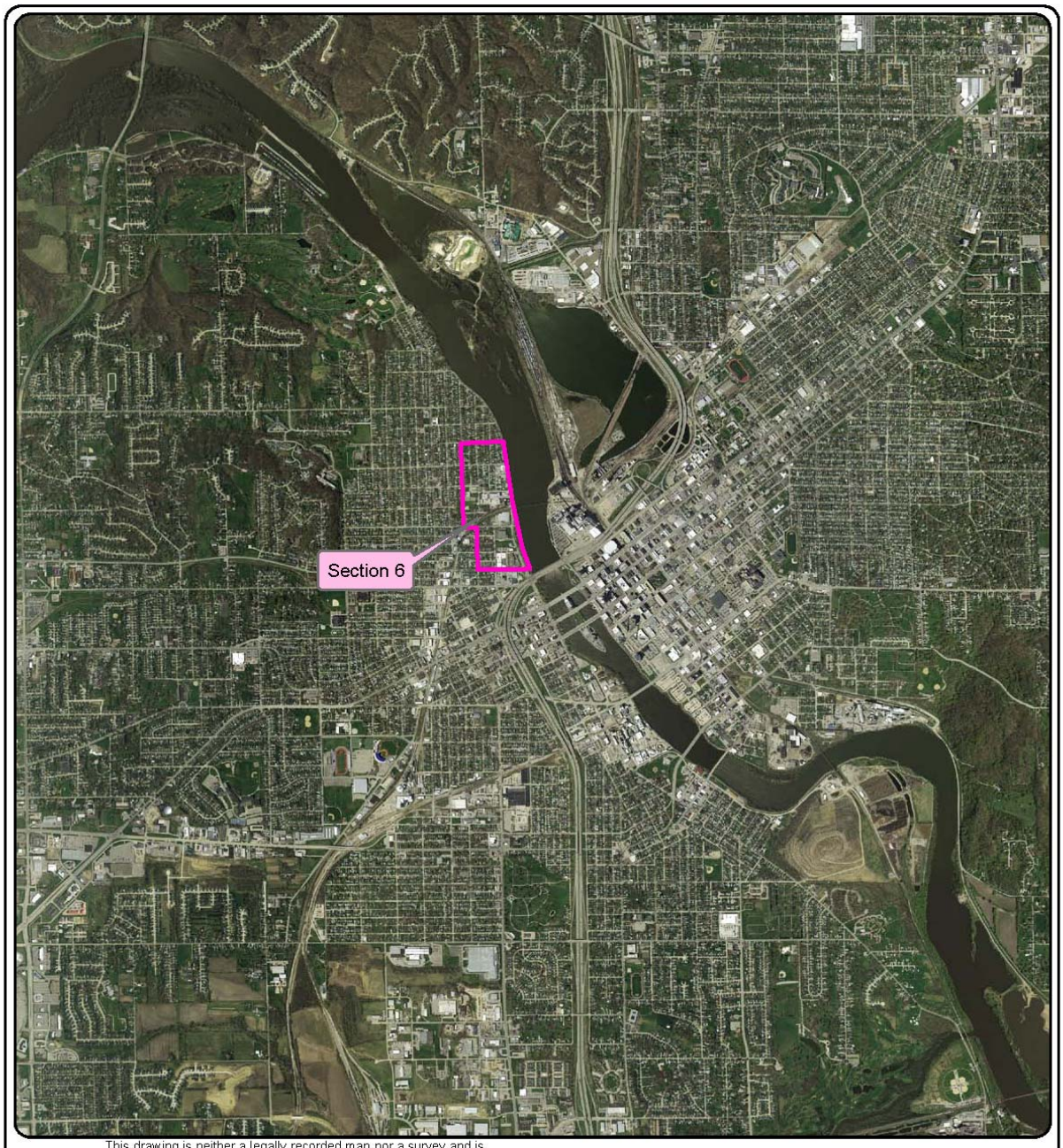

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Section 6

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SECTION 6
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

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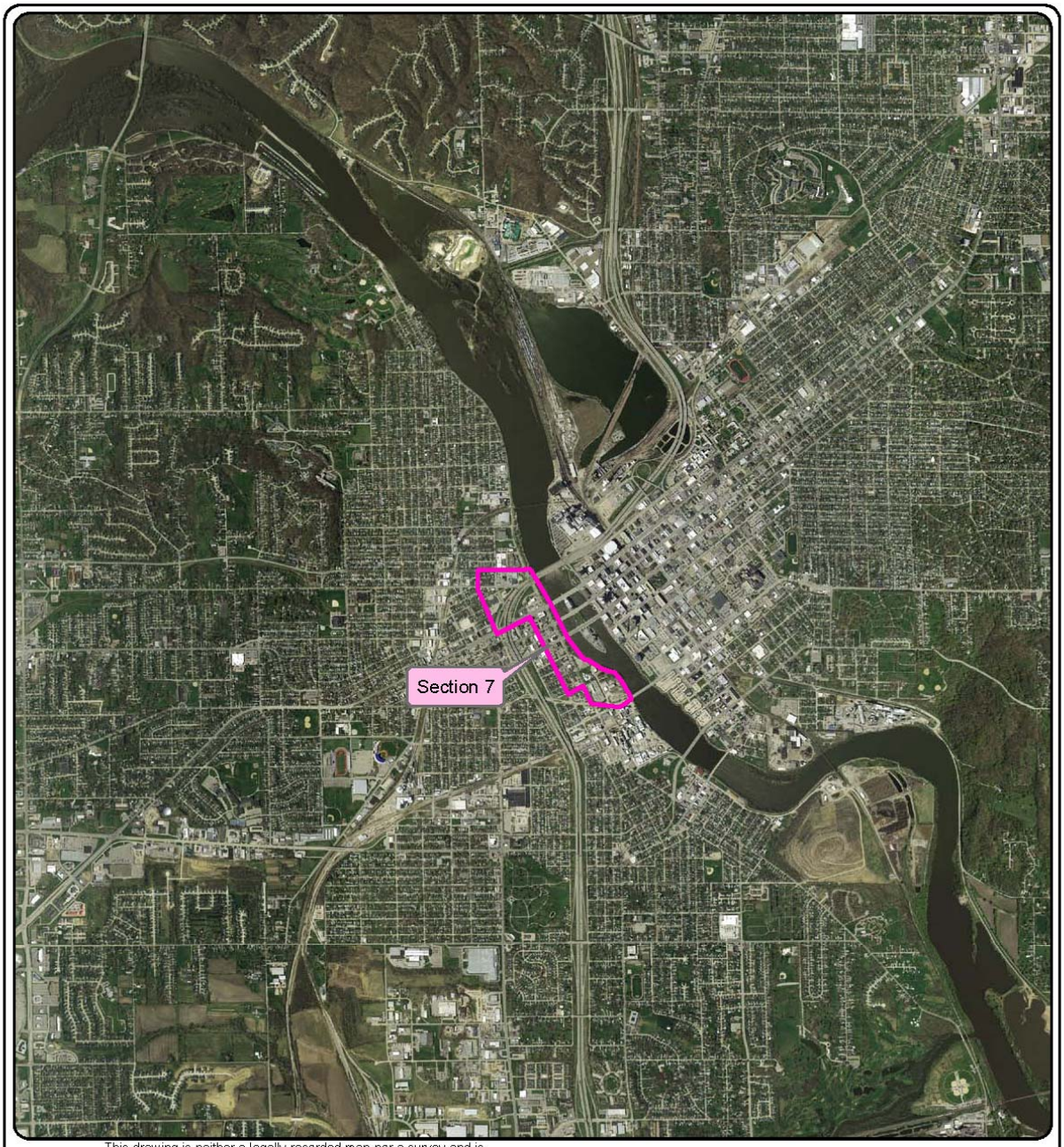

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Section 7

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SECTION 7
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

DATE: 05-12-2010
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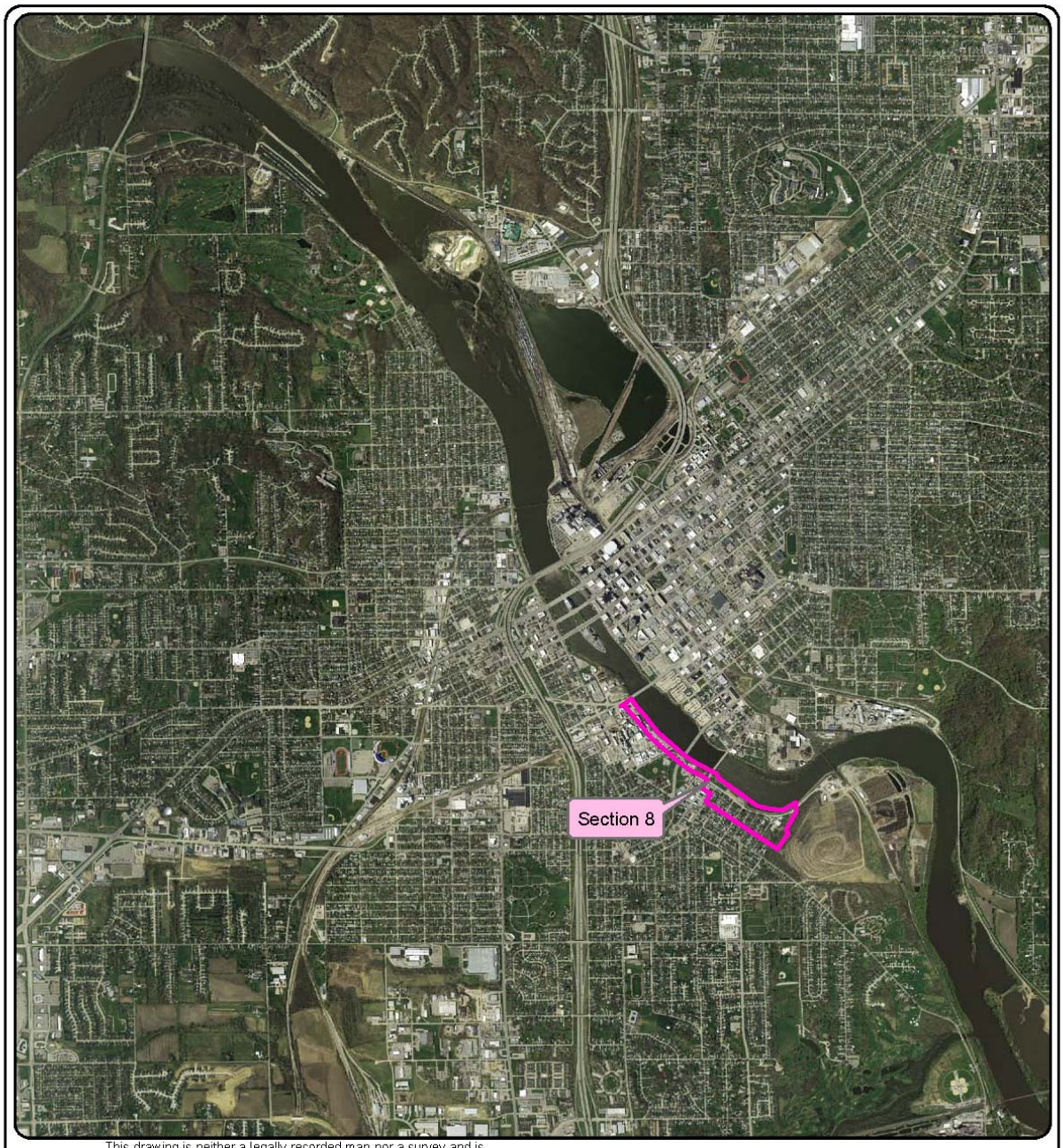

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Section 8

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SECTION 8
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

DATE: 05-12-2010
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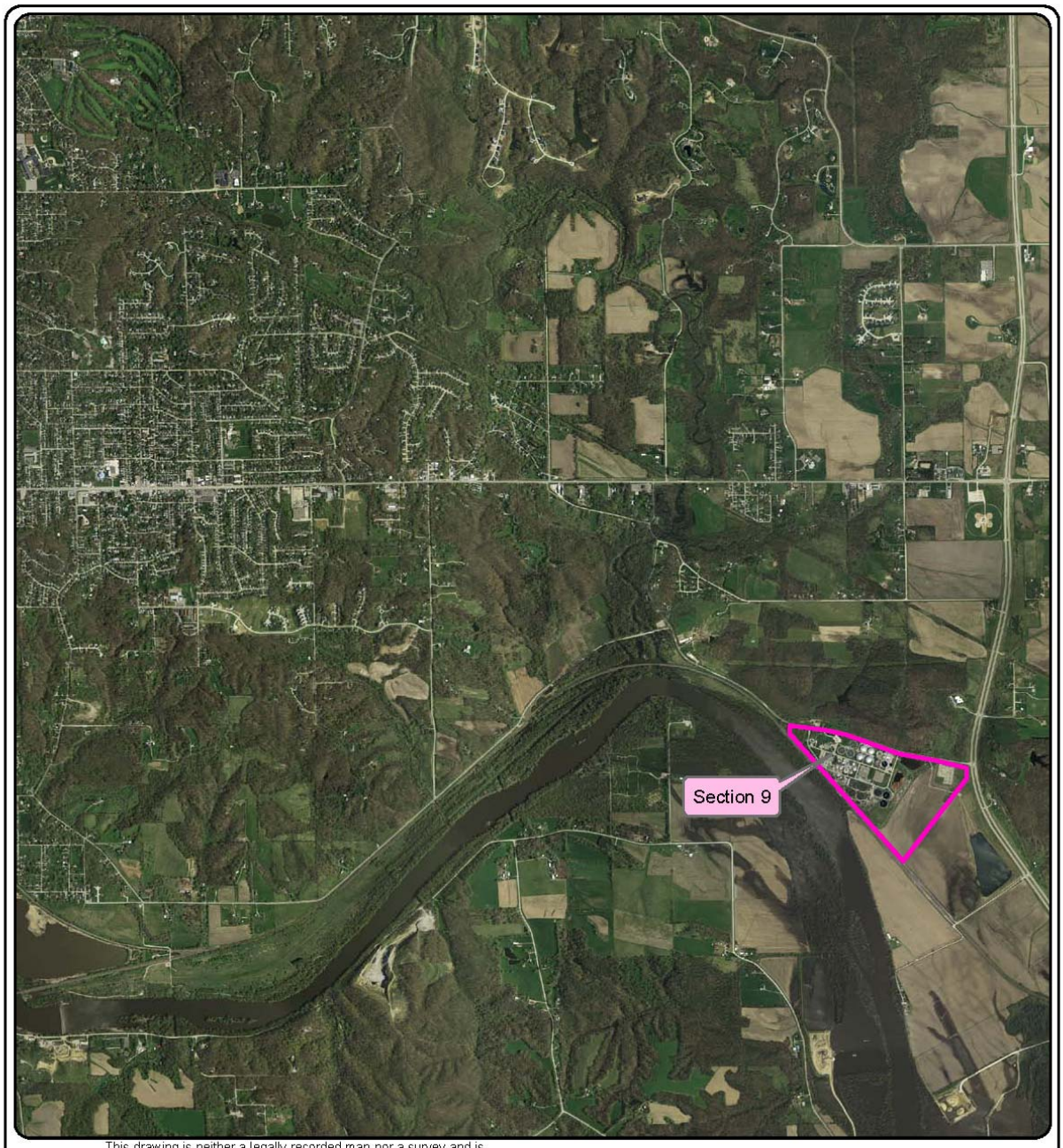

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Section 9

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SECTION 9
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

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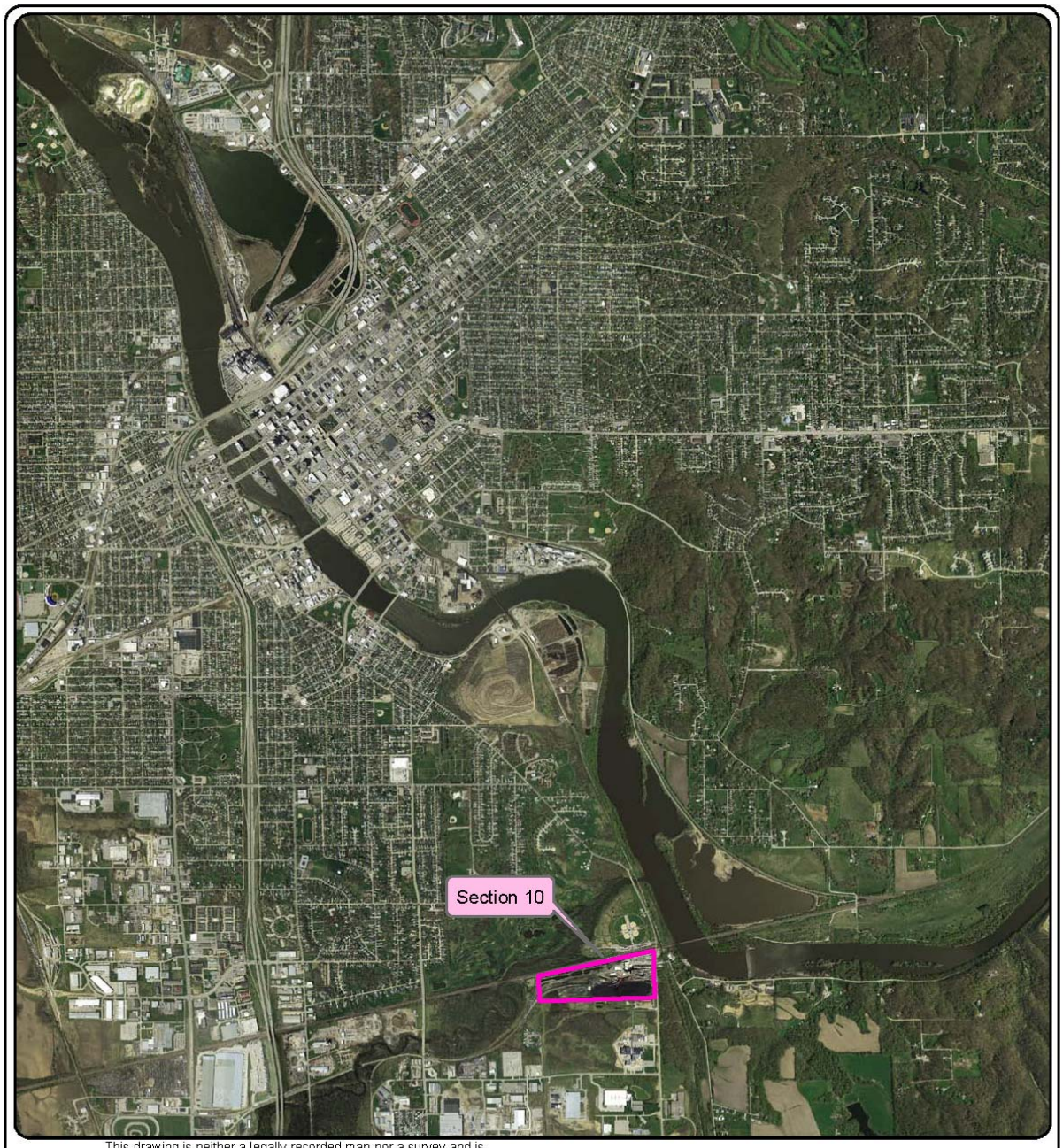

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Section 10

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SECTION 10
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

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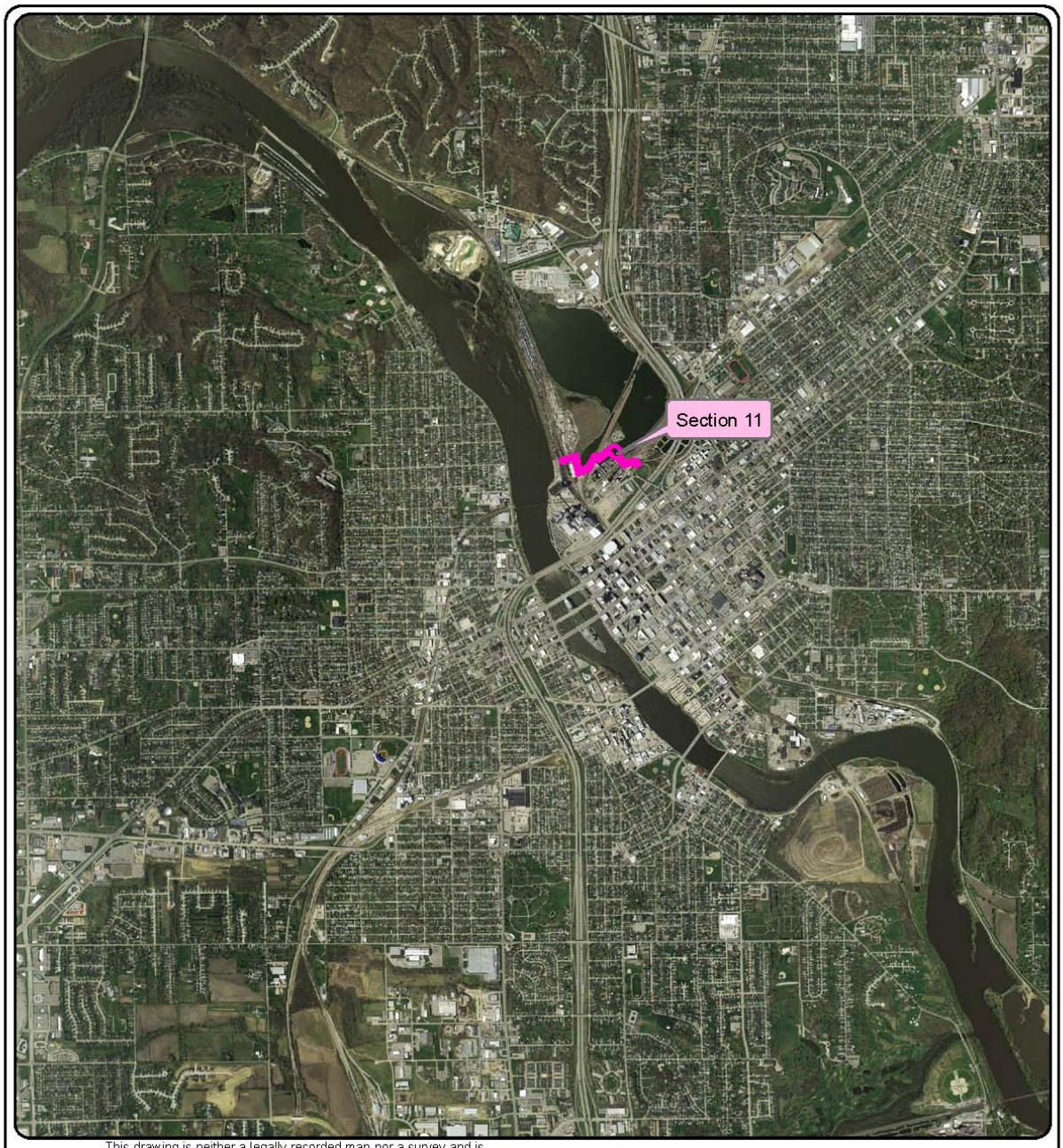

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Section 11

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SECTION 11
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

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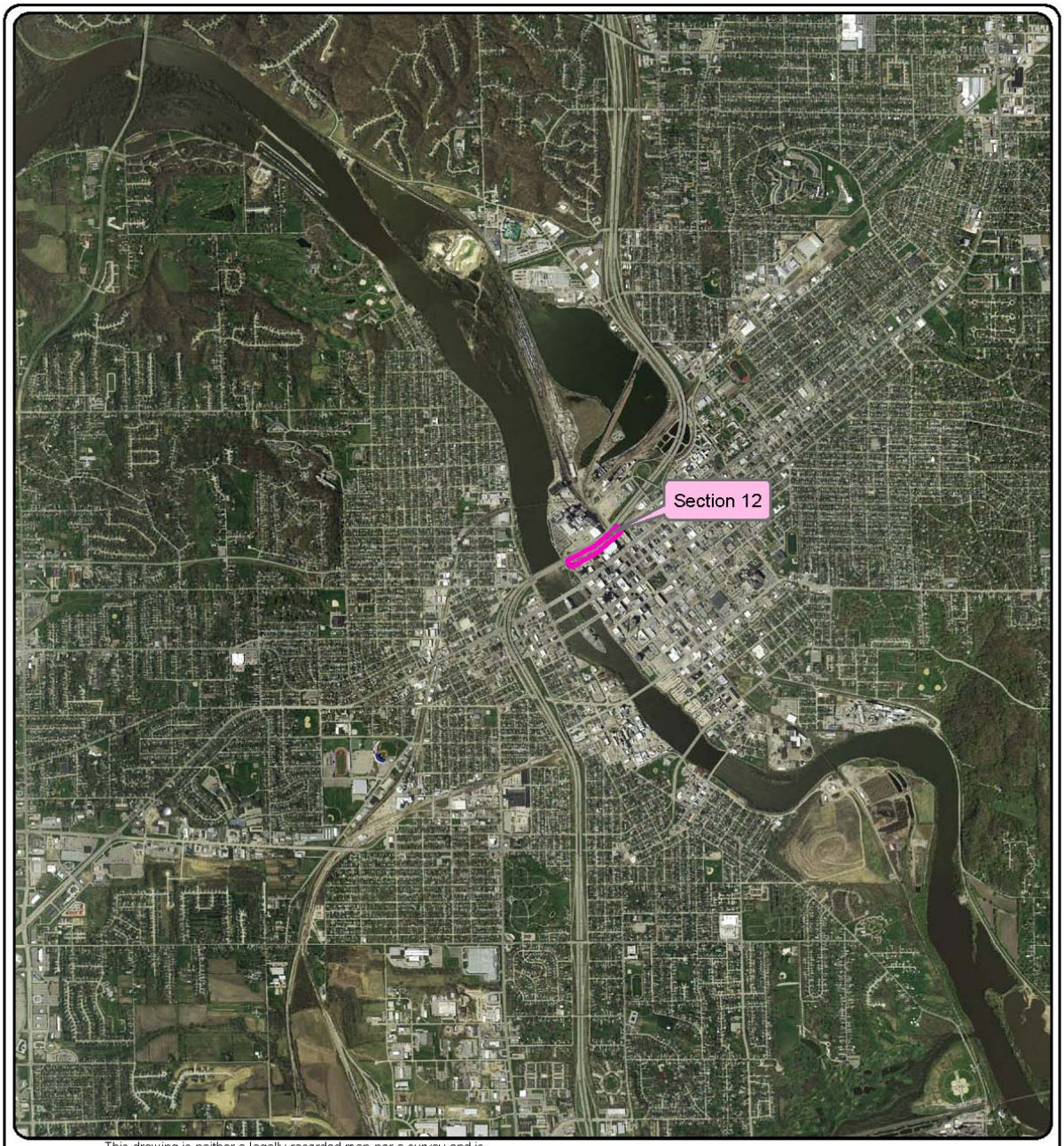

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Section 12

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U.S. ARMY CORPS OF ENGINEERS

SECTION 12
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

DATE: 05-12-2010
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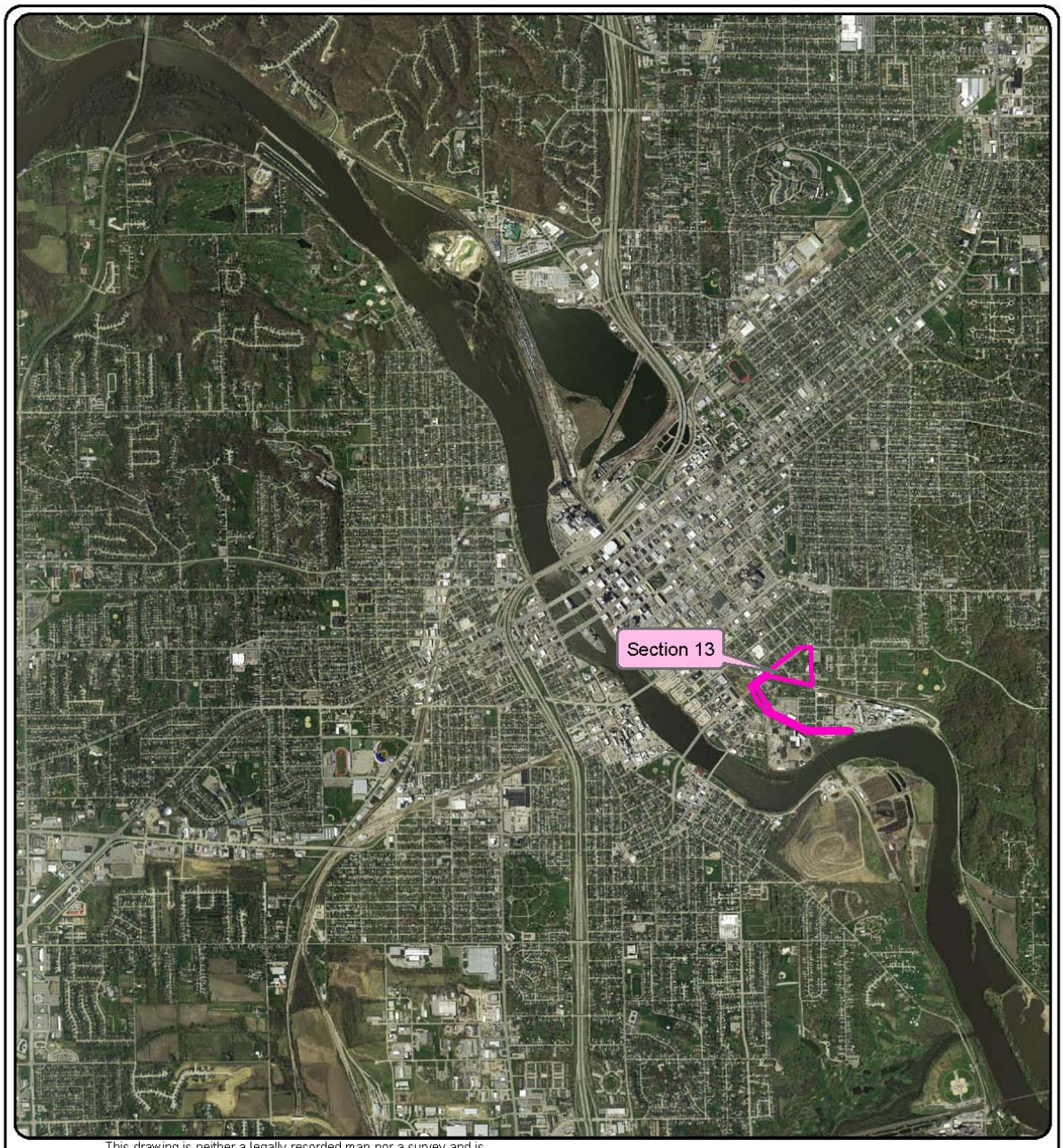

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Section 13

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U.S. ARMY CORPS OF ENGINEERS

SECTION 13
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
PHASE 1 ENVIRONMENTAL SITE ASSESSMENT
CEDAR RIVER, CEDAR RAPIDS IOWA

SCALE: 0 1,500 3,000 Feet

PROJECT ID: 09U050.01

DATE: 05-12-2010
PREPARED BY: DAT
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Appendix
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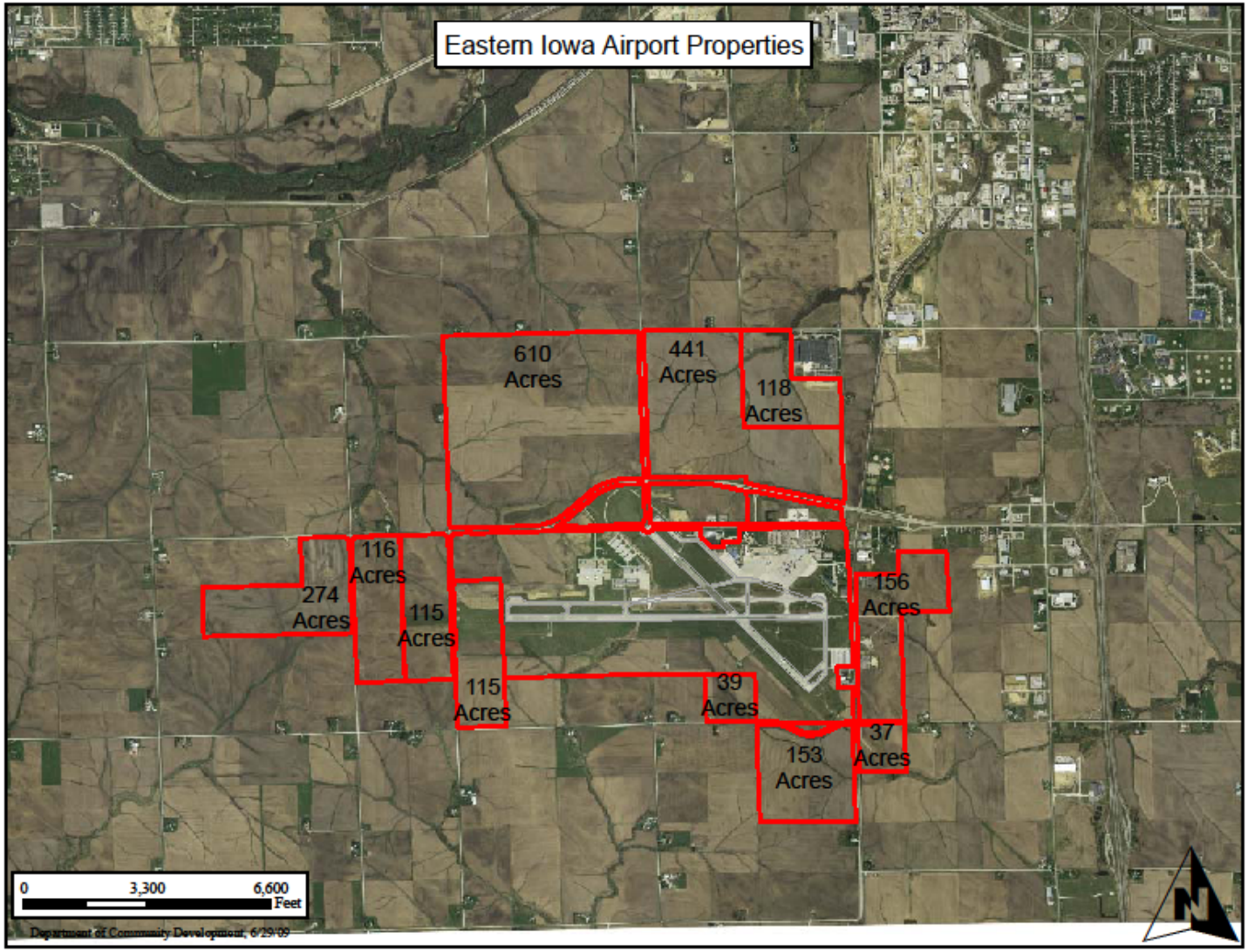
CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT

APPENDIX F
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

APPENDIX F-D
PROPOSED BORROW AREA OVERVIEW MAP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441 Acres
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116 Acres
274 Acres
115 Acres
115 Acres
156 Acres
39 Acres
37 Acres
153 Acres
0
3,300
6,600
Feet
Department of Community Development, 6/29/09
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CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
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INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

APPENDIX F-E
HTRW LETTER OF INTENT

CEDAR RAPIDS
City of Five Seasons

Office of the City Manager
City Hall
3851 River Ridge Drive NE
Cedar Rapids, IA 52401 1256
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September 17, 2010

Steve Gustafson, P.G.
Environmental Engineering Section
Rock Island District Corps of Engineers, Clock Tower Building
Rock Island, IL 61201-2004

RE: Sponsor Commitment

Dear Mr. Gustafson

This letter is to acknowledge should there be a known hazardous, toxic, or radiological waste (HTRW) problem identified on City property, the City accepts responsibility for the required response as part of the cost share project. The City will also work with the Army Corps of Engineers to initiate procedures to require other property owners to respond to HTRW issues.

Sincerely,

Allan Thoms
Interim City Manager

cc: Dave Eglin, Pat Ball, Christine Butterfield

September 17, 2010

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX F
HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

APPENDIX F-F
PROPOSED GEOTECHNICAL/HTRW BORINGS FOR ALTERNATIVE 4



Stanley Consultants INC.

0 150 300 600 900 1,200 Feet

PLATE 1

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX G
GEOTECHNICAL

Flood Risk Management Feasibility Study

Cedar River, Linn County
Cedar Rapids, Iowa

Geotechnical Appendix

United States Army Corps of Engineers
Rock Island District

August 2010

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A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

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Geotechnical Design

I. INTRODUCTION

The geotechnical design aspects of the proposed Cedar River Flood Protection Project at Cedar Rapids, IA are described in this appendix. The appendix includes descriptions of site geology, geotechnical investigations, subsurface conditions, design approach, construction considerations, and conclusions.

Project Description. The proposed flood protection measure controls flooding of the commercial and industrial areas east of the Cedar River designated as Alternative 4C. The scope of work necessary for the flood protection system includes:

1. Earthen levees
2. Concrete "I" and "T" floodwalls
3. Flood gates at roadways
4. Demountable floodwalls at railroads and selected roadways
5. Sanitary and sewer pump stations

II. SITE GEOLOGY

Terracon Consultants, Inc. provided the following information in regards to the geology of the Cedar Rapids area:

> "Topographically speaking, the City of Cedar Rapids, Iowa can be divided into two general environments: the northwestern bluffs and the central lowlands. The Cedar River enters the City from the northwest through a relative "bottle neck" of steep bluffs before entering the relatively flat-lying area of the City. The bluffs along the Cedar River located to the northwest of the downtown area are composed of Devonian-age carbonate bedrock. The bedrock underlying the City is of the Otis and Bertram formations consisting of unfossiliferous to poorly fossiliferous limestones and dolostones. Depths to bedrock range from near surface to up to 100 feet below ground surface.
>
> Unconsolidated materials overlying bedrock in the Cedar Rapids area are primarily comprised of pre-Illinoisan glacial and interglacial deposits. The glacial deposits are loamy tills from 0 to 100 feet thick. The interglacial deposits are comprised of interbedded loess, eolian sands, and stream-derived sand and gravel layers. The interbedded glacial/interglacial deposits include several erosional surfaces making unit thicknesses highly varied laterally. Adding to the variable thicknesses of unconsolidated material in the Cedar Rapids area is the presence of many ancient buried stream channels that are incised into the carbonate bedrock.
>
> The Cedar River runs atop bedrock through Cedar Rapids and has a relatively shallow channel depth. Coupled with the relatively low river banks, excess flow volume in the channel exacerbates the effects of flooding, especially towards the south-southwest of the City where the majority of the land sits within 20 feet of the typical river level."

* This letter was constructed using various online maps and publications for general subsurface information only and is not considered a comprehensive geological survey of the Cedar Rapids area.

III. SUBSURFACE EXPLORATION

The US Army Corps of Engineers has provided data for 518 previous soil borings throughout the Cedar Rapids area dating as far back as 1965. In addition to these previous soil borings, Terracon Inc. was recently contracted by the Corps of Engineers to drill an additional 13 soil borings and perform associated testing along the Alternative 4C alignment and 18 soil borings and associated testing at proposed borrow pit areas. The current Terracon Inc. soil boring program logs and gradation data have been furnished and are included as reference data in this appendix, but additional laboratory testing data has not been furnished at the time this report was prepared.

Subsurface profiles and stratigraphy were developed based on results of the current Terracon Inc. Alternative 4C alignment soil borings along with several previous geotechnical investigation soil borings taken in the vicinity of the proposed alignment.

A. Overburden. The overburden encountered in previous and current subsurface investigation programs can be generalized into three different material types: fill, cohesive formation, and granular deposits.

Fill: Most of the soil borings encountered a layer of fill material at the surface. The thickness of the fill materials ranged from 0 feet to approximately 10 feet. The fill materials consisted of sand, gravel, and silty clay. The density varies from very loose to medium-dense for granular fills and the stiffness varies from soft to very stiff for cohesive fills based on soil boring descriptions, blow counts, and pocket penetrometer resistance values. Standard Penetration Test (SPT) N-values of granular fill material ranged from 1 to 22 blows per foot (bpf). To minimize effects of overburden stress, the N-value was corrected to an effective vertical overburden stress of one ton per square foot using the following equation:

$N' = C_N * N$

Where:

N' = corrected resistance
C_N = correction factor = Sqrt(1/effective overburden in tsf)
N = measured resistance

Corrected resistance values for granular fill ranged from 1-45 blows per foot.
Cohesive Formation: Several of the investigation soil borings encountered clay-based cohesive materials. The lean clay, silty clay, and sandy clay formations ranged in elevation from shallow formations encountered beneath the fill material to deeper formations encountered immediately above the bedrock.

The shallow formations range in stiffness from very soft to hard, typically depending on the amount of sand and silt content in the cohesive material. Shallow cohesive substratum materials generally range from 0 feet to approximately 15 feet in thickness. The fine-grained soil at a shallow depth exhibited Pocket Penetrometer Resistance (PPR) values ranging from 0.25 tons per square foot (tsf) to more than

2.5 tsf, indicating a soft to hard consistency. The consistency of the fine-grained materials improved to very stiff to hard with depth with PPR values ranging from 1.75 to more than 2.5 tsf.

The deeper cohesive formations generally exhibit stiff to hard consistency. The deeper clay formation strata are situated directly above the bedrock in elevation and range from 0 feet to approximately 20 feet in thickness. Pocket penetrometer unconfined strength measurements ranged from 1,500 psf to 9,000 psf in the deep cohesive formations.

Granular Deposits: Granular deposits of varying thickness were encountered over a majority of the soil borings advanced along the proposed alignments. The granular soils ranged in classification from clayey sands (SC) to silty sands (SM) to well or poorly graded sands (SW, SP). The thickness of the granular deposit strata ranged from 0 feet to 60 feet deep, with many of the soil borings that did not encounter bedrock terminating in a granular deposit stratum. Granular deposits ranged in density from very loose to very dense. Standard Penetration Test (SPT) N-values of granular fill material ranged from 4-41 blows per foot with corresponding corrected N-values ranging from 4-44 blows per foot.

The vertical location of the granular deposit strata varied significantly along the proposed alignment. In some instances, the granular deposits were encountered just beneath the surface. In other instances, granular deposits were first encountered at depths of 20 feet or more below the ground surface.

B. Bedrock. Auger and spoon refusal, indicating the top of bedrock, was encountered in 19 of the previous and new soil borings chosen as representative borings closest to the proposed alignment. The bedrock was encountered at depths ranging from approximately 5 feet to greater than 75 feet below the ground surface, corresponding to elevations ranging from approximately elevation 645 NAVD to elevation 715 NAVD. Based on descriptions from subsurface investigation soil borings, the bedrock encountered typically consisted of highly weathered limestone in the upper 10 feet to 15 feet, underlain by moderately weathered dolomite.

Bedrock was cored to a maximum of 20 feet as part of the current Terracon Inc. subsurface investigation. The Rock Quality Designation (RQD) and core recovery are presented on the logs for each core run. Results of the current Terracon Inc. investigation, including rock core results and RQD were pending at the time this report was prepared.

The relatively shallow depth of the bedrock will have an influence on the types and styles of flood protection systems utilized as part of the Cedar Rapids flood protection system. Floodwall structures will typically consist of reinforced concrete T-walls bearing on shallow foundations. The installation of deep sheet piles, whether as seepage cutoffs or I-wall foundations, will be limited by the bedrock at some locations.

C. Groundwater . Groundwater levels were indicated in most of the previous and current soil borings. Groundwater depths ranged from approximately 0 to 25 feet below the ground surface, ranging from approximately elevation 695 to elevation 725. The normal river elevation, based on survey file contours, is assumed as elevation 701.

D. Borrow Material. In February 2010, Terracon Inc. performed a total of seventeen soil borings 20 feet in depth at potential borrow pit areas near the Cedar Rapids Airport. Soil boring logs and gradation test data are included in the reference material at the end of this appendix.
The borrow pit soil boring logs typically indicate material that will likely be suitable for use as impervious fill for levee construction, backfill, and impervious cutoff inspection trenches. The soil borings typically encountered approximately two feet of topsoil underlain by a 1 to 3 feet thick layer of Lean to Fat Clay, underlain by Sandy Lean Clay till material with trace gravel and sand seams to the limits of the borings. Moisture content of the Sandy Lean Clay typically ranged from 14-22 percent. These materials (with the exception of the topsoil) will likely be suitable for use as impervious fill for the flood protection project.
Some of the borrow pit borings, however, indicated strata that will not be suitable for use as impervious fill on the project.

- Soil boring 1A encountered Poorly Graded Sand from a depth of 4.5 feet to 17 feet, which may not be suitable for use as impervious fill on the project.
- Soil boring 4A encountered a mixture of Lean Clay and Clayey Sand from a depth of 5.5 feet to 12 feet, which may not be suitable for use as impervious fill on the project.
- Soil boring 6A encountered layers of Poorly Graded Sand and Silty Sand beneath the topsoil to the limits of the boring, which may not be suitable for use as impervious fill on the project.
- Soil boring 13A encountered Silty Sand from a depth of 5 feet to 12.5 feet, which may not be suitable for use as impervious fill on the project.

See the soil boring logs and gradation testing reference data at the end of this appendix for additional information regarding the potential borrow pit soil borings.

IV. SUBSURFACE CONDITIONS AND PARAMETERS

In order to reduce the large number of soil borings available from previous investigations, the individual soil borings that were located closest to the proposed alignment were selected as representative borings used to develop subsurface profiles and parameters. Thirteen soil borings from the 2010 Terracon Inc. investigation were advanced to supplement 24 soil borings from previous investigations that were designated as representative borings along the proposed Alternative 4C alignment. Locations of the borings in relation to the proposed Alternative 4C alignment are shown in Exhibits 1 - 4, and logs of the borings are included in the reference material at the end of the appendix.

The results of the borings indicate variable subsurface conditions throughout the proposed Alternative 4C alignment. The naturally occurring subsurface soils were classified according to the Unified Soil Classification System as ranging from CL to SP or SW. The fill materials were also highly variable in both content and stratum thickness. Soil profiles were developed from soil boring log data and are included as Exhibits 5 -7.

Based on Standard Penetration Test (SPT) N-values, the consistency of the soils typically ranges from very soft to very stiff, depending on the formation and the location. Typical strength parameters and unit weights for the various soil units were developed based on limited laboratory testing results and soil boring log data. Hydraulic conductivity values for use in seepage analysis were also determined based on soil classifications and gradation testing results. The parameters assigned to each of the individual soil units are as shown in table G-1.

These parameters were used in conjunction with subsurface profiles developed at specific locations for geotechnical evaluations of "typical" proposed flood barrier construction. It should be noted that these are typical parameters based upon limited test data and are generalized to cover a large sample set exhibiting variable soil conditions. As the design progresses, additional laboratory testing and soil boring information should be analyzed at specific locations along the alignment and the parameters defined above should be adjusted accordingly. Parameters of levee fill material were assumed based on logs of borrow pit soil borings and past project experience. These parameters will be verified with laboratory test data as the design progresses.

Table G-1. Soil Unit Parameters

		S-Case (Drained)		Q-Case (Undrained)			
Soil Type	**Unit Weight (pcf)**	**c (psf)**	**phi (deg.)**	**c (psf)**	**phi (deg.)**	**Hydraulic Conductivity (cm/s)**	**Typical N-Value (blows/ft)**
Levee Fill	125	0	30	750	0	1.0x10^-7	5 - 15
Non-Levee Fill (Clay)	115	0	28	500	0	1.0x10^-6	<5
Non-Levee Fill (Sand)	115	0	28	0	28	5.6x10^-3	<5
Soft Cohesive Formation	110	0	28	250	0	1.0x10^-7	<5
Loose – Med Dense Granular Deposits	115	0	28	0	28	4.0x10^-2	5 - 10
Medium-Dense Granular Deposits	125	0	33	0	33	4.0x10^-2	10 – 30
Limestone Bedrock	Impenetrable					1.0x10^-6	N/A

V. EXISTING FLOOD PROTECTION

Six separable flood protection systems currently exist along the Cedar River through the central core of Cedar Rapids. These systems were all locally built either by the City or private entities. None of these existing systems have ever been included in the Public Law 84-99 Rehabilitation and Inspection Program. No as-builts or specifications were found to reference as to the criteria used during construction.

Visual inspection of the existing systems reveals many items that do not meet federal design standards. Significant flood fighting efforts take place by the City during floods to include the building of sand bag tie-offs at elevations that are below the 0.01 percent chance event. Storm intake grates throughout

the interior are capped with precast manhole structures and sandbags in order to prevent flood water from flooding from within through the storm drain systems that have no permanent closure gates (photograph G-1). The following points summarize additional specific conditions stated within a memorandum for record attached as Appendix G-B.

- Vegetation and tree growth covering the surrounding and existing levee embankments encourage rodent burrowing activities, induce potential seepage paths due to rotting root systems, and hinder the visibility required for periodic maintenance and inspections.
- Permanent tie-ins to high ground do not exist for the Time Check Levee.
- There are no permanent pump stations at existing levees or permanent closure gates for gravity storm drains.
- Existing side slopes of the levees are not safe, with slopes as steep as 1H:1V and ½H:1V on the landside and riverside slopes, respectively.
- The minimum Public Law 84-99 levee eligibility standards for levees are not met.
- The levees are not accredited by the Federal Emergency Management Agency (FEMA).
- Seepage cutoff trenches were likely not provided in the original construction.



Photograph G-1. A precast manhole with sandbags is placed over an existing storm sewer intake behind the Time Check Levee. No permanent closure gates or pumping stations exist for the interior drainage system.

Another memorandum for record, attached as Appendix G-C, further documents findings during a site visit to the longest existing system, the Time Check Levee.
Given that the existing systems have many aspects that do not meet federal criteria to be eligible for the PL 84-99 Rehabilitation and Inspection Program, no measurable level of flood protection is accounted for within this feasibility report for existing conditions. This is based on a feasibility study that is strictly tied to meeting federal criteria.

VI. DESIGN APPROACH

The geotechnical design of the Cedar River Flood Protection Feasibility Study is in accordance with Corps of Engineers design standards. At the feasibility study level, typical cross sections of the various proposed flood protection measures were analyzed at select locations along the proposed alignment exhibiting a range of soil types and conditions. Analyses were used to determine minimum side-slope requirements for earthen embankments, determine general setback parameters for floodwalls, as well as to analyze various seepage conditions and cutoff requirements.

A. Global Stability Analysis. Global stability analyses were completed using the GEO-SLOPE SLOPE/W v7.14 software. Spencer's Method of analysis was the method selected for output results. The program's optimized circular search routines were utilized to determine critical failure surfaces for each analysis section. Table G-2 indicates the global stability analysis conditions and the minimum required factor of safety in accordance with EM 1110-2-1913.

Table G-2. Global Stability Analysis Requirements

Analysis Condition	FOS_{min} Par	ameters
End-of-Construction	1.3	Q-Case (Undrained)
Long Term	1.4	S-Case (Drained)
Rapid Drawdown	1.2	Q-Case (Undrained)

B. Seepage Analysis. Seepage analyses were completed using the GEO-SLOPE SEEP/W v4 finite element software and in accordance with EM 1110-2-1901. Analyses were performed to determine what, if any, remedial seepage control measures such as embankment toe drains, seepage berms, or cutoff walls may be required to prevent excessive exit gradients on the protected side of the flood protection measure.

Hydraulic conductivity was computed based on results of gradation tests and compared to typical values for each material type. The hydraulic conductivity values used in the seepage analyses are a combination of these computed values and typical values published in EM 1110-2-1901. The hydraulic conductivity assigned to each material type is summarized in table G-1. The ratio of vertical conductivity to horizontal conductivity was assumed as 0.33 for all materials.

C. Settlement Analysis. Settlement analyses should be completed as part of final design in conjunction with EM 1110-2-1904 at critical locations along the alignment. Given the subsurface soils typically encountered in the soil borings, subsurface settlement quantities are anticipated to be in

the range of 6 inches or less. In addition to subsurface settlement, shrinkage of new embankment material and over-excavation fill is estimated to be up to 5 percent of the new fill or embankment height. Embankments and floodwalls should be constructed to a final elevation which takes into account subsurface settlement and new fill shrinkage magnitudes.

During the design phase, a thorough investigation of settlement will be completed when structure locations and specific laboratory testing data and parameters are made available, as well as when over-excavation and replacement locations and depth are more clearly defined. The settlement evaluation will further investigate immediate, primary, and secondary consolidation settlements.

D. Scour Protection. Scour protection on the earthen levee embankments will be accomplished using seeded turf. Riprap scour protection may be required in select areas where bank erosion is evident. In many cases, stability of the flood protection system is dependent upon the existing stream bank remaining intact. Riprap scour protection will be designed using data support from the project hydraulics computations.

VII. CONSTRUCTION CONSIDERATIONS

In addition to the various geotechnical design aspects of the project, there are various geotechnical aspects that have an impact on construction and total project costs.

A. Embankment Inspection Trench. Typical Corps of Engineers levee projects include excavation of an inspection trench beneath the levee footprint. The purpose of the inspection trench is to determine whether suitable and expected soil conditions exist beneath the base of the levee, as well as to determine if any unknown utilities or debris are present immediately beneath the base of the proposed flood protection alignment. If unsuitable soil conditions or debris is encountered, excavation and removal of the unsuitable material may be required.

Typically, the inspection trench is excavated at the proposed alignment centerline. A two-foot minimum width trench is excavated to a depth equal to the proposed height of the levee above natural grade, to a maximum of six feet. In developed urban areas, the inspection trench depth is sometimes increased to 10 feet, due to the risk of buried walls and foundations. In granular soils the inspection trench is typically backfilled with compacted impervious soil in order to provide a seepage cutoff at the base of the levee. Fine-grained soils meeting USCS classifications of CL or CH can typically be replaced as backfill into the inspection trench. For the Cedar River project cost estimate, it was assumed that 50 percent of the inspection trench material excavated will be suitable for re-use as backfill.

B. Over-excavation. In areas where the proposed flood protection type is a floodwall, excavation of soft soils or unsuitable fill in excess of the footing frost depth may be required. Typical floodwall cross sections indicate a 6-foot over-excavation of existing material beneath the floodwall footing (ten feet total excavation). This over-excavation will serve to remove and replace any unsuitable materials beneath the base of the floodwall and provide a solid foundation on which the floodwall will be

constructed. Over-excavation may also be required beneath levee footprints where unsuitable materials are encountered in the inspection trench or indicated in soil boring logs.

Some areas where over-excavation may be anticipated based on depth and makeup of fill material, bearing capacity of subsurface material, and shear strength of subsurface material (based on previous and current soil boring investigation programs along the proposed Alternative 4C alignment) are indicated below. Conditions for anticipated over excavation included but were not limited to SPT blow counts (N-value) less than 4 blows/ft, shear strength less than 500 psf, and/or loose fill material containing debris or foreign materials to depths exceeding approximately 6 ft below ground surface. Soil borings indicating materials to potentially be excavated include:

- B1 to B2_06055099 indicate very soft clay to a depth of 18 ft in the vicinity of Station 175+00.
- BH1_06075097 and B2_06005144 indicate very soft fill with debris to a depth of 18 ft in the vicinity of Station 282+00 and Station 287+00.
- Borings #13, #15, and #17 (2010 Terracon Inc. borings) indicate brick, concrete, and rubble present within fill material to various depths.
- Boring #23 and Boring #24 (2010 Terracon Inc. borings) indicate very loose fill material (N=2) to depths of up to 20 ft in the vicinity of Station 260+00 and Station 266+00.

VIII. CONCLUSIONS AND RESULTS

This section discusses conclusions and results of geotechnical analyses that have been performed to date.

A. Global Stability Analysis. Global stability analyses were performed at levee cross sections representing various design conditions along the proposed alignment. Representative levee analyses were performed at proposed alignment stations 144+00, 230+00, and 265+50.

Station 144+00 was chosen to represent the short piece of levee crossing the existing pond from Station 142+58 to Station 144+12 near the north end of the alignment. The proposed levee at this location is the tallest proposed levee section throughout the project, providing protection to approximately elevation 740 from an approximate existing bottom-of-pond elevation of 716. The levee is modeled with a 10-foot crest and 3H:1V side slopes. Global stability was analyzed for water to top of levee condition assuming undrained (Q-case) soil conditions. Global stability analysis was also performed for flood-side slope failure assuming long-term drained (S-case) soil conditions. The minimum required factor of safety was achieved in each analysis. Global stability factors of safety are summarized in table G-3 and analysis plates and output files are included in the computations section of this appendix.

Station 230+00 was chosen to represent the levee sections from Station 224+56 to Station 245+80. The levee sections in this reach are set back 100 feet or more from the edge of the river and range from approximately 8 feet to 12 feet in height above existing grade. Global stability analyses at this section achieve minimum required factors of safety for both an undrained (Q-case) soil condition analysis with water to the top of the levee and a long-term drained (S-case) soil condition analysis assuming piezometric pressures below the base of the levee. Global stability factors of safety are summarized in table G-3 and analysis plates and output files are included in the computations section of this appendix.

Table G-3. Global Stability Analysis Results

Location Co	ndition	FOS_{req}	FOS_{min}
Sta 144+00	End of Construction	1.30	N/A
Sta 144+00	Undrained	1.40	1.77
Sta 144+00	Long-term, Drained	1.40	1.50
Sta 230+00	End of Construction	1.30	N/A
Sta 230+00	Undrained	1.40	1.42
Sta 230+00	Long-term, Drained	1.40	1.67
Sta 265+50	End of Construction	1.30	2.01
Sta 265+50	Undrained	1.40	1.60
Sta 265+50	Long-term, Drained	1.40	1.65
Sta 265+50	Drawdown, Undrained	1.20	1.23
Floodwall*	Long-term, Drained	1.40	1.49

*Assume Floodwall is setback on a 3H:1V slope from lowest Flood Side elevation point.

Station 265+50 was chosen to represent the levee section from Station 247+20 to Station 266+60. The levee section in this reach has minimal setback from the edge of the river and ranges from approximately 8 ft to 15 ft in height above existing grade at the centerline. Since this levee section is proposed near the existing river bank, undrained (Q-case) analyses were performed for the flood condition, the end-of-construction non-flood condition, and rapid drawdown condition whereas at the previous sections with large setbacks from the river banks, the flood condition controlled by inspection. In addition to the undrained analyses for end-of-construction and rapid drawdown, a long-term drained (S-case) analysis was performed for a flood-side slope failure assuming normal river water levels. Note that at this cross section, existing ground contours were assumed beneath the surface of the water as survey data did not extend into the river. Global stability analyses at the proposed levee section achieved minimum required factors of safety for all cases. Global stability factors of safety are summarized in table G-3 and analysis plates and output files are included in the computations section of this appendix.

A global stability analyses was performed for a generic floodwall cross section with the floodwall situated near an existing steep river bank, as is the case for most of the proposed floodwall reaches along the alignment. The analysis was performed to determine the minimum required floodwall setback from the base of the existing river bank. The analysis was performed for a long-term drained (S-case) condition assuming soil with a friction angle (phi) equal to 28 degrees. From the analysis

results, a 3H:1V setback from the existing river bank is required in order to achieve the minimum required factor of safety of 1.40. The resulting factor of safety is summarized in table G-3 and analysis plates and output files are included in the computations section of this appendix. For the proposed floodwalls currently located within the 3H:1V setback, the floodwalls may need to be founded at greater depth or additional easements may be required to move the floodwalls further from the river bank. Both measures would result in increased cost to the project.

During the design phase, additional global stability analyses will be performed at representative and/or critical flood protection and floodwall locations, as well as an investigation on bearing capacity and sliding stability of structures.

B. Seepage Analysis. Seepage analyses were performed at levee and floodwall cross sections representing various design conditions along the proposed alignment. Representative analyses were performed at proposed alignment stations 240+00, 265+50, and 278+00. In addition, a generic floodwall analysis was performed assuming an entirely pervious foundation with the maximum 24-foot wall height. The levee analyses at stations 240+00 and 265+50 represented two varying sizes of levee and varying foundation materials. The analysis at station 240+00 resulted in an acceptably safe factor of safety for the exit gradient, exceeding the recommended factor of safety of 1.50. The analysis at station 265+50 results in an exit gradient factor of safety of 1.43, which is below the recommended factor of safety of 1.50. Additional seepage measures may be necessary during design to decrease the exit gradient and increase the factor of safety to an acceptably safe value. Additional laboratory testing of soils may also be necessary to determine actual hydraulic gradients to be used in the seepage analyses.

Analysis of a 13-foot floodwall with full pervious foundation and the typical 15-foot sheet pile cutoff at station 178+00 resulted in an acceptably safe exit gradient. An additional generic analysis was also performed for a maximum-height 24-foot floodwall assuming a pervious foundation and the typical 15-foot sheet pile cutoff. The analysis indicates that a 1.1 exit gradient factor of safety is achieved assuming these conditions, short of the recommended 1.50 factor of safety. It is unclear at this time whether this condition of a 24-foot wall with a pervious foundation will actually occur anywhere along the proposed alignment, but additional sheet pile cutoff depth may be required as a remedy for seepage control if these tall floodwall sections are proposed for final design.

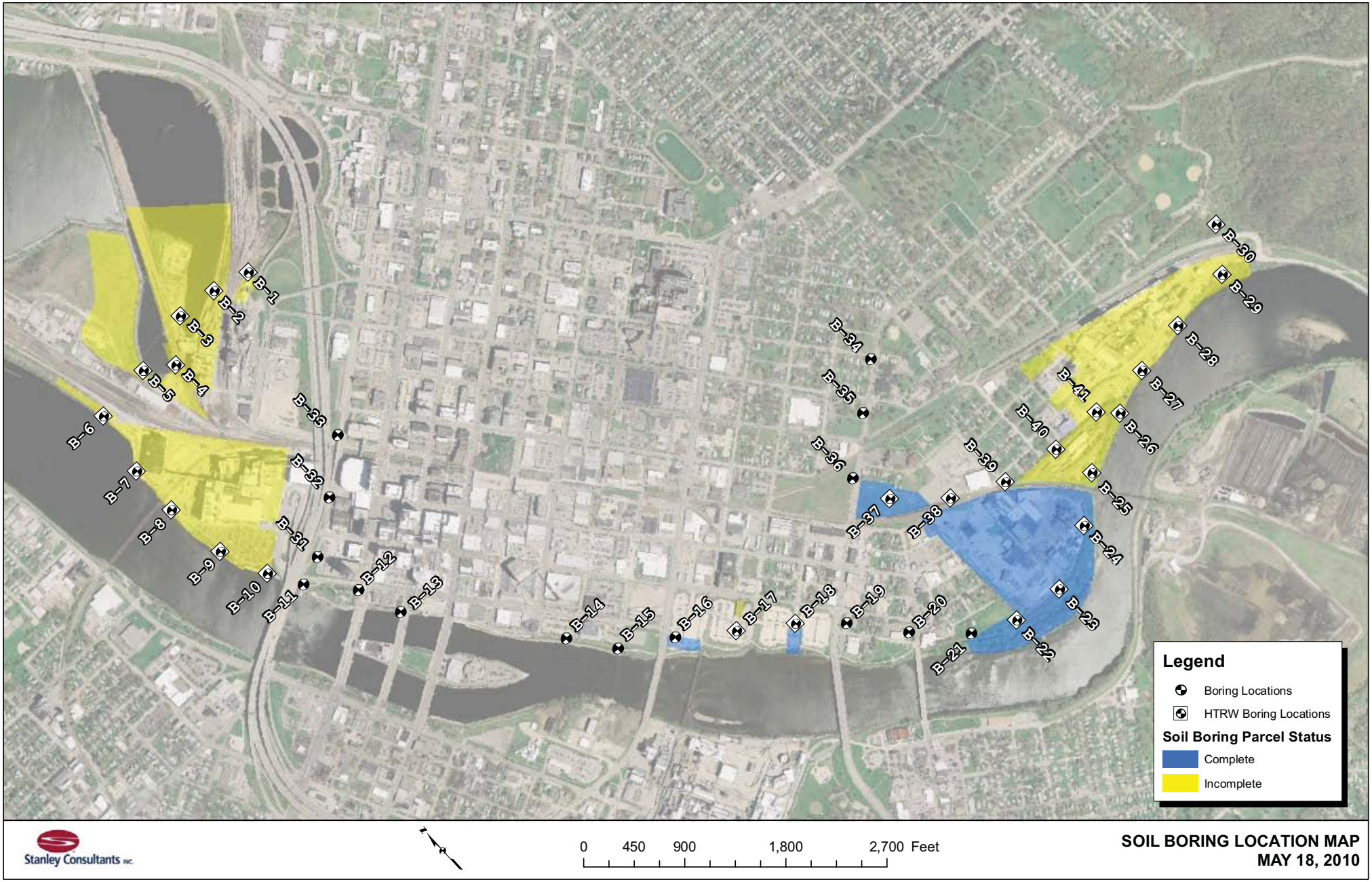
Seepage analysis plates (system, mesh, total head, and gradient) and computations are included in the appropriate computations section at the end of this appendix.

C. Settlement Analysis. Settlement analyses and overbuild parameters will need to consider the shrinkage effects of tall levee sections. Assuming a 5 percent shrinkage within the new levee fill material, 1.2 feet of overbuild will be required for the levee section between station 142+58 and 144+12, where 24 feet of new fill material will be placed. Any anticipated subsurface settlement will need to be added to the total overbuild as well.

IX. CODES AND STANDARDS

US Government Design Standards

- EM 1110-1-1804 Geotechnical Investigations
- EM 1110-2-1904 Settlement Analysis
- EM 1110-1-1905 Bearing Capacity of Soils
- EM 1110-2-1901 Seepage Analysis and Control for Dams
- EM 1110-2-1902 Slope Stability
- EM 1110-2-1906 Laboratory Soils Testing
- EM 1110-2-1913 Design and Construction of Levees
- EM 1110-2-2100 Stability Analysis of Concrete Structures
- EM 1110-2-2502 Retaining and Flood Walls
- EM 1110-2-2504 Design of Sheet Pile Walls
- ETL 1110-2-555 Design Guidance on Levees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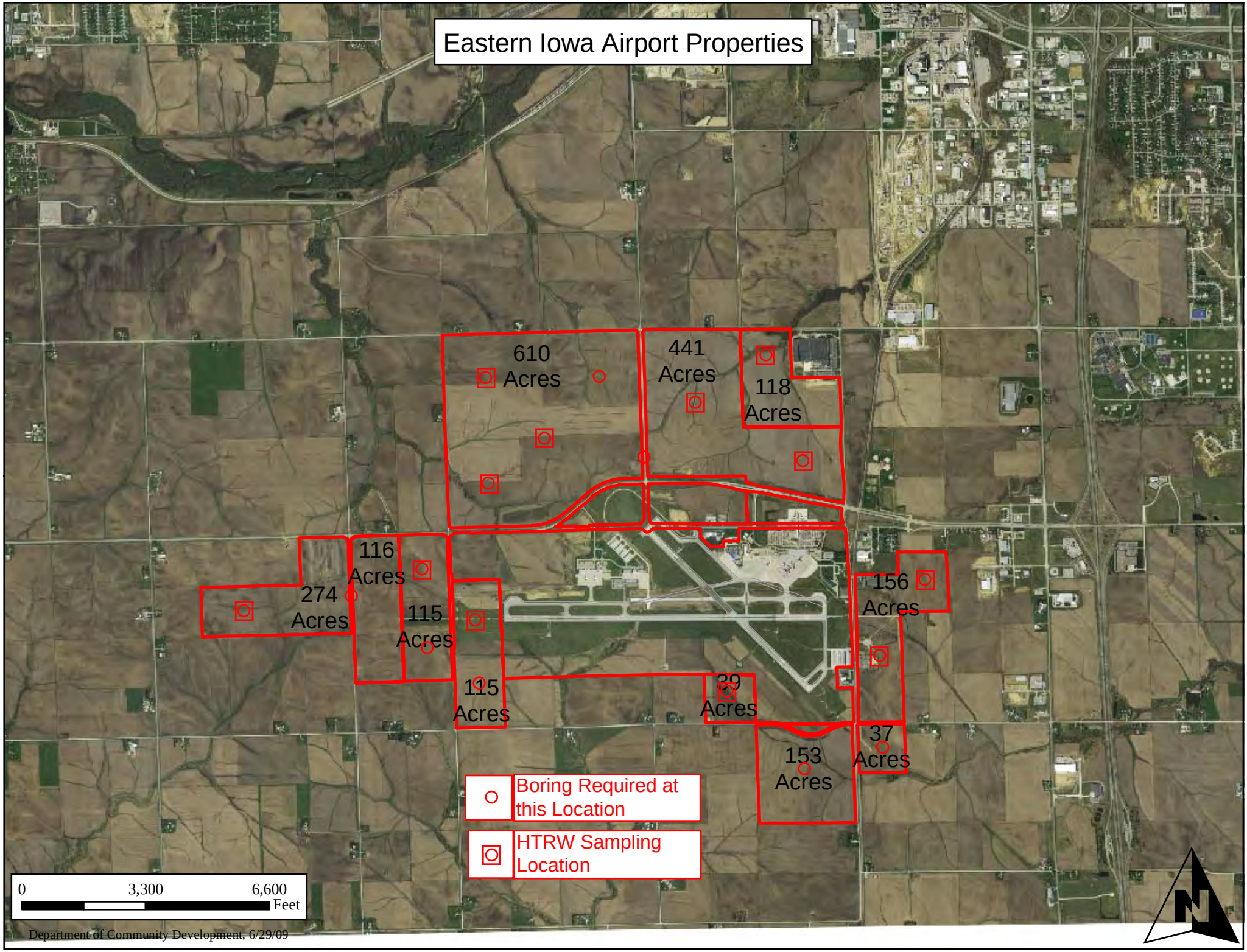
B-34
B-35
B-36
B-37
B-38
B-39
B-40
B-41
Legend
Boring Locations
HTRW Boring Locations
Soil Boring Parcel Status
Complete
Incomplete
0
450
900
1,800
2,700 Feet
Stanley Consultants INC.
SOIL BORING LOCATION MAP
MAY 18, 2010


Eastern Iowa Airport Properties
610 Acres
441 Acres
118 Acres
116 Acres
274 Acres
115 Acres
115 Acres
39 Acres
153 Acres
156 Acres
37 Acres
Boring Required at this Location
HTRW Sampling Location
0
3,300
6,600
Feet
Department of Community Development, 6/29/09

CEDAR RIVER
CEDAR RAPIDS, IA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX G-A

REFERENCE MATERIAL AND COMPUTATIONS

Geotechnical Appendix
Reference Material and Computations

Subsurface Data

Pre-2010 Terracon Soil Borings

LOG OF BORING NO. 1

CLIENT

SITE

PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	0.5 6" Crushed Limestone				PA					
	FILL, FINE TO MEDIUM SAND WITH CINDERS, RUBBLE & BRICK, TRACE CLAY & GRAVEL, Dark Brown and Brown ▽			1	SS	10	9	24		
					PA					
		5		2	SS	2	5	21		
					PA					
	8			3	SS	0	1			
					PA					
	FILL, CINDERS WITH SAND, Black	10		4	SS	4	2	60		
					PA					
				5	SS	6	1	73		
					PA					
		15		6	SS	4	1	80		
	18				PA					
	FAT CLAY, TRACE SAND, Brown									
	20	20	CH	7	SS	14	20	58		
					PA					
	FINE TO MEDIUM SAND, TRACE CLAY, Gray, Dense									
	25	25	SP	8	SS	16	41	12		
					PA					
	*** VERY HIGHLY WEATHERED & BROKEN LIMESTONE WITH OCCASIONAL CLAY SEAMS, Brown	30		9	SS	11	50/5"	16		
					PA					
		35		10	SS	2	50/2"	13		
	38				PA					
	Practical Auger Refusal @ about 38 feet. **BOTTOM OF BORING**									

*** Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 5	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	7-30-08		
BORING COMPLETED	7-30-08		
RIG	#14	FOREMAN	MW
APPROVED	TTW	JOB #	06085088

BOREHOLE 06085088.GPJ TERRACON.GDT 8/29/08

LOG OF BORING NO. 1

CLIENT | ARCHITECT/NGINEER

SITE | PROJECT

Approx. Surface Elevation.: 98 ft

DEPTH, ft.	GRAPHIC LOG	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
		12" Crushed Limestone			HS					
		FILL, LEAN CLAY WITH SAND, TRACE GRAVEL & ORGANICS, Dark Brown		1	SS	9	10	14		
4					HS					
94				2	SS	8	8	4		
5					HS					
			SP	3	SS	12	8	4		
					HS					
			SP	4	SS	12	6	4		
10					HS					
		FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL, Brown, Loose to Medium Dense	SP	5	SS	12	21	6		
15					HS					
			SP	6	SS	15	22	5		
20					HS					
			SP	7	SS	18	22	17		
25					HS					
			SP	8	SS	10	9	18		
30										
30		BOTTOM OF BORING								
68										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23	WD	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	11-14-07		
BORING COMPLETED	11-14-07		
RIG	#83E	FOREMAN	RH
APPROVED	TTW	JOB #	06075119

BOREHOLE 06075119.GPJ TERRACON.GDT 11/23/07

APPENDIX G-A

LOG OF BORING NO. 1

OWNER | CLIENT

SITE | PROJECT

Boring Location: **NORTHERN BORING**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	12" Crushed Limestone				PA					
	2 FILL, LEAN CLAY, TRACE SAND & CINDERS, Brown			1	SS	12	6	20		
	FILL, FINE TO MEDIUM SAND WITH CINDERS, TRACE CLAY & GRAVEL, Dark Brown				PA					
				2	AS		2	11		
		5			PA					
				3	SS	13	6	12		
	8 ▽				PA					
	LEAN CLAY TO SILTY CLAY, TRACE SAND & GRAVEL WITH SAND SEAMS, Dark Gray to Brown Gray, Soft		CL/ML	4	SS	17	2	22		*500
		10			PA					
			CL/ML	5	SS	18	2	23		*500
		15			PA					
	18									
	20 LEAN CLAY, TRACE SAND, GRAVEL & ORGANICS WITH SAND SEAMS & LAYERS, Dark Gray, Soft		CL/SP	6	SS	10	4	43		*500
	BOTTOM OF BORING	20								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 8	WD	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	10-28-05		
BORING COMPLETED	10-28-05		
RIG	#14	FOREMAN	GAE
APPROVED	LSB	JOB #	06055099

BOREHOLE 06055099.GPJ TERRACON.GDT 11/8/05

APPENDIX G-A

LOG OF BORING NO. 1

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

Approx. River Elev.: 78.2 ft.

DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
WATER	3.9 / 74.3								
FINE TO COARSE SAND, TRACE SILT & COBBLES, Brown	5.5 / 72.7			WB					
SANDY LEAN CLAY, TRACE GRAVEL, Gray, Very Stiff	7.5 / 70.7	CL	1	SS	17	50/5"	19.5 23.5		*5000
HIGHLY WEATHERED LIMESTONE,** Yellow Brown	10.0 / 68.2			WB					
WEATHERED LIMESTONE,**Light Gray	12.2 / 66.0		2	SS	2	50/5"			
BOTTOM OF BORING									

**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS		
WL	▽	▼
WL		
WL		

Terracon

BORING STARTED	8-29-91		
BORING COMPLETED	8-29-91		
RIG	NO. 37	FOREMAN	REF
APPROVED	TAS	JOB #	06915072

LOG OF BORING NO. 2

CLIENT

SITE

PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	0.2 2" Crushed Limestone				HS					
	FILL, CLAYEY FINE TO MEDIUM SAND WITH CINDERS, BRICK & RUBBLE, Dark Brown			1	SS	6	5	17		
	6				HS					
		5		2	SS	6	5	24		
					HS					
	FILL, FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL, Gray Brown			3	SS	10	1	17		
					HS					
		10		4	SS	12	1	19		
	13				HS					
	FILL, CINDERS WITH SAND, Black			5	SS	14	1	18		
	15.5				HS					
		15		6	SS	12	1	32		
	FAT CLAY, TRACE SAND, Brown				HS					
	19									
	FINE TO MEDIUM SAND WITH CLAY, TRACE GRAVEL, Gray, Medium Dense	20	SP	7	SS	12	22	24		
					HS					
	24									
	*** VERY HIGHLY WEATHERED & BROKEN LIMESTONE WITH OCCASIONAL CLAY SEAMS, Brown	25		8	SS	6	50/4"	8		
					HS					
	29									
	Practical Auger Refusal @ about 29 feet.									
	31 *** HIGHLY TO MODERATELY WEATHERED LIMESTONE, Brown, Moderately Hard	30		R1	DB	90%	RQD 18%			
	*** HIGHLY TO MODERATELY WEATHERED LIMESTONE, Brown, Moderately Hard, Vuggy	35		R2	DB	100%	RQD 15%			
	39									
	BOTTOM OF BORING									
	*** Classification estimated from disturbed and core samples. Petrographic analysis may reveal other rock types.									

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 5	WS	▼
WL	▼		▼
WL	Backfilled		

Terracon

BORING STARTED	7-31-08		
BORING COMPLETED	7-31-08		
RIG	#14	FOREMAN	MW
APPROVED	TTW	JOB #	06085088

BOREHOLE 06085088.GPJ TERRACON.GDT 8/29/08

LOG OF BORING NO. 3

CLIENT | ARCHITECT/NGINEER

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elevation.: 96.5 ft									
	0.5 **FILL, LEAN CLAY WITH SAND & CRUSHED LIMESTONE**, Brown — 96				PA					
	FILL, LEAN CLAY WITH SAND, TRACE GRAVEL & ORGANICS, Dark Brown			1	SS	9	7	15		
	4 — 92.5				PA					
	FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL WITH OCCASIONAL CLAY LAYERS, Dark Brown to Brown, **(Possible Fill)**	5		2	SS	9	5	8		
					PA					
			SP	3	SS	12	9	3		
	10 — 86.5				PA					
			SP	4	SS	8	4	10		
	FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL, Brown, Loose to Medium Dense	10			PA					
			SP	5	SS	15	13	5		
		15			PA					
			SP	6	SS	18	20	7		
		20			PA					
			SP	7	SS	9	8	16		
		25			PA					
			SP	8	SS	18	14	16		
	30 — 66.5	30								
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23	WD	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	11-14-07		
BORING COMPLETED	11-14-07		
RIG	#83E	FOREMAN	RH
APPROVED	TTW	JOB #	06075119

BOREHOLE 06075119.GPJ TERRACON.GDT 11/23/07

LOG OF BORING NO. 2

OWNER | CLIENT

SITE | PROJECT

Boring Location: **SOUTHERN BORING**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
					PA					
	FILL, HIGHLY WEATHERED & CRUSHED LIMESTONE WITH FINE TO COARSE SAND, TRACE CLAY & CINDERS, Dark Gray & Light Brown			1	SS	9	4	9		
					PA					
				2	SS	12	3	8		
		5			PA					
				3	SS	8	3	22		
	7.5 ▽				PA					
			CL/ML	4	SS	7	WOH	22		
	LEAN CLAY TO SILTY CLAY, TRACE SAND & GRAVEL WITH SAND SEAMS, Dark Gray to Brown Gray, Soft	10			PA					
			CL/ML	5	AS		WOH	21		*500
	Wood fragments encountered @ about 18 to 18.5 feet.	15			PA					
	18.5									
	LEAN CLAY, TRACE SAND & GRAVEL WITH SAND SEAMS & LAYERS, Dark Gray, Medium Stiff		CL/SP	6	SS	6	4	25		
	21.5	20			PA					
	FINE TO COARSE SAND, TRACE GRAVEL, Gray ***	25								
		30								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 7	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	10-28-05		
BORING COMPLETED	10-28-05		
RIG	#14	FOREMAN	GAE
APPROVED	LSB	JOB #	06055099

BOREHOLE 06055099.GPJ TERRACON.GDT 11/8/05

LOG OF BORING NO. 2

OWNER | CLIENT

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
		35			PA					
	FINE TO COARSE SAND, TRACE GRAVEL, Gray ***									
	37									
	SANDY LEAN CLAY, TRACE GRAVEL, Gray ***									
	39									
	BOTTOM OF BORING									

*** Classification based on driller's visual observation only. Soil sampling and laboratory testing may reveal other soil types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 7	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	10-28-05		
BORING COMPLETED	10-28-05		
RIG	#14	FOREMAN	GAE
APPROVED	LSB	JOB #	06055099

BOREHOLE 06055099.GPJ TERRACON.GDT 11/8/05

LOG OF BORING NO. 2

OWNER | CLIENT/ENGINEER

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	6" Concrete over 12" Crushed Stone				HS					
	FILL, FINE TO MEDIUM SAND, TRACE CLAY, ORGANICS, GRAVEL, CONCRETE, BRICK, CINDERS, WOOD, GLASS WITH OCCASIONAL CLAY SEAMS, Dark Brown and Brown			1	SS	10	9	8		
				2	SS	4	6	10		
		5		3	SS	2	2	12		
				4	SS	12	3	27		
				5	SS	12	2	20		
		10		6	SS	14	3	34		
				7	SS	2	6	11		
				8	SS	10	3	41		
				9	SS	10	5	32		
		15		10	SS	12	4	42		
	18 ▽			11	SS	12	6	30		
	FINE TO MEDIUM SAND, TRACE CLAY, Gray, Loose to Medium Dense		SP	12	SS	10	11	13		
		20			HS					
	25.5		SP	13	SS	10	9	10		
	BOTTOM OF BORING	25								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 17.5	WS	▽
WL	▽		▽
WL	WCI @ 18.5' (7/20/00)		

Terracon

BORING STARTED	7-18-00		
BORING COMPLETED	7-18-00		
RIG	#14	FOREMAN	GAE
APPROVED	BFG	JOB #	06005144

BOREHOLE 06005144.GPJ TERRACON.GDT 7/28/00

LOG OF BORING NO. 2

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

Approx. River Elev.: 78.1 ft.

DEPTH (FT.)	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	WATER								
4.0	74.1								
5.0	FINE TO COARSE SAND, WITH GRAVEL & COBBLES, Brown — 73.1			WB					
5									
8.5	SANDY LEAN CLAY, TRACE GRAVEL, Gray, Stiff — 69.6	CL	1	SS	18	30	19.0		*4000
10.5	HIGHLY WEATHERED LIMESTONE,**Yellow Brown — 67.6			WB					
10									
12.1	WEATHERED LIMESTONE,**Light Gray — 66.0		2	SS	0	50/1"			
	BOTTOM OF BORING								

**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS		
WL	▽	▼
WL		
WL		

Terracon

BORING STARTED	8-28-91		
BORING COMPLETED	8-29-91		
RIG	NO. 37	FOREMAN	REF
APPROVED	TAS	JOB #	06915072

LOG OF BORING NO. 3

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	Approx. River Elev.: 78.0 ft.									
	WATER									
	3.0 75.0									
	FINE TO COARSE SAND, WITH GRAVEL & COBBLES, Brown				WB					
	5.0 73.0	5								
	SANDY LEAN CLAY, TRACE GRAVEL, Gray, Stiff		CL	1	SS	18	13	19.0		*4000
					WB					
	11.0 67.0	10								
	HIGHLY WEATHERED LIMESTONE** Yellow Brown			2	SS	15	54	18.8		
	14.5 63.5				WB					
	WEATHERED LIMESTONE** Light Gray	15								
	17.1 60.9			3	SS	025/0.5'				
	BOTTOM OF BORING									
	**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS		
WL	▽	▼
WL		
WL		

Terracon

BORING STARTED	8-28-91		
BORING COMPLETED	8-28-91		
RIG	NO. 37	FOREMAN	REF
APPROVED	TAS	JOB #	06915072

LOG OF BORING NO. 3

OWNER | ARCHITECT/ENGINEER

SITE | PROJECT

Approx. Surface Elev.: 718. ft.

DESCRIPTION		DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
4" Asphalt					HS					
1. FILL, FINE TO MEDIUM SAND, TRACE SILT, Dark Brown	717									
4. FILL, FINE TO MEDIUM SAND, Brown	714.			1	SS	12	15	15.4		
5.5	712.5	5			HS					
FILL, SANDY LEAN CLAY, TRACE WOOD & GLASS, PARTLY ORGANIC, Dark Brown				2	SS	6	5	33.1		
		10			HS					
FILL, CLAYEY FINE TO COARSE SAND, WITH BRICK, CINDERS & PLASTIC, Brown & Dark Brown				3	SS	9	7	38.2		
		15			HS					
19.	699.									
LEAN CLAY, PARTLY ORGANIC, Dark Brown, Stiff		20	CL	4	SS	18	9	31.2		*2500
22.	696.				HS					
FINE TO COARSE SAND, TRACE SILT & GRAVEL, Gray, Medium Dense		25	SP	5	SS	15	12	18.6		
					WB					
			SP	6	SS	6	14	15.4		
		30			WB					

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS				
WL	▽ 24'	WS	▽ 20'	ACR
WL				
WL				

Terracon

BORING STARTED	8-21-91		
BORING COMPLETED	8-21-91		
RIG	NO. 2	FOREMAN	REF
APPROVED	DEW	JOB #	06915078

LOG OF BORING NO. 3

OWNER

ARCHITECT/ENGINEER

SITE

PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	FINE TO COARSE SAND, TRACE SILT & GRAVEL, Medium Dense	35	SP	7	SS	8	24	19.1		
					WB					
	38. 680.									
	FINE TO MEDIUM SAND, TRACE SILT, Brown, Very Dense	40	SP	8	SS	10	74	17.1		
	41. 677.				WB					
		45	SP	9	SS	10	36	14.6		
					WB					
		50	SP	10	SS	10	36	9.4		
					WB					
	FINE TO COARSE SAND, TRACE SILT & GRAVEL, Brown, Medium Dense to Dense	55	SP	11	SS	10	39	14.3		
					WB					
		60	SP	12	SS	8	22	19.1		
					WB					
		65								

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS				
WL	▽ 24'	WS	▼ 20'	ACR
WL				
WL				

Terracon

BORING STARTED	8-21-91		
BORING COMPLETED	8-21-91		
RIG	NO. 2	FOREMAN	REF
APPROVED	DEW	JOB #	06915078

LOG OF BORING NO. 3

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	FINE TO COARSE SAND, TRACE SILT, Brown, Medium Dense									
			SP	13	SS	11	17	18.6		
	Numerous Cobbles About 70' to 75'	70			WB					
		75								
	77.0 Split Spoon Bouncing 641.			14	SS	0				
	Weathered Limestone** at 77'									
	BOTTOM OF BORING									
	**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS				
WL	▽ 24'	WS	▽ 20'	ACR
WL				
WL				

Terracon

BORING STARTED	8-21-91		
BORING COMPLETED	8-21-91		
RIG	NO. 2	FOREMAN	REF
APPROVED	DEW	JOB #	06915078

LOG OF BORING NO. 3

OWNER	ARCHITECT-ENGINEER
SITE	PROJECT NAME

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	DB										6" Concrete Slab
	HA										(1.0) FILL, FINE TO COARSE SAND, Gray
Run 1 & 2	NX DB	24									FRACTURED LIMESTONE, Gray Brown (3.0) REC: 100% RQD: 27%
Run 2	NX DB	24							5		FRACTURED LIMESTONE, Gray Brown (5.0) REC: 100% RQD: 17%
											Bottom of Boring

WATER LEVEL OBSERVATIONS			
W.L.		W.S. OR W.D.	
W.L.	2.5 B.C.R.		A.C.R.
W.L.			

SOIL TESTING SERVICES
of IOWA, INC.
Cedar Rapids – Iowa City
Davenport Des Moines

BORING STARTED	3/2/76		
BORING COMPLETED	3/3/76		
RIG	Port Cor	FOREMAN	DMM
DRAWN	HHE	APPROVED	JAC
JOB #	675673	SHEET	1 of 1

LOG OF BORING NO. 4

CLIENT

ARCHITECT/ENGINEER

SITE

PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	FIELD VAPOR TEST (ppm)
	Approx. Surface Elev.: 723 ft										
					PA						
				1	SS	13	6	15			0
					PA						
	FILL, FINE TO MEDIUM SAND, TRACE CLAY, GRAVEL, BRICK, CONCRETE, CINDERS & GLASS, Dark Brown to Brown			2	SS	13	5	9			0
		5			PA						
				3	SS	10	2	21			0
					PA						
				4	SS	13	3	25			0
		10			PA						
	13 710										
	FINE TO COARSE SAND, TRACE CLAY & GRAVEL, Brown, Medium Dense		SP/SW	5	SS	14	23	8			0
	14.5 708.5	15			PA						
	*** HIGHLY WEATHERED & FRACTURED LIMESTONE WITH OCCASIONAL CLAY SEAMS, Brown										
	17.5 705.5										
	Auger Refusal @ 17.5 feet. BOTTOM OF BORING										

*** Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE	WD	▽
WL	▽		▽
WL	DCI @ 16.5' (10/4/99)		

Terracon

BORING STARTED	10-1-99		
BORING COMPLETED	10-1-99		
RIG	#14	FOREMAN	GAE
APPROVED	BFG	JOB #	06995207

BOREHOLE 06995207.GPJ TERRACON.GDT 10/29/99

LOG OF BORING NO. 4

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

Approx. River Elev.: 77.9 ft.

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	WATER									
	3.3 74.6									
	FINE TO COARSE SAND, WITH GRAVEL, TRACE COBBLES, Brown	5			WB					
	5.5 72.4		CL	1	SS	16	11	19.5		*4500
					WB					
	SANDY LEAN CLAY, TRACE GRAVEL, Gray, Stiff to Very Stiff	10	CL	2	SS	18	13	19.1		*5000
					WB					
		15	CL	3	SS	18	14	25.7		*5000
	Wood Layer at 17.8' to 18.2'				WB					
		20	CL	4	SS	16	24	24.3		*4000
	Cobble at 21.5'				WB					
	26.0 51.9	25		5	SS WB	0	25/0"			
	WEATHERED LIMESTONE** Light Gray									
	31.0 46.9	30								
	BOTTOM OF BORING									
	**See note for Boring No. 1									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS		
WL	▽	▼
WL		
WL		

Terracon

BORING STARTED	8-29-91		
BORING COMPLETED	8-29-91		
RIG	NO. 37	FOREMAN	REF
APPROVED	TAS	JOB #	06915072

LOG OF BORING NO. 5

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

Approx. Surface Elev.: 714. ft.

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
					HS					
	FILL, SANDY LEAN CLAY, WITH BRICK, CINDERS, GRAVEL & CONCRETE, Dark Brown & Brown	5		1	SS	12	6	15.5		
					HS					
		10		2	SS	7	4	25.6		
					HS					
	14. 700.	15	CL	3	SS	3	8	23.0		
	LEAN CLAY, PARTLY ORGANIC, WITH SAND & GRAVEL, Dark Brown & Blue Gray (Slight Chemical Odor) 18. 696.				HS					
	FINE TO MEDIUM SAND, TRACE SILT, Gray	20	SP	4	SS	14	15	2.2		
	▽				HS					
		25	SP	5	SS	17	11	16.3		
					WB					
	28. 686.		SP	6	SS	15	14	14.7		
	FINE TO COARSE SAND, TRACE SILT & GRAVEL, Gray, Medium Dense	30			WB					

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS			
WL	▽ 23'	WS	▽
WL			
WL	DCI @ 22.5' 24HR AB		

Terracon

BORING STARTED	8-22-91		
BORING COMPLETED	8-22-91		
RIG	NO. 2	FOREMAN	REF
APPROVED	DEW	JOB #	06915078

LOG OF BORING NO. 5

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	Occasional Cobble below 37'	35	SP	7	SS WB	16	21	14.9		
		40	SP	8	SS WB	12	85	8.4		
		45	SP	9	SS WB	6	21	17.8		
	FINE TO COARSE SAND, TRACE SILT & GRAVEL, Brown, Medium Dense to Dense	50	SP	10	SS WB	6	25	14.9		
		55	SP	11	SS WB	3	22	14.4		
		60	SP	12	SS WB	7	33	15.5		
	61.5 652.5			13	SS	0				
	63. Bit Refusal at 63' WEATHERED LIMESTONE** 651.									
	BOTTOM OF BORING									

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS			
WL	▽ 23'	WS	▼
WL			
WL	DCI @ 22.5' 24HR AB		

Terracon

BORING STARTED	8-22-91		
BORING COMPLETED	8-22-91		
RIG	NO. 2	FOREMAN	REF
APPROVED	DEW	JOB #	06915078

LOG OF BORING NO. 5

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS			
				NUMBER	TYPE	RECOVERY	SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH PSF	
	**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.										

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS			
WL	▽ 23'	WS	▼
WL			
WL	DCI @ 22.5' 24HR AB		

Terracon

BORING STARTED	8-22-91		
BORING COMPLETED	8-22-91		
RIG	NO. 2	FOREMAN	REF
APPROVED	DEW	JOB #	06915078

LOG OF BORING NO. 5

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	Approx. River Elev.: 77.9 ft.									
	WATER									
	3.5 — 74.4									
	FINE TO COARSE SAND, TRACE GRAVEL & COBBLES, Brown				WB					
	5.5 — 72.4	5								
			CL	1	SS	12	12	20.7		*4000
	SANDY LEAN CLAY, TRACE GRAVEL, Gray, Stiff				WB					
		10								
			CL	2	SS	3	11	24.4		*4000
					WB					
	16.0 — 61.9	15								
	HIGHLY WEATHERED LIMESTONE,**Light Gray			3	SS	6	50/4"	19.0		
	18.0 — 59.9				WB					
	WEATHERED LIMESTONE,**WITH OCCASIONAL CLAY SEAMS,	20								
	22.0 — 55.9									
	BOTTOM OF BORING			4	SS	0	50/0"			
	**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS		
WL	▽	▼
WL		
WL		

Terracon

BORING STARTED	8-29-91		
BORING COMPLETED	8-29-91		
RIG	NO. 37	FOREMAN	REF
APPROVED	TAS	JOB #	06915072

LOG OF BORING NO. 6

CLIENT c/o

SITE PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elev.:103.0 ft									
	6" Portland Cement Concrete									
	FILL, FINE TO COARSE SAND, TRACE BRICK & CONCRETE, Dark Brown			1	HA AS					
	Brick @ about 3.5 to 3.8 feet.									
	4 — 99									
	FINE TO MEDIUM SAND, Brown	5								
	7.5 — 95.5				#					
	Hand Auger Refusal @ about 7.5 feet.									
	APPARENT HIGHLY WEATHERED & BROKEN LIMESTONE									
	10 — 93	10								
	BOTTOM OF BORING									
	Classifications based on driller's visual observation of materials and the advancement of the test hole only. Soil sampling and laboratory testing may reveal other soil types.									
	# - Below HA Refusal, a section of reinforcing steel was driven with a sledgehammer to refusal.									

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE	WD	▼
WL	▼		▼
WL	Backfilled and Patched		

Terracon

BORING STARTED	10-6-08		
BORING COMPLETED	10-6-08		
RIG	HA	FOREMAN	GAE
APPROVED	BKS	JOB #	06085076

BOREHOLE 06085076.GPJ TERRACON.GDT 10/31/08

LOG OF BORING NO. 6

OWNER	ARCHITECT/ENGINEER
SITE	PROJECT

Approx. River Elev.: 77.8 ft.

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	SAMPLES SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH PSF
	WATER									
	2.7 75.1									
	FINE TO COARSE SAND, TRACE GRAVEL & COBBLES, Brown		SP	1	SS	1	8			
	5.0 72.8				WB					
	SANDY LEAN CLAY, TRACE GRAVEL, Gray, Stiff	5	CL	2	SS	12	13	24.1		*4000
					WB					
	11.0 66.8	10								
	HIGHLY WEATHERED LIMESTONE,**Light Gray			3	SS	12	64	19.1		
	14.0 63.8				WB					
	WEATHERED LIMESTONE,**Light Gray	15								
	17.0 60.8			4	SS	030/0.5'				
	BOTTOM OF BORING									

**Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

Calibrated Hand Penetrometer*

WATER LEVEL OBSERVATIONS		
WL	▽	▼
WL		
WL		

Terracon

BORING STARTED	8-29-91		
BORING COMPLETED	8-29-91		
RIG	NO. 37	FOREMAN	REF
APPROVED	TAS	JOB #	06915072

LOG OF BORING NO. 7

CLIENT c/o

SITE , PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elevation.: 100 ft									
	0.5 5" Portland Cement Concrete	99.5			PA					
	FILL, LEAN CLAY WITH SAND, GRAVEL, & COBBLES, TRACE ORGANICS, Dark Gray and Brown ▽			1	SS	10	6	16		
					PA					
				2	SS	12	2	19		
	5	95								
	LEAN CLAY, TRACE SAND & ORGANICS, Dark Gray				PA					
	6.5	93.5								
	7 *** HIGHLY WEATHERED & BROKEN LIMESTONE	93		3	SS	10	50/3"	17		
	Practical Sampler Refusal @ about 7 feet. BOTTOM OF BORING									
	*** Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 2	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	7-18-08		
BORING COMPLETED	7-18-08		
RIG	#83E	FOREMAN	RH
APPROVED	BKS	JOB #	06085076

BOREHOLE 06085076.GPJ TERRACON.GDT 8/4/08

LOG OF BORING NO. 8

CLIENT c/o

SITE PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elevation.: 100 ft									
					PA					
	FILL, FINE TO MEDIUM SAND WITH CLAY, GRAVEL, & BROKEN CONCRETE PIECES, Brown			1	SS	12	7	7		
					PA					
				2	SS	10	4	17		
	▽	5								
					PA					
				3	SS	10	4	29		
	8 92									
					PA					
	VERY SANDY LEAN CLAY WITH HIGHLY WEATHERED LIMESTONE FRAGMENTS, Brown to Gray,			4	SS	10	50/4"	21		
	10 90	10								
	***Practical Sampler Refusal @ about 10 feet on apparent highly weathered limestone. **BOTTOM OF BORING**									
	*** Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 5	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	7-18-08		
BORING COMPLETED	7-18-08		
RIG	#83E	FOREMAN	RH
APPROVED	BKS	JOB #	06085076

BOREHOLE 06085076.GPJ TERRACON.GDT 8/5/08

LOG OF BORING NO. 22

CLIENT | ARCHITECT/ENGINEER

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	0.2 Approx. 2" Crushed Limestone				HS					
	FILL, CONCRETE & BRICK PIECES WITH ASPHALT, SAND & CLAY, Dark Brown to Brown and Dark Gray ▽			1	SS	6	2	18		
	7				HS					
	FILL, FINE TO COARSE SAND WITH CLAY, ASPHALT, GRAVEL & COBBLES, Dark Brown, Gray to Dark Gray	10		2	SS	8	2	43		
	12				WB					
	FILL, LEAN CLAY WITH SAND, GRAVEL & COBBLES, Dark Brown, Gray to Dark Gray	15		3	SS	8	1	26		
	20				WB					
	FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL, Gray to Dark Gray, Loose	20		4	SS	10	19	51		
					WB					
		25	SP	5	SS	6	9	19		
					WB					
	32	30	SP	6	SS	10	9	24		
					WB					
	FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL, Gray Brown, Medium Dense	35	SP	7	SS	6	15	27		
					WB					
	40.5	40	SP	8	SS	10	15	18		
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 4	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	7-31-08		
BORING COMPLETED	7-31-08		
RIG	#14	FOREMAN	MW
APPROVED	BKS	JOB #	06085065

BOREHOLE 06085065.GPJ TERRACON.GDT 8/14/08

LOG OF BORING NO. 25

CLIENT | ARCHITECT/ENGINEER

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	FILL, FINE TO COARSE SAND WITH GRAVEL, COBBLES & CONCRETE PIECES, Brown				PA					
		5		1	SS	10	22	10		
					WB					
	FINE TO MEDIUM SAND WITH CLAY, TRACE GRAVEL & COBBLES, Brown, Medium Dense to Dense		SP	2	SS	6	35	16		
		10			WB					
			SP	3	SS	8	21	17		
		15			WB					
		18								
	FINE TO MEDIUM SAND, TRACE CLAY & GRAVEL, Gray, Loose to Medium Dense		SP	4	SS	8	4	20		
		20			WB					
		25		5	SS	0	20			
	FINE TO COARSE SAND WITH CLAY, GRAVEL & ORGANICS, Dark Brown to Gray, Medium Dense				WB					
		30	SP/SW	6	SS	8	11	22		
					WB					
	Hydrocarbon odor in Samples 6 thru 8		SP/SW	7	SS	8	12	18		
		35			WB					
			SP/SW	8	SS	12	16	14		
		40			WB					
		41								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NI	▼	
WL	▽	▼	
WL	Backfilled		

Terracon

BORING STARTED	10-2-08		
BORING COMPLETED	10-2-08		
RIG	#83E	FOREMAN	RH
APPROVED	BKS	JOB #	06085065

BOREHOLE 06085065.GPJ TERRACON.GDT 11/19/08

LOG OF BORING NO. 25

CLIENT | ARCHITECT/ENGINEER

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
		45	SP/SW	9	SS	8	6	20		
	FINE TO COARSE SAND WITH GRAVEL, TRACE CLAY & ORGANICS, Gray to Dark Gray, Loose				WB					
		50	SP/SW	10	SS	6	6	18		
	BOTTOM OF BORING									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NI	▼	
WL	▽	▼	
WL	Backfilled		

Terracon

BORING STARTED	10-2-08		
BORING COMPLETED	10-2-08		
RIG	#83E	FOREMAN	RH
APPROVED	BKS	JOB #	06085065

BOREHOLE 06085065.GPJ TERRACON.GDT 11/19/08

LOG OF BORING NO. BH-1

CLIENT

ARCHITECT/ENGINEER

SITE

PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Approx. Surface Elevation.: 99.5 ft									
	4" Asphalt				HS					
	FILL, CLAYEY FINE TO MEDIUM SAND, TRACE GRAVEL, ORGANICS & CRUSHED CONCRETE PIECES, Dark Brown and Brown			1	SS	12	8	5		
					HS					
		5		2	SS	8	2	23		
					HS					
				3	SS	9	2	22		
					HS					
	▽			4	SS	12	6	18		
	10 89.5	10			HS					
	FILL, LEAN CLAY WITH SAND, TRACE GRAVEL, BRICK PIECES & ORGANICS, Dark Brown			5	SS	3	7	19		
		15			HS					
	20 79.5			6	SS	9	12	28		
		20			WB					
	FINE TO COARSE SAND, TRACE SILT & GRAVEL, Brown, Medium Dense		SP/SW	7	SS	12	13	22		
		25			WB					
			SP/SW	8	SS	6	21	20		
		30			WB					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	8-28-07		
BORING COMPLETED	8-28-07		
RIG	#83E	FOREMAN	RH
APPROVED	TTW	JOB #	06075097

BOREHOLE 06075097.GPJ TERRACON.GDT 10/26/07

LOG OF BORING NO. BH-1

CLIENT | ARCHITECT/ENGINEER

SITE | PROJECT

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
					WB					
			SP/SW	9	SS	9	16	22		
		35			WB					
			SP/SW	10	SS	15	11	23		
		40			WB					
			SP/SW	11	SS	11	19	17		
		45			WB					
			SP/SW	12	SS	14	22	16		
		50			WB					
			SP/SW	13	SS	14	26	16		
		55			WB					
			SP/SW	14	SS	15	37	20		
		60			WB					

FINE TO COARSE SAND, TRACE SILT & GRAVEL,
Brown, Medium Dense to Dense

61 — 38.5

62.5 — 37

*** **HIGHLY WEATHERED & BROKEN LIMESTONE**

Practical Auger Refusal @ about 62.5 feet.
BOTTOM OF BORING
*** **SAME NOTE AS B-2**

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9	WS	▽
WL	▽		▽
WL	Backfilled		

Terracon

BORING STARTED	8-28-07		
BORING COMPLETED	8-28-07		
RIG	#83E	FOREMAN	RH
APPROVED	TTW	JOB #	06075097

BOREHOLE 06075097.GPJ TERRACON.GDT 10/26/07

2010 Terracon Soil Borings

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 7 — LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6 — DISTURBED: 6 — UNDISTURBED: 0
4. NAME OF DRILLER(S): Matt White / Rick Alexander	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: --- — BEARING:	14. ELEVATION GROUND WATER: 716.8 7/13/10
	15. DATE BORING — STARTED: 7/13/10 — COMPLETED: 7/13/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 726.8
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 22.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
						0' to 3': SANDY LEAN CLAY, **(Fill)**, brown and gray brown, trace gravel.										
723.8	3.0	4 3 5	8				56	1 SS						18		
						3' to 10': POORLY GRADED SAND, **(Fill)**, fine to coarse; gray, trace gravel, silt, concrete, brick and glass.										
		5 3 5	8				44	2 SS						9		
		2 12 9	21				33	3 SS						13		
716.8 ▼	10.0	2 6 4	10				22	4 SS						20		
						10' to 21': POORLY GRADED SAND (SP-SM), fine to medium; gray brown, loose to medium dense, with silt.										
		1 1 1	2				67	5 SS						17	SP-SM	
		10 4 7	11				89	6 SS						17	SP-SM	
705.8	21.0															
704.8	22.0					**21' to 22':** HIGHLY WEATHERED LIMESTONE.										
						22': AUGER REFUSAL @ 22 FEET.										

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 7/27/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids Flood Damage Reduction Project, Cedar Rapids, Iowa

2. HOLE NUMBER: 8

LOCATION COORDINATES:

3. DRILLING AGENCY: Terracon Consultants, Inc.

4. NAME OF DRILLER(S): Matt White / Rick Alexander

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN:

7. DEPTH DRILLED INTO ROCK:

8. TOTAL DEPTH OF BORING: 30.5

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT:

11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550

12. TOTAL SAMPLES: 8; DISTURBED: 8; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: N/A

14. ELEVATION GROUND WATER: 718.8 7/13/10

15. DATE BORING: STARTED 7/13/10; COMPLETED 7/13/10

16. ELEVATION TOP OF BORING: 726.8

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
724.8	2.0	2 2 3	5			**0' to 2':** POORLY GRADED SAND, **(Fill)**, fine to coarse; dark gray, with gravel, trace cinders.										
						2' to 8': SILTY CLAY, **(Fill)**, brown, with sand, trace gravel and cinders.	56	1 SS						19		
		1 1 2	3				67	2 SS						15		
718.8 ▼	8.0	1 1 2	3				56	3 SS						19		
						8' to 12': SILTY CLAY (CL-ML), gray brown, soft, with sand, trace gravel.										
		1 1 1	2				89	4 SS						23	CL-ML	
714.8	12.0					**12' to 18':** SILTY SAND (SM), fine to medium; gray brown, very loose, trace organics.										
		1 1 2	3				78	5 SS						21	SM	
708.8	18.0					**18' to 23':** LEAN CLAY (CL), dark gray, soft, trace organics.										
		1 1 1	2				83	6 SS						28	CL	
703.8	23.0					**23' to 27':** POORLY GRADED SAND (SP), fine to coarse; gray brown, medium dense.										
		7 9 11	20				100	7 SS						12	SP	
699.8	27.0					**27' to 30.5':** POORLY GRADED SAND (SP), fine to coarse; gray brown, medium dense, with gravel.										
		9 14 10	24				100	8 SS						10	SP	
696.3	30.5															

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 7/27/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids Flood Damage Reduction Project, Cedar Rapids, Iowa

2. HOLE NUMBER: 9

LOCATION COORDINATES:

3. DRILLING AGENCY: Terracon Consultants, Inc.

4. NAME OF DRILLER(S): Matt White / Rick Alexander

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN:

7. DEPTH DRILLED INTO ROCK:

8. TOTAL DEPTH OF BORING: 18.5

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT:

11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550

12. TOTAL SAMPLES: 5; DISTURBED: 5; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: N/A

14. ELEVATION GROUND WATER: 714.6 7/13/10

15. DATE BORING: STARTED 7/13/10; COMPLETED 7/13/10

16. ELEVATION TOP OF BORING: 726.6

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
725.6	1.0					**0' to 1':** LEAN CLAY (CL), dark brown, trace sand & organics.										
		1 1 2	3			**1' to 4':** CLAYEY SILT (ML/CL), brown gray, soft, trace sand.	67	1 SS						16	ML/CL	
722.6	4.0															
		5 5 7	12			**4' to 8':** SILTY CLAY (CL-ML), brown, stiff, trace sand.	78	2 SS						21	CL/ML	
718.6	8.0						50	3 ST						16	CL/ML	
		2 2 2	4			**8' to 15':** FAT CLAY (CH), brown, medium stiff, with sand.	67	4 SS						21	CH	
		2 11 27	38				78	5 SS						21	CH	
711.6	15.0					**15' to 18.5':** HIGHLY WEATHERED & BROKEN LIMESTONE.										
708.1	18.5															

18.5': AUGER REFUSAL @ 18.5 FEET.

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY 27-DO NOT USE.GDT 7/27/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 10 — LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 5 — DISTURBED: 5 — UNDISTURBED: 0
4. NAME OF DRILLER(S): Matt White / Rick Alexander	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: --- — BEARING:	14. ELEVATION GROUND WATER: 716.3 7/14/10
	15. DATE BORING — STARTED: 7/14/10 — COMPLETED: 7/14/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING: 725.8
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: 1138%
8. TOTAL DEPTH OF BORING: 25.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
724.8	1.0					**0' to 1':** SANDY LEAN CLAY, **(Fill)**, brown, with gravel.										
		2 4 3	7			**1' to 4':** POORLY GRADED SAND, **(Fill)**, fine to coarse; gray and dark gray, loose, with gravel, trace cinders.	78	1 SS						14		
721.8	4.0															
		3 2 3	5			**4' to 8':** CLAYEY SAND, **(Fill)**, brown, with gravel.	56	2 SS						14		
		7 6 13	19				22	3 SS						9		
717.8	8.0															
		7 2 4	6			**8' to 13':** SHOT ROCK (BOULDER), **(Fill)**.	33	4 SS						6		
712.8	13.0															
		2 23 50	73			**13' to 17':** CLAYEY SAND, **(Fill)**, gray and light gray, with gravel.	22	5 SS						25		
708.8	17.0															
						17' to 20': CONCRETE, **(Fill)**, gray.										
705.8	20.0															
						20' to 25': HIGHLY WEATHERED LIMESTONE, gray brown.										
700.8	25.0															

25': AUGER REFUSAL @ 25 FEET.

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 7/27/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 11 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6 / DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / Matt White	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 712.3 3/31/10
	15. DATE BORING: STARTED 3/31/10 / COMPLETED 3/31/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 726.8
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: 18%
8. TOTAL DEPTH OF BORING: 28.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
722.8	4.0	3 2 2	4			**0' to 4':** SANDY LEAN CLAY, **(Fill)**, dark brown and gray brown, trace gravel, organics and crushed limestone.	67	1 SS						14		
717.8	9.0	5 4 4 / 7 9 12	8 / 21			**4' to 9':** CLAYEY SAND, **(Fill)**, fine to coarse; gray brown, trace gravel, brick, concrete and organics.	78 / 44	2 SS / 3 SS	1	59	40			10 / 9		
713.8	13.0	5 5 6	11			**9' to 13':** SANDY LEAN CLAY, **(Fill)**, brown gray, trace gravel and crushed limestone.	44	4 SS						11		
711.8	15.0	3 15 20	35			**13' to 15':** SILTY SAND (SM), fine to medium; brown, loose to medium dense, trace gravel.	56	5 SS						11	SM	
710.8	16.0					**15' to 16':** LIMESTONE, highly weathered, and broken with sand seams.										
704.8	22.0	2 5 7	12			**16' to 22':** SANDY LEAN CLAY (CL), **(Till)**, gray, very stiff, trace gravel.	78	6 SS						15	CL	Qp = 3.75 tsf
703.8	23.0					**22' to 23':** LIMESTONE, highly weathered, and broken Practical Auger Refusal @ about 23 feet.										
699.3	27.5					**23' to 27.5':** LIMESTONE, moderately weathered, moderately hard, vuggy, gray brown.										Rec = 85% RQD = 68
698.8	28.0					**27.5' to 28':** SHALE, weathered, gray.										

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 12 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / Matt White	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 707.8 3/31/10
	15. DATE BORING: STARTED 3/31/10 / COMPLETED 3/31/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 724.8
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
723.8	1.0					**0' to 1':** **(Topsoil)**.										
		9 12 11	23			**1' to 14':** CLAYEY SAND, **(Fill)**, fine to coarse; brown, trace gravel.	78	1 SS						6		
		3 4 4	8				72	2 SS						12		
		4 5 7	12				78	3 SS	8	71	21			8		
		2 2 3	5				67	4 SS						5		
710.8	14.0															
709.8	15.0	23 11 3	14			**14' to 15':** **(Fill)**, gray, Concrete rubble with clay.	44	5 SS						9		
						15' to 20': SANDY LEAN CLAY, **(Till)**, brown, hard, trace gravel with sand seams.										
704.8	20.0	2 6 8	14				100	6 SS						16 17	CL	Qp = 4.5 tsf Qp = 2.25 tsf
						20' to 22.5': SANDY LEAN CLAY, **(Till)**, gray, very stiff to hard, trace gravel.										
702.3	22.5					**22.5' to 30':** Highly weathered, and broken with sand and clay.	22	7 SS						11		
						Practical sampler refusal @ about 30 feet.										
694.8	30.0						0	8 SS						0		

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 13 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / Eric Harris	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 707.4 4/6/10
	15. DATE BORING: STARTED 4/6/10 / COMPLETED 4/6/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 726.4
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
724.9	1.5					**0' to 1.5':** 4" Asphalt over 14" Crushed Limestone.										
		4 3 2	5			**1.5' to 24.5':** CLAYEY SAND, **(Fill)**, fine to medium; dark brown to dark gray, trace brick, cinders, crushed limestone, concrete and rubble.	11	1 SS						24		
		4 9 7	16				11	2 SS						16		
		4 7 7	14				17	3 SS						14		
		7 6 5	11				39	4 SS						14		
		3 2 2	4				50	5 SS						20		
		2 2 3	5				28	6 SS						23		
701.9	24.5	2 3 3	6			**24.5' to 25':** WELL GRADED SAND GRAVELLY (SW), fine to coarse; brown, loose, trace silt.	61	7 SS						15	SW	
701.4	25.0					**25' to 30.5':** SANDY LEAN CLAY (CL), **(Till)**, gray, medium stiff, trace gravel with occasional sand seams and zones.										
695.9	30.5	4 6 7	13				44	8 SS						14	CL	Qp = 0.75 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 15 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / Eric Harris	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 697.5 4/6/10
	15. DATE BORING: STARTED 4/6/10 / COMPLETED 4/6/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 719.5
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 29.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		2 3 4	7			**0' to 6':** LEAN CLAY, **(Fill)**, dark brown to brown gray, trace sand.	89	1 SS						20		
		3 3 3	6				89	2 SS						20		
713.5	6.0															
		3 2 2	4			**6' to 22':** CLAYEY SAND GRAVELLY, **(Fill)**, fine to coarse; dark brown, brown gray and gray, trace cinders, brick, crushed limestone and concrete rubble.	67	3 SS						12		
		2 2 2	4				78	4 SS	30	58	12			10		
		1 2 2	4				89	5 SS						9		
		2 3 3	6				17	6 SS						12		
697.5 ▼	22.0															
						22' to 28': CLAYEY SAND (SC), fine to medium; reddish brown, trace gravel.	72	7 SS						29	SC	
691.5	28.0															
690.0	29.5					**28' to 29.5':** LIMESTONE, highly weathered, and broken with clay, brown. Practical auger refusal @ about 29.5 feet.	100	8 SS						27		

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 16 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6 / DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / William Everman	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 704.9 3/17/10
	15. DATE BORING: STARTED 3/17/10 / COMPLETED 3/17/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 725.9
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 25.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
725.5	0.4					**0' to 0.4':** 4" Concrete.										
724.9	1.0					**0.4' to 1':** WELL GRADED SAND, **(Fill)**, fine to coarse; brown, trace clay and gravel.										
723.4	2.5	8 8 9	17			**1' to 2.5':** SANDY LEAN CLAY, **(Fill)**, dark brown, trace organics.	72	1 SS						11		
		3 3 3	6			**2.5' to 8':** POORLY GRADED SAND, **(Fill)**, fine to medium; brown, trace clay.	83	2 SS						11		
717.9	8.0	2 2 3	5				67	3 SS						10		
		1 1 2	3			**8' to 19':** POORLY GRADED SAND, **(Fill)**, fine to medium; dark brown, trace clay and gravel.	78	4 SS						13		
		1 2 4	6				39	5 SS						15		
706.9	19.0					**19' to 21':** OBSTRUCTION, Possible concrete rubble.	0	6 SS						0		
704.9 ▼	21.0					**21' to 25':** POORLY GRADED SAND (SP), fine to medium; dark brown, trace clay and gravel										
700.9	25.0					Boring terminated at 25 feet due to apparent contamination.										

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 17 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / William Everman	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 708.9 3/17/10
	15. DATE BORING: STARTED 3/17/10 / COMPLETED 3/17/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 722.9
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
721.9	1.0					**0' to 1':** 4" Concrete over 8" Crushed Limestone.										
		5 8 6	14			**1' to 7':** POORLY GRADED SAND, **(Fill)**, fine to medium; dark brown, trace clay, gravel, cinders and brick.	78	1 SS						3		
		1 2 3	5				33	2 SS						5		
715.9	7.0	2 1 2	3			**7' to 9':** CLAYEY SAND, **(Fill)**, fine to medium; dark brown, trace gravel.	61	3 SS						23		
713.9	9.0	2 2 2	4			**9' to 12':** LEAN CLAY WITH SAND (CL), brown, and sand seams.	83	4 SS						20	CL	
710.9	12.0	1 1 4	5			**12' to 18':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay.	83	5 SS						20	SP	
704.9	18.0	2 2 2	4			**18' to 26':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay and gravel.	100	6 SS						20	SP	
		7 14 15	29				100	7 SS						14	SP	
696.9	26.0	5 6 4	10			**26' to 30.5':** WELL GRADED SAND WITH GRAVEL (SW), medium to coarse; brown, medium dense.	22	8 SS						9	SW	
692.4	30.5															

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER: 18	LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55	
3. DRILLING AGENCY: Terracon Consultants, Inc.		12. TOTAL SAMPLES: 11	DISTURBED: 11 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / Eric Harris		13. TOTAL NUMBER CORE BOXES: N/A	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 705.5	4/6/10
		15. DATE BORING	STARTED: 4/6/10 / COMPLETED: 4/6/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING: 723.0	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.5		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
722.3	0.7					**0' to 0.7':** 7" Concrete.										
720.0	3.0	12 12 7	19			**0.7' to 3':** CLAYEY SAND WITH GRAVEL, **(Fill)**, fine to coarse; dark brown, trace cinders.	89	1 SS	19	68	13			7		
717.0	6.0	2 2 3	5			**3' to 6':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay.	78	2 SS						8	SP	
712.0	11.0	2 4 4	8			**6' to 11':** LEAN CLAY WITH SAND (CL), brown, medium stiff, occasional sand seams.	89	3 SS						15	CL	Qp = 1.0 tsf
		3 3 2	5				83	4 SS						21	CL	
708.0	15.0	2 2 2	4			**11' to 15':** POORLY GRADED SAND WITH CLAY (SP-SC), fine to medium; brown, loose.	94	5 SS						10	SP	
705.0	18.0	3 4 5	9			**15' to 18':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay and gravel.	83	6 SS						6	SP	
		3 4 4	8			**18' to 40.5':** WELL GRADED SAND (SW), fine to coarse; brown, loose to medium dense, trace clay and gravel.	100	7 SS						15	SW	
		3 10 8	18				89	8 SS						12	SW	
		3 5 8	13				89	9 SS						15	SW	
		1 4					89	10						14	SW	

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5, 30.0, 32.5, 35.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG (Cont Sheet)

INSTALLATION	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Cedar Rapids			

LOCATION COORDINATES	ELEVATION TOP OF BORING
	723.0

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		6	10			**18' to 40.5':** WELL GRADED SAND (SW), fine to coarse; brown, loose to medium dense, trace clay and gravel. *(continued)*		SS								
682.5	40.5	2 4 10	14				33	11 SS						18	SW	

35.0
37.5
40.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 19 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 7 / DISTURBED: 7 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Gary Everman	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 706.6 3/18/10
	15. DATE BORING: STARTED 3/18/10 / COMPLETED 3/18/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 721.6
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 24.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
720.8	0.8					**0' to 0.8':** 4" Asphalt over 4" Crushed Limestone.										
		7 5 4	9			**0.8' to 6':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay.	56	1 SS	0	95	5			10	SP	
		3 2 3	5				67	2 SS						16	SP	
715.6	6.0					**6' to 8.5':** VERY SANDY LEAN CLAY (CL), brown gray, stiff.										
		4 4 5	9				100	3 SS						15	CL	Qp = 1.25 tsf
713.1	8.5					**8.5' to 18':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay with clay layers.										
		4 6 3	9				100	4 SS						13	SP	
		4 4 4	8				100	5 SS						19	SP	
703.6	18.0					**18' to 24.5':** LIMESTONE, highly weathered, with clay, brown										
							67	6 SS						11		
						Practical sampler refusal @ about 24.5 feet.										
697.1	24.5						117	7 SS						21		

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids Flood Damage Reduction Project Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 20 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 7 / DISTURBED: 7 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Mark Dutra	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 707.2 3/19/10
	15. DATE BORING: STARTED 3/19/10 / COMPLETED 3/19/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 720.7
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 25.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
720.5	0.2					**0' to 0.2':** 2" Asphalt.										
		5 3 2	5			**0.2' to 3.5':** CLAYEY SAND, **(Fill)**, fine to medium; dark brown, trace cinders.	67	1 SS						15		
717.2	3.5															
716.2	4.5	3 2 3	5			**3.5' to 4.5':** CLAYEY SAND, **(Fill)**, fine to medium; dark brown.	100	2 SS						18		
		2 2 2	4			**4.5' to 13':** CLAYEY SAND (SC), fine to medium; brown, loose, with clay seams.	100	3 SS						16	SC	
		2 3 3	6				100	4 SS						17	SC	
707.7	13.0															
		2 3 4	7			**13' to 17':** POORLY GRADED SAND (SP), fine to medium; gray brown, loose, trace clay.	100	5 SS						19	SP	
703.7	17.0					**17' to 25':** LIMESTONE, highly weathered, and broken										
		14 40 16	56				67	6 SS						14		
						Practical sampler refusal @ about 25 feet.	17	7 SS						9		
695.7	25.0															

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 21 — LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 — DISTURBED: 8 — UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / David Dyer	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: --- — BEARING:	14. ELEVATION GROUND WATER: 708.0 3/24/10
	15. DATE BORING — STARTED: 3/24/10 — COMPLETED: 3/24/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING: 722.0
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		2 2 2	4			**0' to 12':** VERY SANDY LEAN CLAY, **(Fill)**, dark brown to brown gray, trace gravel and organics.	100	1 SS						16		
		3 2 2	4				100	2 SS						18		
		2 2 2	4				94	3 SS						13		
		3 3 2	5				100	4 SS						17		
710.0	12.0															
		3 2 1	3			**12' to 22':** CLAYEY SAND (SC), fine to medium; brown, very loose to loose, with clay seams and gravel.	89	5 SS						24	SC	
		2 2 3	5				100	6 SS						22	SC	
700.0	22.0															
		7 12 15	27			**22' to 30':** WELL GRADED SAND WITH GRAVEL (SW), fine to coarse; brown, loose to medium dense, trace clay.	89	7 SS						10	SW	
		2 2 2	4				83	8 SS						14	SW	
692.0	30.0															

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5, 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 22 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / David Dyer	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 707.9 3/24/10
	15. DATE BORING: STARTED 3/24/10 / COMPLETED 3/24/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 721.9
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
						0' to 3': VERY SANDY LEAN CLAY, **(Fill)**, dark brown to brown gray, trace gravel and organics.										
718.9	3.0	3 5 4	9				100	1 SS						13		
						3' to 7': CLAYEY SAND, **(Fill)**, fine to coarse; brown gray, trace gravel.										
		3 2 2	4				100	2 SS						11		
714.9	7.0	3 2 3	5				100	3 SS	3	63	34			19		
						7' to 19': WELL GRADED SAND WITH GRAVEL, **(Fill)**, fine to coarse; dark brown to dark gray, cinders, clay and cobbles.										
		2 2 2	4				89	4 SS						29		
		2 2 3	5				100	5 SS						41		
702.9	19.0	1 1 2	3			**19' to 21':** LEAN CLAY (CL), dark gray, with organics, trace sand.	83	6 SS						45	CL/OL	
700.9	21.0					**21' to 26':** WELL GRADED SAND (SW), fine to coarse; brown, loose, trace clay and gravel.										
		3 3 4	7				89	7 SS						16	SW	
695.9	26.0					**26' to 30':** WELL GRADED SAND GRAVELLY (SW), fine to coarse; brown, medium dense, trace clay.										
691.9	30.0	10 9 6	15				72	8 SS						12	SW	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 23 — LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 — DISTURBED: 8 — UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / David Dyer	13. TOTAL NUMBER CORE BOXES: N/A
	14. ELEVATION GROUND WATER: 707.1 3/24/10
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: --- — BEARING:	15. DATE BORING — STARTED: 3/24/10 — COMPLETED: 3/24/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 721.1
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		2 1 3	4			**0' to 9':** VERY SANDY LEAN CLAY, **(Fill)**, dark brown to brown gray, trace gravel and organics.	72	1 SS						23		
		3 3 3	6				100	2 SS						17		
		2 4 4	8				89	3 SS						23		
712.1	9.0	3 4 4	8				94	4 SS						25 21		
						9' to 18': WELL GRADED SAND GRAVELLY, **(Fill)**, fine to coarse; dark brown to dark gray, with cinders, trace clay and cobbles.										
		2 1 1	2				100	5 SS						39		
703.1	18.0															
701.1	20.0	2 2 3	5			**18' to 20':** CLAYEY SAND (SC), fine to coarse; dark gray, loose, trace gravel.	100	6 SS						38	SC	
						20' to 26': LEAN CLAY WITH SAND (CL), dark gray.										
		2 2 2	4				100	7 SS						32	CL	
695.1	26.0															
						26' to 30': WELL GRADED SAND (SW), fine to coarse; gray, medium dense, trace clay and gravel.										
691.1	30.0	5 8 9	17				100	8 SS						16	SW	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 24 — LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-550
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 — DISTURBED: 8 — UNDISTURBED: 0
4. NAME OF DRILLER(S): Rob Hunt / David Dyer	13. TOTAL NUMBER CORE BOXES: N/A
	14. ELEVATION GROUND WATER: 695.0 3/24/10
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: --- — BEARING:	15. DATE BORING — STARTED: 3/24/10 — COMPLETED: 3/24/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 719.0
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		4 2 2	4			**0' to 5.5':** VERY SANDY LEAN CLAY, **(Fill)**, dark brown to brown gray, trace gravel, organics and wood particles.	89	1 SS						17		
		3 3 3	6				100	2 SS						14		
713.5	5.5															
		3 4 4	8			**5.5' to 10':** CLAYEY SAND, **(Fill)**, fine to coarse; dark brown to brown gray, trace gravel.	100	3 SS						16		
		3 3 3	6				100	4 SS	1	69	30			16		
709.0	10.0															
		3 2 2	4			**10' to 25':** WELL GRADED SAND GRAVELLY, **(Fill)**, fine to coarse; dark brown to dark gray, with cinders, clay and cobbles.	67	5 SS						40		
		1 1 1	2				83	6 SS						50		
		5 7 9	16				83	7 SS						19		
694.0	25.0															
		3 4 7	11			**25' to 30':** WELL GRADED SAND (SW), fine to coarse; brown, medium dense, trace clay and gravel.	89	8 SS						15	SW	
689.0	30.0															

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5, 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 31 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 4 / DISTURBED: 4 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Rob Hunt	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER
	15. DATE BORING: STARTED 3/30/10 / COMPLETED 3/30/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 730.9
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 13.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
727.4	3.5	3 2 3	5			**0' to 3.5':** LEAN CLAY WITH SAND, **(Fill)**, dark brown, trace gravel and cinders.	67	1 SS						14		
723.9	7.0	1 2 1	3			**3.5' to 7':** LEAN CLAY WITH SAND (CL), gray brown.	78	2 SS						17	CL	
722.4	8.5	4 15 22	37			**7' to 8.5':** POORLY GRADED SAND (SP), fine to medium; brown, dense, trace clay with highly weathered limestone zones.	67	3 SS						6	CL	
717.9	13.0	37 33 37	70			**8.5' to 13':** LIMESTONE, highly weathered, and broken with clay, brown Practical sampler refusal @ about 13 feet.	67	4 SS						9		

0.0 2.5 5.0 7.5 10.0 12.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 32 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6 / DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Mark Dutra	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 722.2 3/19/10
	15. DATE BORING: STARTED 3/19/10 / COMPLETED 3/19/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 732.2
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 20.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
731.7	0.5					**0' to 0.5':** 6" Concrete.										
		4 5 5	10			**0.5' to 3.5':** CLAYEY SAND, **(Fill)**, fine to medium; gray brown, trace brick and crushed limestone.	100	1 SS						8		
728.7	3.5															
		4 4 4	8			**3.5' to 5.5':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay.	67	2 SS						3	SP	
726.7	5.5															
		1 2 3	5			**5.5' to 7':** LEAN CLAY WITH SAND (CL), brown, medium stiff.	100	3 SS						25 12	CL SP	Qp = 0.75 tsf
725.2	7.0					**7' to 10':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace clay.										
		2 2 3	5				100	4 SS						29	SP	
722.2 ▼	10.0															
						10' to 12.5': SILTY SAND (SM), fine to medium; brown.										
719.7	12.5															
		20 21 20	41			**12.5' to 20':** LIMESTONE, highly weathered, and broken with clay, gray brown	100	5 SS						3		
						Practical sampler refusal @ about 20 feet.										
712.2	20.0						28	6 SS						5		

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 33 — LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 5 — DISTURBED: 5 — UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Rob Hunt	13. TOTAL NUMBER CORE BOXES: N/A
	14. ELEVATION GROUND WATER:
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: --- — BEARING:	15. DATE BORING — STARTED: 3/30/10 — COMPLETED: 3/30/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING: 738.8
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 19.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
736.3	2.5	4 6 7	13			**0' to 2.5':** POORLY GRADED SAND, **(Fill)**, fine to medium; dark brown, trace clay, gravel and cinders.	67	1 SS						11		
733.8	5.0	3 2 3	5			**2.5' to 5':** LEAN CLAY, **(Fill)**, dark brown, trace sand, brick and cinders.	67	2 SS						16		
		3 3 3	6			**5' to 14':** SANDY LEAN CLAY, **(Till)**, gray, stiff to very stiff, trace gravel.	78	3 SS						16	CL	Qp = 2.0 tsf
		3 4 5	9				78	4 SS						15	CL	Qp = 2.5 tsf
724.8	14.0					**14' to 19':** LIMESTONE, highly weathered, and broken with clay, brown	6	5 SS						17		
719.8	19.0					Practical sampler refusal @ about 19 feet.										

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids Flood Damage Reduction Project Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 34 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / Eric Harris	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. DEPTH GROUND WATER 15. DATE BORING: STARTED 4/6/10 / COMPLETED 4/6/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	0.5					**0' to 0.5':** 6" Concrete.										
		2 3 2	5			**0.5' to 29':** POORLY GRADED SAND (SP), fine to coarse; brown, very loose to medium dense, trace clay.	67	1 SS						4	SP	
		2 1 2	3				89	2 SS						6	SP	
		2 3 2	5				56	3 SS	0	94	5			13	SP	
		3 2 3	5				72	4 SS						13	SP	
		3 3 2	5				89	5 SS						11	SP	
		4 6 8	14				67	6 SS						6	SP	
		3 3 3	6				89	7 SS						9	SP	
	29.0															
	30.5	1 5 5	10			**29' to 30.5':** WELL GRADED SAND (SW), fine to coarse; brown, medium dense, trace clay and gravel.	89	8 SS						21	SW	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 35 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 8 / DISTURBED: 8 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Gary Everman	13. TOTAL NUMBER CORE BOXES: N/A
	14. ELEVATION GROUND WATER
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	15. DATE BORING: STARTED 3/18/10 / COMPLETED 3/18/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 725.8
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 30.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		1 2 1	3			**0' to 3.5':** LEAN CLAY WITH SAND, **(Fill)**, dark brown, sand layers, trace cinders and organics.	100	1 SS						18		
722.3	3.5	2 2 2	4			**3.5' to 7.5':** SILTY SAND (SM), fine to medium; dark brown, loose, trace organics.	100	2 SS						22	SM	
718.3	7.5	3 3 4	7			**7.5' to 20':** WELL GRADED SAND (SW), fine to coarse; brown, loose to dense, trace clay and gravel.	100	3 SS						18 13	SM	
		3 3 4	7				100	4 SS						12	SW	
		4 6 6	12				100	5 SS						14	SW	
705.8	20.0	6 26 23	49				89	6 SS						12 8	SW	
704.8	21.0					**20' to 21':** WELL GRADED SAND GRAVELLY (SW), fine to coarse; brown, dense, trace clay.										
		25 8 29	37			**21' to 30.5':** LIMESTONE, highly weathered, and broken with clay and clay seams, brown.	67	7 SS						10		
695.3	30.5	7 9 8	17				94	8 SS						18		

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5, 30.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 36 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 7 / DISTURBED: 7 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Gary Everman	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 706.5 3/18/10
	15. DATE BORING: STARTED 3/18/10 / COMPLETED 3/18/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 719.5
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 24.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		3 2 2	4			**0' to 6.5':** LEAN CLAY WITH SAND, **(Fill)**, dark brown, trace gravel, cinders and brick.	56	1 SS						17		
		2 2 2	4				100	2 SS						15 14		
713.0	6.5															
		2 3 3	6			**6.5' to 16.5':** WELL GRADED SAND (SW), fine to coarse; brown, loose, trace clay and gravel.	100	3 SS						6	SW	
		3 4 3	7				89	4 SS	1	96	3			11	SW	
		2 3 3	6				78	5 SS						19	SW	
703.0	16.5															
		18 26 12	38			**16.5' to 24.5':** LIMESTONE, highly weathered, and broken with clay, brown gray	67	6 SS						9		
						Practical sampler refusal @ about 24.5 feet.										
695.0	24.5						50	7 SS						23		

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

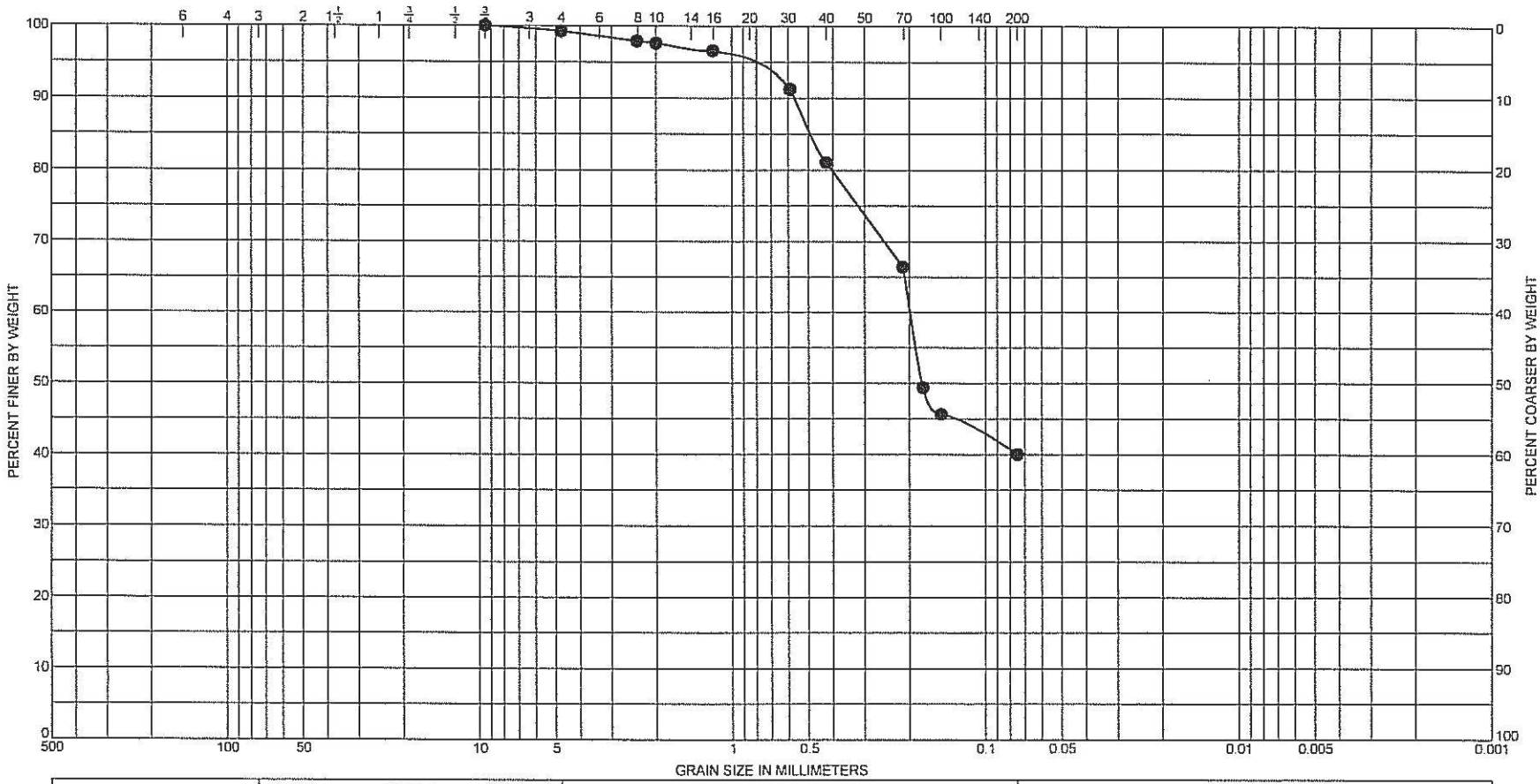
1. PROJECT: Cedar Rapids, Flood Damage Reduction Project, Cedar Rapids, Iowa	9. COORDINATE SYSTEM / HORIZONTAL / VERTICAL
	10. SIZE AND TYPE OF BIT
2. HOLE NUMBER: 37 / LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME - 55
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 5 / DISTURBED: 5 / UNDISTURBED: 0
4. NAME OF DRILLER(S): David Dyer / Mark Dutra	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED / DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 706.2 3/19/10
	15. DATE BORING: STARTED 3/19/10 / COMPLETED 3/19/10
6. THICKNESS OF OVERBURDEN	16. ELEVATION TOP OF BORING: 719.2
7. DEPTH DRILLED INTO ROCK	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 15.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		4 7 8	15			**0' to 3.5':** CLAYEY SAND, **(Fill)**, fine to medium; dark brown, trace cinders and brick.	100	1 SS						17		
715.7	3.5	2 3 2	5			**3.5' to 5.5':** LEAN CLAY (CL), brown, trace sand.	100	2 SS						21	CL	Qp = 1.0 tsf
713.7	5.5	2 15 13	28			**5.5' to 6.5':** CLAYEY SAND (SC), fine to medium; brown, medium dense.	100	3 SS						19 7	SC	
		8 19 30	49			**6.5' to 15':** LIMESTONE, highly weathered, and broken with clay and sand, brown gray to gray.	100	4 SS						26		
704.2	15.0						28	5 SS						14		

0.0 2.5 5.0 7.5 10.0 12.5 15.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137FDR.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/21/10

APPENDIX G-A



Boring No.	Depth	Classification	Nat w %	LL	PL	PI
● B-11	4.0 to 5.5	Clayey Sand, trace gravel, fine to coarse	9.6			

GRADATION CURVES

Project: Cedar Rapids Flood Damage Reduction Project

Cedar Rapids, Iowa

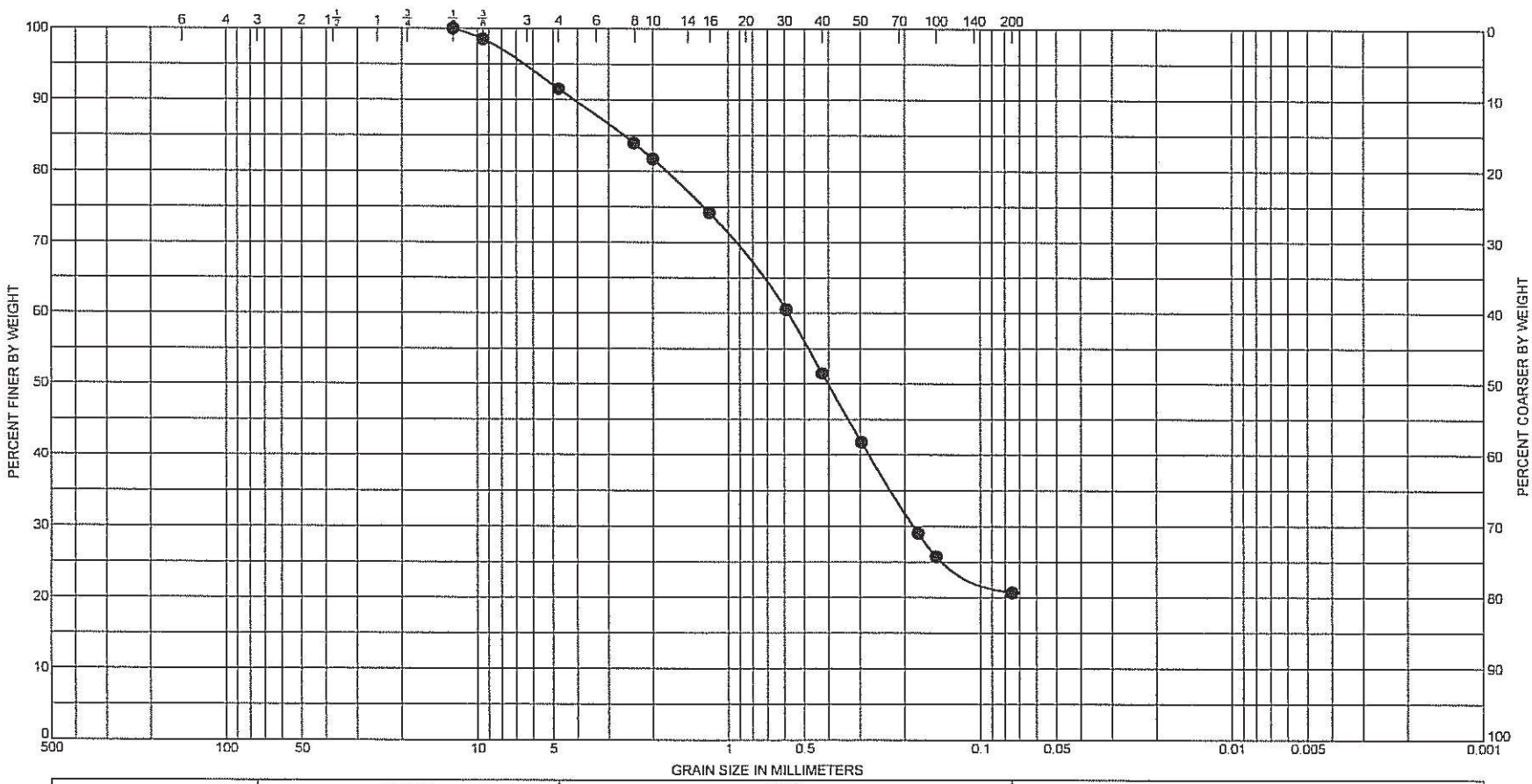
Area:

Project No.: 06095137

Date: 4/21/10

ENG FORM 24 FEB 2009 2087-MVR

APPENDIX G-A



Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-12	718.3 / 6.5 to 8.0	Clayey Sand, trace gravel, fine to coarse	7.6			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

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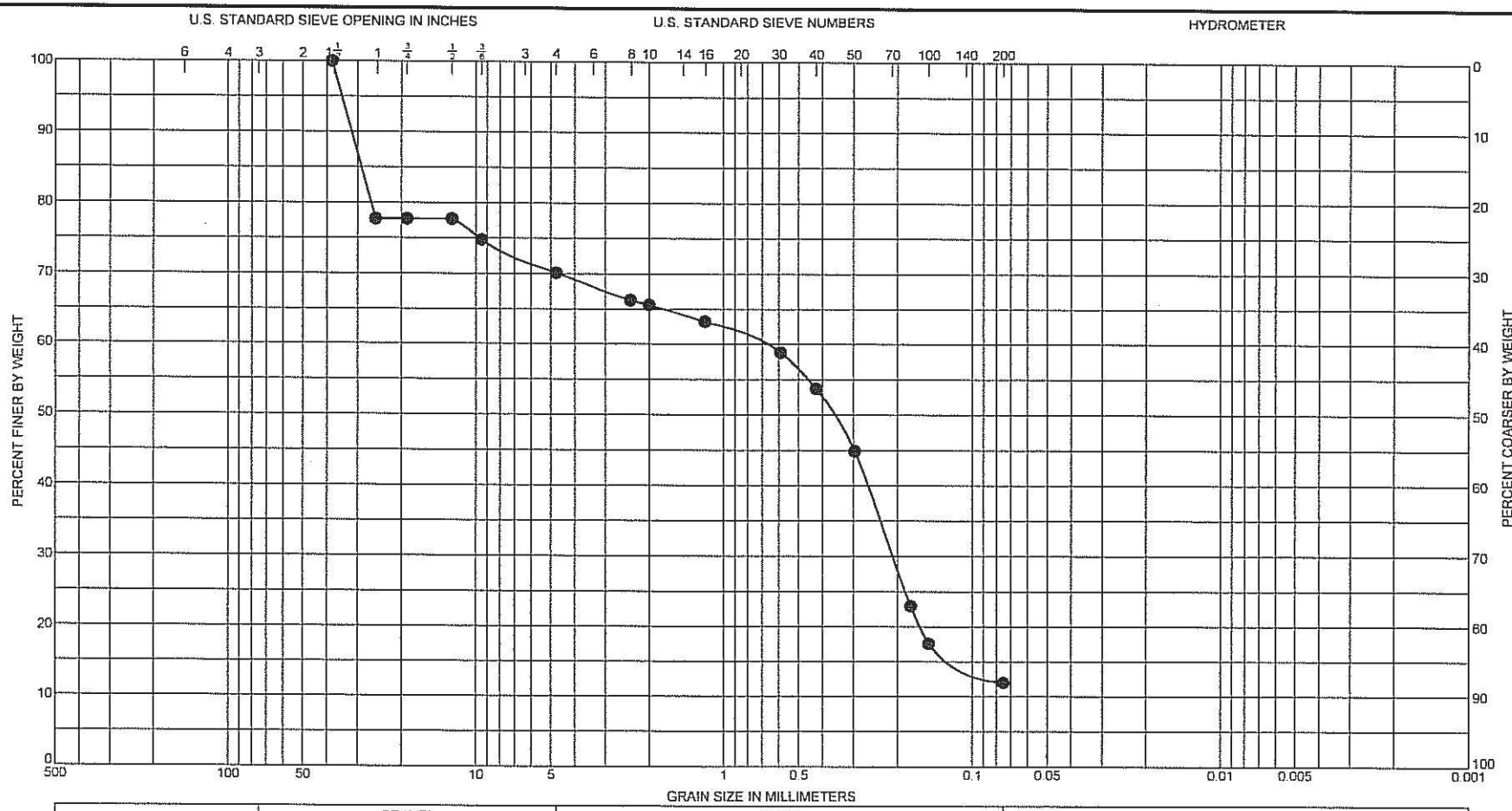
APPENDIX G-A



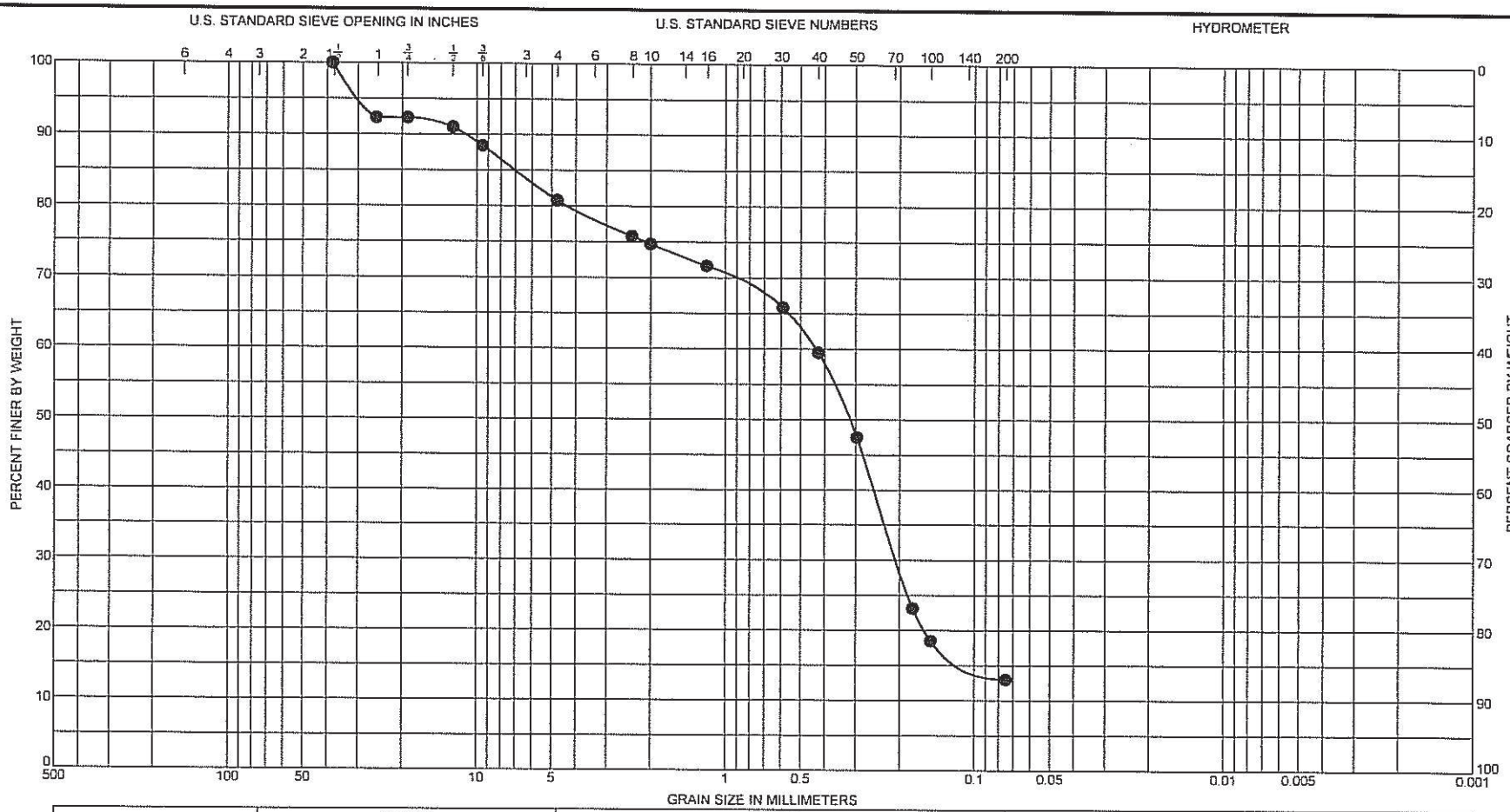
Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-15	16.9 / 9.0 to 10.5	Gravelly Clayey Sand, fine to coarse	10.1			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

ENG FORM 24 FEB 2009 2087-MVR

APPENDIX G-A



Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-18	721.5 / 1.5 to 3.0	Clayey Sand with Gravel, fine to coarse	6.8			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

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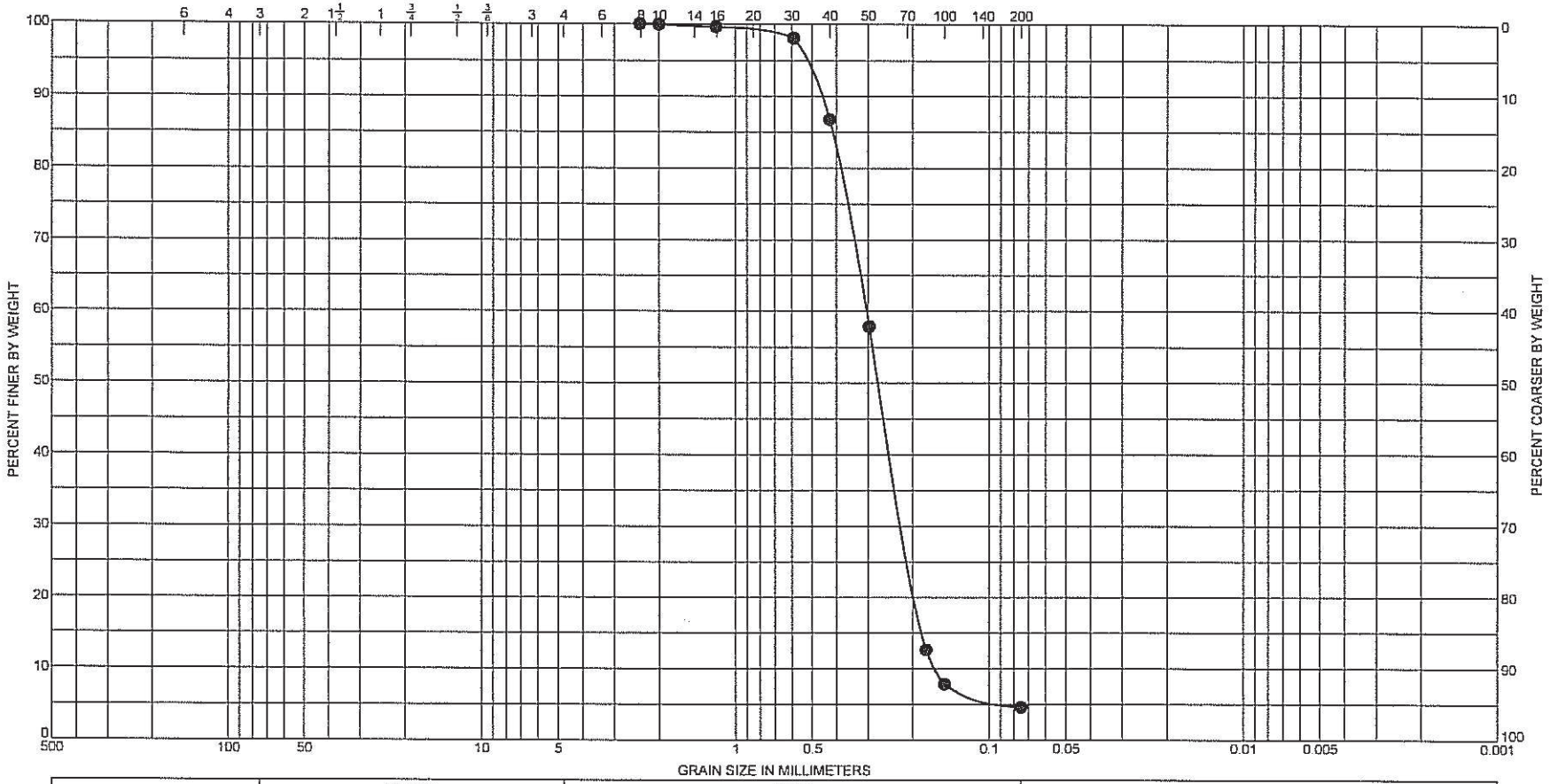
APPENDIX G-A



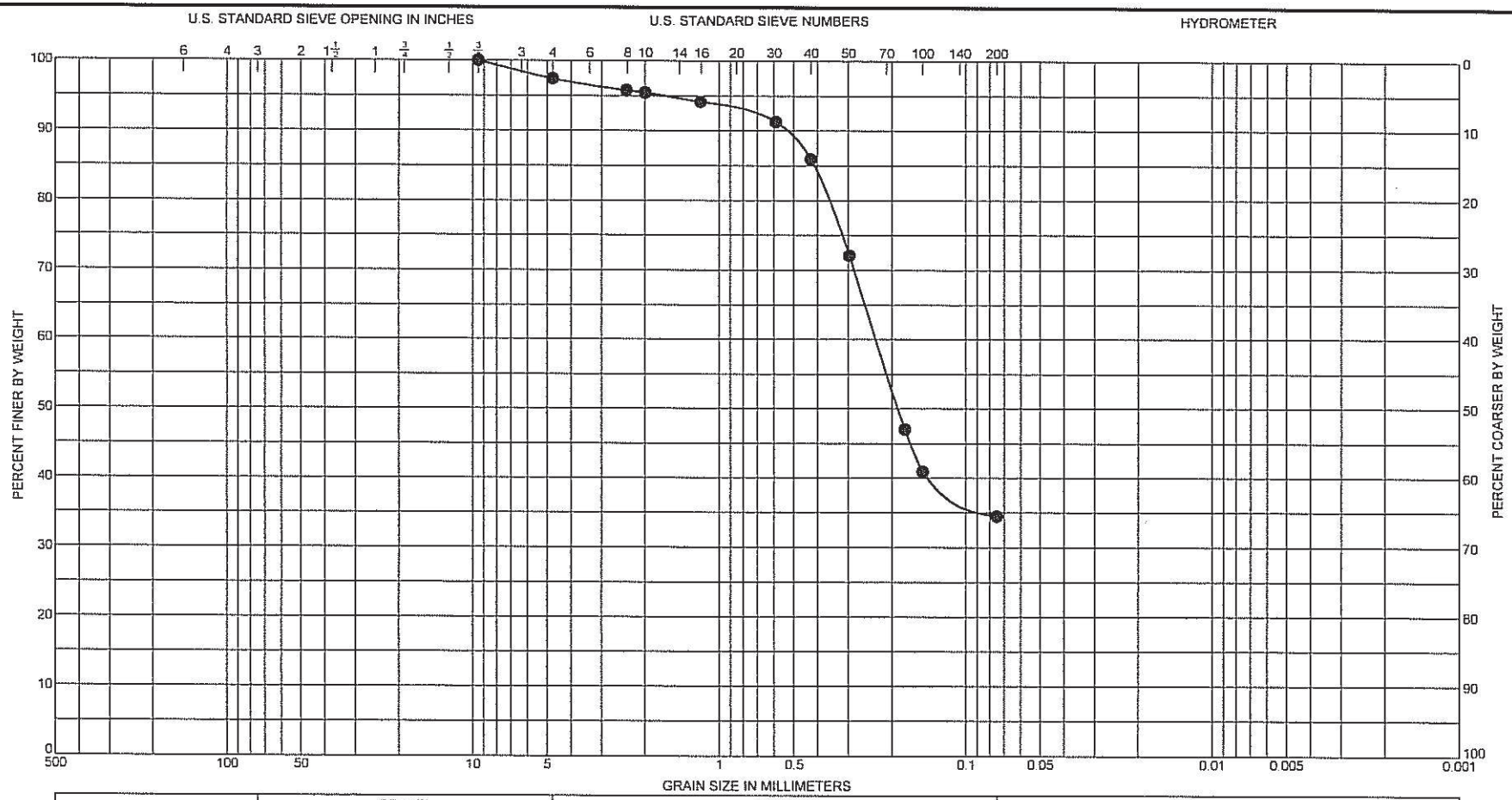
Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-19	720.1 / 1.5 to 3.0	Sand, trace Clay, fine to medium	10.1			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

ENG FORM 24 FEB 2009 2087-MVR

APPENDIX G-A

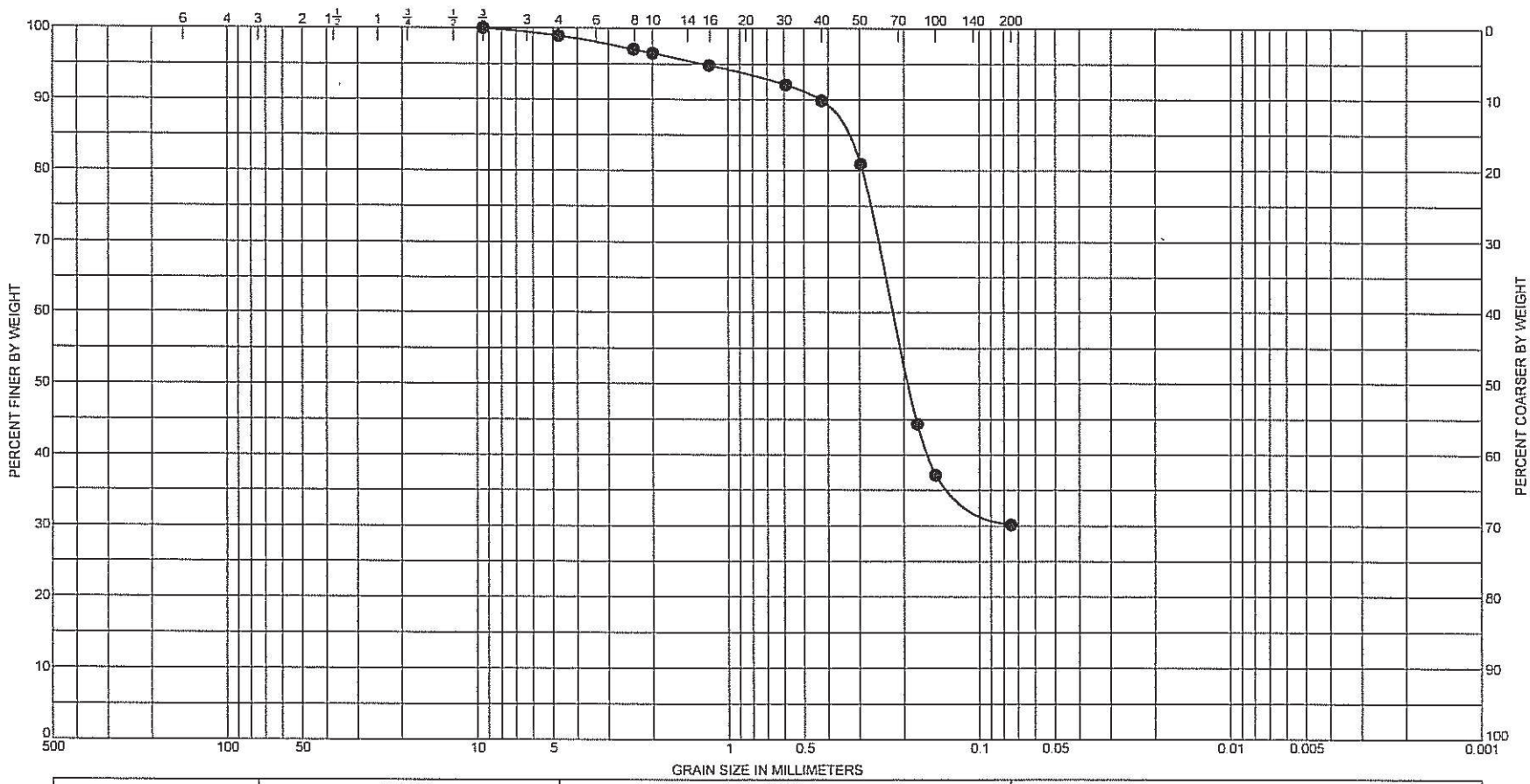


Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-22	716.4 / 5.5 to 7.0	Clayey Sand, trace Gravel, fine to coarse	18.7			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

ENG FORM 24 FEB 2009 2087-MVR

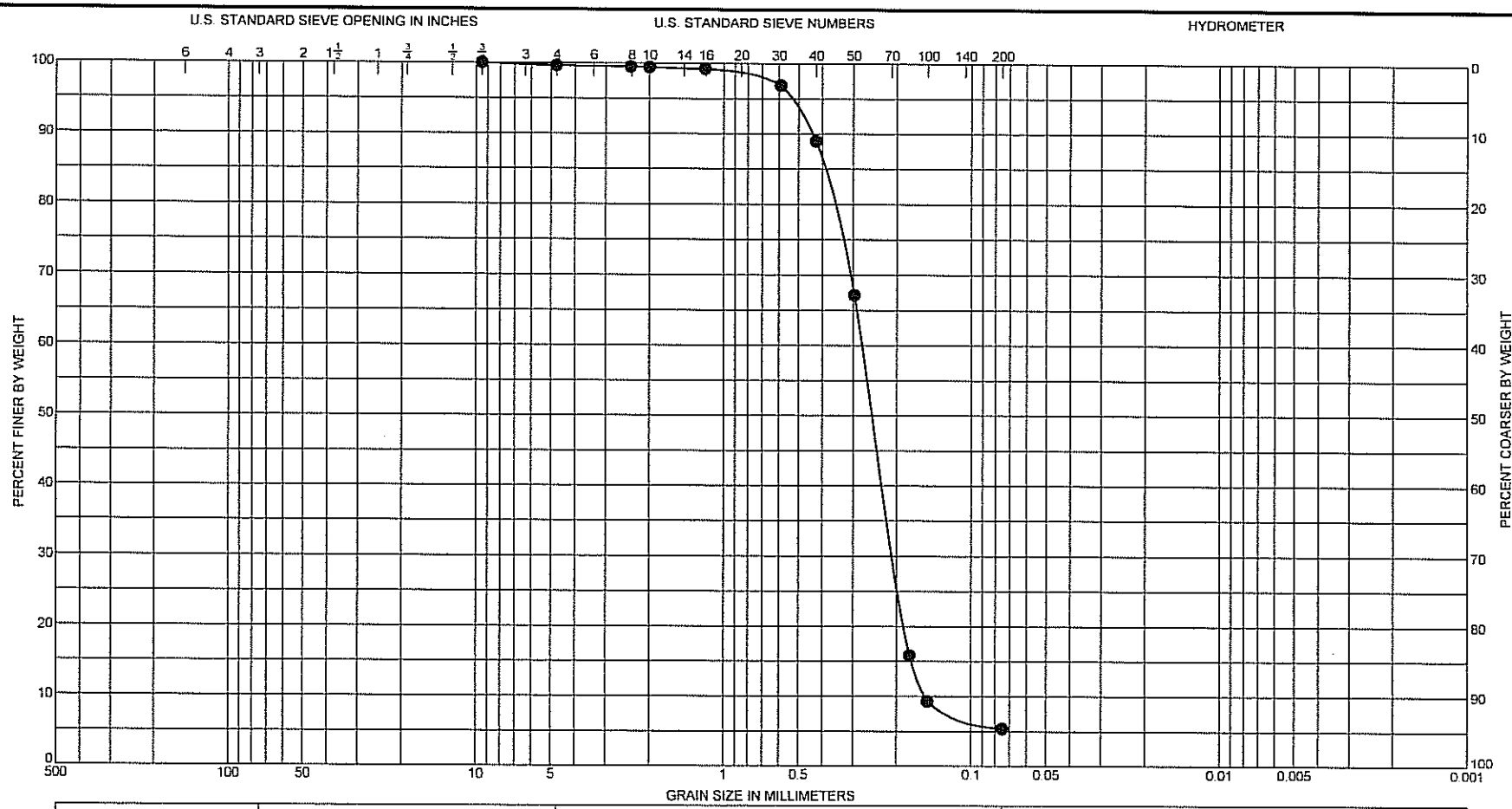


Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-24	710.5 / 8.5 to 10.0	Clayey Sand, trace Gravel, fine to coarse	16.1			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

ENG FORM 24 FEB 2009 2087-MVR



Boring No.	Depth	Classification	Nat w %	LL	PL	PI
● B-34	6.5 to 8.0	Sand, trace Clay and Gravel, fine to coarse	12.6			

GRADATION CURVES

Project: Cedar Rapids Flood Damage Reduction Project

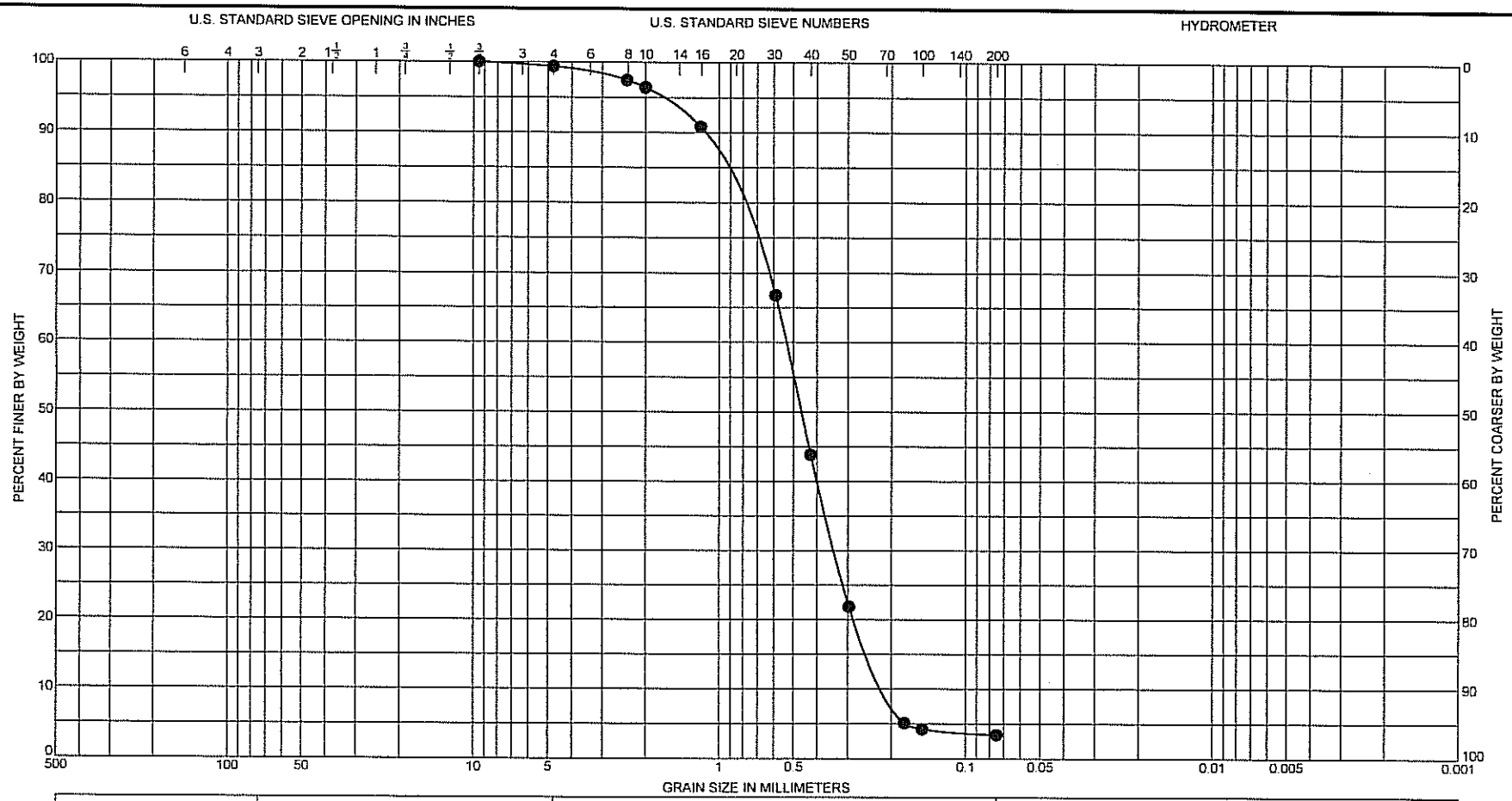
Cedar Rapids, Iowa

Area

Project No. 06095137

Date 4/21/10

ENG FORM 24 FEB 2009 **2087-MVR**



Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● B-36	710.5 / 9.0 to 10.5	Sand, trace Clay and Gravel, fine to coarse	11.1			

GRADATION CURVES

Project: Cedar Rapids Flood Damage Reduction Project

Cedar Rapids, Iowa

Area:

Project No.: 06095137

Date: 4/21/10

Terracon Borrow Pit Soil Borings

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 1A; LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6; DISTURBED: 6; UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / David Dyer	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. DEPTH GROUND WATER:
	15. DATE BORING: STARTED: 2/4/10; COMPLETED: 2/4/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING:
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 20.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_1	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	2.5	2 3 3	6			**0' to 2.5':** LEAN CLAY (CL), **(Topsoil)**, dark brown, medium stiff, trace sand and organics.	67	1 SS						25	CL/OL	Qp = 1.5 tsf
	4.5	2 4 4	8			**2.5' to 4.5':** LEAN TO FAT CLAY (CL/CH), gray brown, stiff, trace sand.	56	2 SS						23	CL/CH	
		3 4 4	8			**4.5' to 17':** POORLY GRADED SAND (SP-SM), fine to medium; brown, loose to medium dense, with silt, trace gravel.	83	3 SS						17	SP-SM	
		3 4 4	8				100	4 SS						19	SP-SM	
		3 6 6	12				100	5 SS						18	SP-SM	
	17.0															
	20.0	2 2 2	4			**17' to 20':** SANDY LEAN CLAY (CL), (Till), gray, medium stiff, trace gravel.	83	6 SS						23	CL	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/19/10

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER: 2A	LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
3. DRILLING AGENCY: Terracon Consultants, Inc.		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / David Dyer		13. TOTAL NUMBER CORE BOXES: N/A	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. DEPTH GROUND WATER	
		15. DATE BORING	STARTED: 2/4/10 / COMPLETED: 2/4/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	REC #	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	2.0	4 4 4	8			**0' to 2':** LEAN CLAY (CL), **(Topsoil)**, dark brown and brown, stiff, trace sand and organics.										
						2' to 20': SANDY LEAN CLAY (CL), **(Till)**, brown, medium stiff to very stiff, trace gravel with sand seams and layers.	72	1 SS						20	CL	
		3 3 2	5				100	2 SS						17	CL	Qp = 0.75 tsf
							100	3 ST						15	CL	Qp = 1.5 tsf Qu = 1.3 tsf
							88	4 ST						14	CL	DD = 117 pcf Qu = 1.92 tsf
		5 7 8	15				100	5 SS						14	CL	Qp = 2.75 tsf
	20.0	5 5 7	12				100	6 SS						16	CL	Qp = 2.25 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/19/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT	Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa	9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER	3A	11. MANUFACTURER'S DESIGNATION OF DRILL	CME-850
3. DRILLING AGENCY	Terracon Consultants, Inc.	12. TOTAL SAMPLES / DISTURBED / UNDISTURBED	6 / 6 / 0
4. NAME OF DRILLER(S)	Scott Zeien / David Dyer	13. TOTAL NUMBER CORE BOXES	N/A
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. DEPTH GROUND WATER	
		15. DATE BORING	STARTED 2/4/10; COMPLETED 2/4/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	20.0	18. INSPECTOR SIGNATURE AND ORGANIZATION	-

ELEV	DEPTH	Blows/0.5 ft	N_1	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	1.5					**0' to 1.5':** LEAN CLAY (CL), **(Topsoil)**, dark brown, medium stiff, trace sand and organics.										
	3.0	2 3 3	6			**1.5' to 3':** FAT CLAY (CH), brown, stiff, trace sand.	89	1 SS				51	30	31	CH	Qp = 1.5 tsf
		2 3 3	6			**3' to 20':** SANDY LEAN CLAY (CL), **(Till)**, brown, soft to very stiff, trace gravel with sand layers.	89	2 SS				30	17	22	CL	Qp = < 0.25 tsf
		2 2 2	4				100	3 SS						19	CL	
		3 3 4	7				100	4 SS						16	CL	Qp = 1.5 tsf
		4 4 6	10				100	5 SS						15	CL	Qp = 2.0 tsf
	20.0	6 6 9	15				100	6 SS						16	CL	Qp = 2.25 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 4A; LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6; DISTURBED: 6; UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / David Dyer	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. DEPTH GROUND WATER:
	15. DATE BORING: STARTED: 2/4/10; COMPLETED: 2/4/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING:
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 20.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_1	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	1.5					**0' to 1.5':** LEAN CLAY (CL), **(Topsoil)**, dark brown, trace sand and organics.										
		2 2 2	4			**1.5' to 5.5':** LEAN CLAY (CL), brown and gray, medium stiff, with sand.	83	1 SS						16	CL	Qp = 1.25 tsf
		2 2 2	4				83	2 SS						22	CL	
	5.5															
	6.5					**5.5' to 6.5':** CLAYEY SAND (SC), brown, trace gravel.	92	3 ST						21	SC	Qp = 0.75 tsf DD = 105.1 pcf Qu = 0.31 tsf
	8.0					**6.5' to 8':** SANDY LEAN CLAY (CL), brown gray.								22	CL	
		2 2 1	3			**8' to 12':** CLAYEY SAND (SC), brown, loose to very loose, trace gravel.	100	4 SS						18	SC	
	12.0															
		4 10 12	22			**12' to 19':** SANDY LEAN CLAY (CL), (Till), brown and gray, very stiff, trace gravel with sand layers.	100	5 SS						15	CL	Qp = 3.25 tsf
	19.0															
	20.0	6 13 17	30			**19' to 20':** SANDY LEAN CLAY (CL), (Till), gray, hard, trace gravel.	100	6 SS						13	CL	Qp = 4.5+ tsf

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa

2. HOLE NUMBER: 5A

LOCATION COORDINATES

3. DRILLING AGENCY: Terracon Consultants, Inc.

4. NAME OF DRILLER(S): Scott Zeien / David Dyer

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN

7. DEPTH DRILLED INTO ROCK

8. TOTAL DEPTH OF BORING: 20.0

9. COORDINATE SYSTEM; HORIZONTAL; VERTICAL

10. SIZE AND TYPE OF BIT

11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850

12. TOTAL SAMPLES: 6; DISTURBED: 6; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: N/A

14. DEPTH GROUND WATER

15. DATE BORING: STARTED 2/4/10; COMPLETED 2/4/10

16. ELEVATION TOP OF BORING

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_i	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		2 2 3	5			**0' to 4.5':** FAT CLAY (CH), **(Topsoil)**, dark brown, medium stiff, trace sand and organics.	78	1 SS						28	CH	
	4.5	2 2 2	4				100	2 SS						28	CH	
						4.5' to 7': SANDY LEAN CLAY (CL), **(Till)**, brown gray, medium stiff, trace gravel with sand layers.	83	3 ST						20	CL	Qp = 0.5 tsf DD = 107.1 pcf Qu = 0.62 tsf
	7.0					**7' to 18':** SANDY LEAN CLAY (CL), **(Till)**, gray brown, stiff, trace gravel with sand seams and layers.	46	4 ST						16	CL	Qp = 1.5 tsf DD = 114.8 pcf Qu = 1.52 tsf
		4 5 6	11				100	5 SS						15	CL	Qp = 2.0 tsf
	18.0															
	20.0	7 7 22	29			**18' to 20':** SANDY LEAN CLAY (CL), **(Till)**, gray, very stiff, trace gravel.	89	6 SS						13	CL	Qp = 2.25 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
2. HOLE NUMBER: 6A	LOCATION COORDINATES	10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY: Terracon Consultants, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
4. NAME OF DRILLER(S): Scott Zeien / David Dyer		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	13. TOTAL NUMBER CORE BOXES: N/A	
6. THICKNESS OF OVERBURDEN		14. DEPTH GROUND WATER	
7. DEPTH DRILLED INTO ROCK		15. DATE BORING: STARTED 2/4/10 / COMPLETED 2/4/10	
8. TOTAL DEPTH OF BORING: 20.0		16. ELEVATION TOP OF BORING	
		17. TOTAL CORE RECOVERY FOR BORING: N/A	
		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	2.0					**0' to 2':** LEAN CLAY (CL), **(Topsoil)**, dark brown and brown, medium stiff, trace sand and organics.										
		2 2 2	4			**2' to 12':** POORLY GRADED SAND (SP), fine to medium; brown, loose, trace silt and clay.	78	1 SS						12	CL	
		3 2 4	6				89	2 SS						11	SP	
		3 3 3	6				72	3 SS						13	SP	
		3 3 5	8				83	4 SS						17	SP	
	12.0					**12' to 20':** SILTY SAND (SM), fine to medium; brown, loose.										
		3 3 5	8				100	5 SS						20	SM	
	20.0	3 4 4	8				100	6 SS						19	SM	

0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5, 20.0

ACE ENG 1835 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT	Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa
2. HOLE NUMBER	7A
LOCATION COORDINATES	
3. DRILLING AGENCY	Terracon Consultants, Inc.
4. NAME OF DRILLER(S)	Scott Zeien / David Dyer
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	
7. DEPTH DRILLED INTO ROCK	
8. TOTAL DEPTH OF BORING	20.0
9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
10. SIZE AND TYPE OF BIT	
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-850
12. TOTAL SAMPLES	6
DISTURBED	6
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	N/A
14. DEPTH GROUND WATER	
15. DATE BORING STARTED	2/4/10
COMPLETED	2/4/10
16. ELEVATION TOP OF BORING	
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. INSPECTOR SIGNATURE AND ORGANIZATION	-

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	REC %	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	1.5					**0' to 1.5':** LEAN CLAY (CL), **(Topsoil)**, dark brown, trace sand and organics.										
		2 3 2	5			**1.5' to 8':** SANDY LEAN CLAY (CL), **(Till)**, gray brown, medium stiff, trace gravel with sand seams.	89	1 SS				31	17	18	CL	Qp = 0.5 tsf
		2 2 3	5				100	2 SS						19	CL	Qp = 0.75 tsf
	8.0						54	3 ST						19	CL	Qp = 0.5 tsf DD = 104.5 pcf Qu = 0.40 tsf
						8' to 17': SANDY LEAN CLAY (CL), **(Till)**, brown gray, very stiff, trace gravel with sand seams.	75	4 ST						14	CL	DD = 118.1 pcf Qu = 2.19 tsf
		4 5 6	11				100	5 SS						14	CL	Qp = 2.25 tsf
	17.0															
		5 5 7	12			**17' to 20':** SANDY LEAN CLAY (CL), **(Till)**, gray and brown, very stiff, trace gravel.	100	6 SS						15	CL	Qp = 2.5 tsf
	20.0															

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DD NOT USE.GDT 4/19/10

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER: 8A	LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
3. DRILLING AGENCY: Terracon Consultants, Inc.		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / David Dyer		13. TOTAL NUMBER CORE BOXES: N/A	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. DEPTH GROUND WATER	
		15. DATE BORING	STARTED: 2/4/10 / COMPLETED: 2/4/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft.	N_I	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
		2 2 3	5			**0' to 3.5':** FAT CLAY (CH), **(Topsoil)**, dark brown, medium stiff, trace sand and organics.	50	1 SS						27	CH	
	3.5	2 2 2	4			**3.5' to 20':** SANDY LEAN CLAY (CL), **(Till)**, brown, medium stiff to very stiff, trace gravel with sand seams.	83	2 SS						23	CL	Qp = 0.25 tsf
							63	3 ST						17	CL	DD = 111.8 pcf Qu = 0.64 tsf
							42	4 ST						16	CL	DD = 115.1 pcf Qu = 1.91 tsf
		4 5 8	13				89	5 SS						15	CL	Qp = 3.5 tsf
	20.0	4 8 10	18				100	6 SS						14	CL	Qp = 3.5 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER: 9A	LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
3. DRILLING AGENCY: Terracon Consultants, Inc.		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / David Dyer		13. TOTAL NUMBER CORE BOXES: N/A	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. DEPTH GROUND WATER	
		15. DATE BORING	STARTED: 2/4/10 / COMPLETED: 2/4/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_1	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	2.0	3 4 4	8			**0' to 2':** LEAN CLAY, **(Topsoil)**, dark brown, medium stiff, trace sand and organics.										
	3.5					**2' to 3.5':** FAT CLAY, brown, stiff, trace sand.	56	1 SS				56	31	28	CH	Qp = 2.0 tsf
		2 3 3	6			**3.5' to 13':** SANDY LEAN CLAY, (Till), gray brown, stiff, trace gravel and sand seams and layers.	83	2 SS				34	19	17	CL	Qp = 2.0 tsf
		3 4 4	8				89	3 SS						16	CL	
		3 3 4	7				100	4 SS						15	CL	Qp = 1.5 tsf
	13.0															
		3 5 8	13			**13' to 20':** SANDY LEAN CLAY, (Till), brown, hard, trace gravel.	89	5 SS						13	CL	Qp = 4.5+ tsf
	20.0	3 7 10	17				100	6 SS						14	CL	Qp = 4.5+ tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
2. HOLE NUMBER: 10A	LOCATION COORDINATES	10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY: Terracon Consultants, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
4. NAME OF DRILLER(S): Scott Zeien / David Dyer		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	13. TOTAL NUMBER CORE BOXES: N/A	
		14. DEPTH GROUND WATER	
		15. DATE BORING: STARTED 2/4/10	COMPLETED 2/4/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
						0' to 3': LEAN CLAY (CL), **(Topsoil)**, dark brown, medium stiff, trace sand and organics.	67	1 SS						31	CL	Qp = 1.75 tsf
	3.0	3 4 4	8			**3' to 6':** LEAN TO FAT CLAY (CL/CH), brown, stiff, trace sand.	67	2 SS						30	CL/CH	
	6.0	2 3 3	6			**6' to 8':** SANDY LEAN CLAY (CL), **(Till)**, brown gray, medium stiff to stiff, trace gravel with sand layers.	50	3 ST						18	CL	Qp= 0.75 tsf DD = 101.5 pcf Qu = 0.62 tsf
	8.0					**8' to 15.5':** SANDY LEAN CLAY (CL), **(Till)**, gray brown, stiff to very stiff, trace gravel.	50	4 ST						15	CL	DD = 116.4 pcf Qu = 1.52 tsf
	15.5	3 6 6	12				83	5 SS						14	CL	Qp = 2.75 tsf
						15.5' to 20': SANDY LEAN CLAY (CL), **(Till)**, gray, very stiff, trace gravel.										
	20.0	4 6 8	14				94	6 SS						12	CL	Qp = 3.5 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
2. HOLE NUMBER: 11A	LOCATION COORDINATES	10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY: Terracon Consultants, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
4. NAME OF DRILLER(S): Scott Zeien / David Dyer		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	13. TOTAL NUMBER CORE BOXES: N/A	
		14. DEPTH GROUND WATER	
		15. DATE BORING	STARTED: 2/4/10 / COMPLETED: 2/4/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_i	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	1.5					**0' to 1.5':** FAT CLAY (CH), **(Topsoil)**, dark brown and brown, medium stiff, trace sand and organics.										
	3.0	3 3 4	7			**1.5' to 3':** FAT CLAY (CH), brown, stiff, trace sand.	56	1 SS						31	CH	Qp = 1.75 tsf
		2 2 3	5			**3' to 8':** SANDY LEAN CLAY (CL), **(Till)**, gray brown, medium stiff, trace gravel with sand seams and layers.	67	2 SS						20	CL	
	8.0						58	3 ST						20	CL	DD = 105.6 pcf Qu = 0.5 tsf
						8' to 20': SANDY LEAN CLAY (CL), **(Till)**, brown gray, stiff to very stiff, trace gravel.	58	4 ST						15	CL	DD = 116.6 pcf Qu = 1.99 tsf
		4 5 7	12				89	5 SS						15	CL	Qp = 2.5 tsf
	20.0	6 7 7	14				100	6 SS						15	CL	Qp = 2.25 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
2. HOLE NUMBER: 12A	LOCATION COORDINATES	10. SIZE AND TYPE OF BIT	
3. DRILLING AGENCY: Terracon Consultants, Inc.		11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
4. NAME OF DRILLER(S): Scott Zeien / Shane Neuhaus		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	13. TOTAL NUMBER CORE BOXES: N/A	
		14. DEPTH GROUND WATER	
		15. DATE BORING: STARTED 2/5/10	COMPLETED 2/5/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	1.5					**0' to 1.5':** FAT CLAY (CH), **(Topsoil)**, dark brown, trace sand and organics.										
	3.0	2 3 3	6			**1.5' to 3':** FAT CLAY (CH), gray brown, medium stiff, trace sand.	56	1 SS						33	CH	Qp = 1.0 tsf
		2 3 3	6			**3' to 20':** SANDY LEAN CLAY (CL), **(Till)**, gray brown, stiff, trace gravel with sand seams.	50	2 SS						22	CL	
		2 2 2	4				67	3 SS						22	CL	
		3 3 4	7				56	4 SS						16	CL	Qp = 2.0 tsf
		3 4 5	9				67	5 SS						16	CL	
	20.0	6 7 9	16				67	6 SS						15	CL	Qp = 2.0 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY 27-DO NOT USE GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa

2. HOLE NUMBER: 13A

LOCATION COORDINATES

3. DRILLING AGENCY: Terracon Consultants, Inc.

4. NAME OF DRILLER(S): Scott Zeien / Shane Neuhaus

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN

7. DEPTH DRILLED INTO ROCK

8. TOTAL DEPTH OF BORING: 20.0

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT

11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850

12. TOTAL SAMPLES: 6; DISTURBED: 6; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: N/A

14. DEPTH GROUND WATER

15. DATE BORING: STARTED 2/5/10; COMPLETED 2/5/10

16. ELEVATION TOP OF BORING

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
						0' to 2.5': FAT CLAY (CH), **(Topsoil)**, dark gray, medium stiff, trace sand and organics.										
	2.5	3 3 3	6				56	1 SS						26	CH	
						2.5' to 5': LEAN TO FAT CLAY (CL/CH), gray, medium stiff, trace sand.										
	5.0	2 2 3	5				33	2 SS						29	CL/CH	Qp = 0.75 tsf
						5' to 12.5': SILTY SAND (SM), fine to medium; brown, loose, trace clay.										
		2 2 2	4				33	3 SS						17	SM	
		1 2 3	5				39	4 SS						17	SM	
	12.5															
						12.5' to 20': SANDY LEAN CLAY (CL), **(Till)**, gray, stiff to very stiff, trace gravel.										
		2 3 4	7				44	5 SS						16	CL	Qp = 1.25 tsf
		5 6 6	12				39	6 SS						15	CL	Qp = 2.75 tsf
	20.0															

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
2. HOLE NUMBER: 14A; LOCATION COORDINATES:	10. SIZE AND TYPE OF BIT:
3. DRILLING AGENCY: Terracon Consultants, Inc.	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
4. NAME OF DRILLER(S): Scott Zeien / Shane Neuhaus	12. TOTAL SAMPLES: 6; DISTURBED: 6; UNDISTURBED: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	13. TOTAL NUMBER CORE BOXES: N/A
	14. DEPTH GROUND WATER:
	15. DATE BORING: STARTED: 2/6/10; COMPLETED: 2/6/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING:
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 20.0	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	2.0	2 3 4	7			**0' to 2':** FAT CLAY (CH), **(Topsoil)**, dark brown, medium stiff, trace sand and organics.										
						2' to 5': FAT CLAY (CH), gray and brown, stiff, mottled, trace sand.	33	1 SS						30	CH	
	5.0	2 2 3	5				50	2 SS						29	CH	Qp = 1.25 tsf
						5' to 13': SANDY LEAN CLAY (CL), **(Till)**, brown, soft to stiff, trace gravel with sand seams.	78	3 SS						19	CL	Qp = < 0.25 tsf
		1 1 2	3				58	4 ST						17	CL	DD = 114.0 pcf Qu = 1.25 tsf
	13.0															
						13' to 20': SANDY LEAN CLAY (CL), **(Till)**, gray, very stiff, trace gravel.	67	5 ST						14	CL	DD = 118.7 pcf Qu = 3.45 tsf
	20.0	8 11 12	23				61	6 SS						11	CL	Qp = 2.75 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION		INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT	Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa	9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER	15A	11. MANUFACTURER'S DESIGNATION OF DRILL	CME-850
LOCATION COORDINATES		12. TOTAL SAMPLES	6 (DISTURBED 6 / UNDISTURBED 0)
3. DRILLING AGENCY	Terracon Consultants, Inc.	13. TOTAL NUMBER CORE BOXES	N/A
4. NAME OF DRILLER(S)	Scott Zeien / Shane Neuhaus	14. DEPTH GROUND WATER	
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	15. DATE BORING	STARTED 2/5/10; COMPLETED 2/5/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	20.0	18. INSPECTOR SIGNATURE AND ORGANIZATION	-

ELEV	DEPTH	Blows/0.5 ft	N_I	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
						0' to 2.5': FAT CLAY (CH), **(Topsoil)**, brown, medium stiff, trace sand and organics.										
	2.5	2 3 3	6				56	1 SS						27	CH	
	3.5					**2.5' to 3.5':** LEAN TO FAT CLAY (CL/CH), gray brown, medium stiff, trace sand.										
		2 3 3	6			**3.5' to 7.5':** SANDY LEAN CLAY (CL), **(Till)**, brown, medium stiff, trace gravel with sand layers.	0	2 SS						19	CL	
	7.5						54	3 ST						20	CL	DD = 105.8 pcf Qu = 0.62 tsf
						7.5' to 13': SANDY LEAN CLAY (CL), **(Till)**, brown gray, very stiff, trace gravel.	58	4 ST						13	CL	DD = 110.9 pcf Qu = 1.83 tsf
	13.0															
		3 6 8	14			**13' to 20':** SANDY LEAN CLAY (CL), **(Till)**, gray, very stiff, trace gravel with sand layers.	94	5 SS						14	CL	Qp = 2.75 tsf
	20.0	5 8 10	18				100	6 SS						13	CL	Qp = 3.5 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY 27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	
2. HOLE NUMBER: 16A	LOCATION COORDINATES	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850	
3. DRILLING AGENCY: Terracon Consultants, Inc.		12. TOTAL SAMPLES: 6	DISTURBED: 6 / UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / Shane Neuhaus		13. TOTAL NUMBER CORE BOXES: N/A	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. DEPTH GROUND WATER	
		15. DATE BORING: STARTED 2/5/10	COMPLETED 2/5/10
6. THICKNESS OF OVERBURDEN		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 20.0		18. INSPECTOR SIGNATURE AND ORGANIZATION: -	

ELEV	DEPTH	Blows/0.5 ft	N_1	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
	1.5					**0' to 1.5':** LEAN CLAY (CL), **(Topsoil)**, dark brown, trace sand and organics.										
	2.5	2 3 3	6			**1.5' to 2.5':** LEAN TO FAT CLAY (CL/CH), brown, medium stiff, trace sand.	61	1 SS				42	25	21	CL	
		2 3 3	6			**2.5' to 20':** SANDY LEAN CLAY (CL), (Till), brown, medium stiff to stiff, trace gravel with sand layers.	72	2 SS				37	22	19	CL	Gravel = 1 Sand = 37 Fines = 62
							54	3 ST						18	CL	DD = 107.0 pcf Qu = 0.69 tsf
							92	4 ST						16	CL	Qp = 0.5 tsf DD = 109.8 pcf Qu = 0.96 tsf
		4 5 6	11				67	5 SS						15	CL	
	20.0	6 7 8	15				61	6 SS						15	CL	Qp = 1.25 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009_MAY_27-DO NOT USE.GDT 4/19/10

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: Levee Borrow Investigation Around Cedar Rapids Airport Cedar Rapids, Iowa	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:
	10. SIZE AND TYPE OF BIT:
2. HOLE NUMBER: 17A; LOCATION COORDINATES:	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
3. DRILLING AGENCY: Terracon Consultants, Inc.	12. TOTAL SAMPLES: 6; DISTURBED: 6; UNDISTURBED: 0
4. NAME OF DRILLER(S): Scott Zeien / Shane Neuhaus	13. TOTAL NUMBER CORE BOXES: N/A
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. DEPTH GROUND WATER:
	15. DATE BORING: STARTED: 2/5/10; COMPLETED: 2/5/10
6. THICKNESS OF OVERBURDEN:	16. ELEVATION TOP OF BORING:
7. DEPTH DRILLED INTO ROCK:	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 20.5	18. INSPECTOR SIGNATURE AND ORGANIZATION: -

ELEV	DEPTH	Blows/0.5 ft	N_i	N_{60}	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No. & Type	Laboratory: Gravel	Sand	Fines	LL	PI	MC	USCS Class	REMARKS
						0' to 2': LEAN CLAY (CL), gray and brown, medium stiff, mottled, trace sand.										
	2.0	2														
	3.0	3	6			**2' to 3':** LEAN TO FAT CLAY (CL/CH), gray brown, stiff, trace sand.	50	1 SS						30	CL	Qp = 1.25 tsf
		3				**3' to 20.5':** SANDY LEAN CLAY (CL), (Till), brown, soft to very stiff, trace gravel with sand seams and layers.	50	2 SS						18	CL	Qp = 0.25 tsf
		3	6				67	3 ST						15	CL	DD = 117.6 pcf Qu = 1.32 tsf
							42	4 ST						15	CL	DD = 113.8 pcf Qu = 1.25 tsf
							38	5 ST						15	CL	DD = 118.0 pcf Qu = 2.06 tsf
	20.5						71	6 ST						17	CL	DD = 117.4 pcf Qu = 2.62 tsf

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

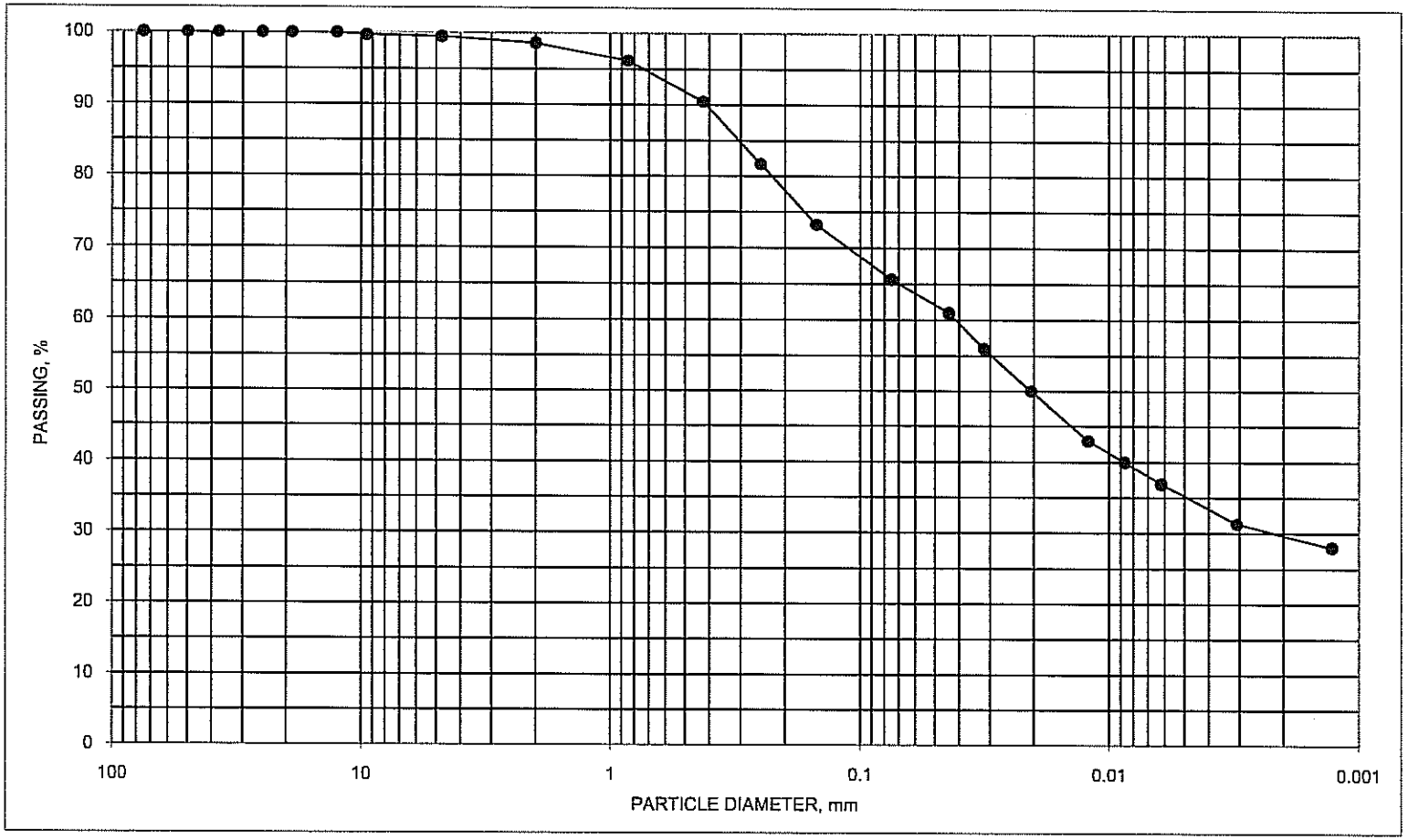
ACE ENG 1836 (DRILLING LOG) - MVR 06095137.GPJ CEB ACE MVD WITH RAPID CPT 2009 MAY 27-DO NOT USE GDT 4/19/10

APPENDIX G-A

SIEVE SIZE	DIAMETER, mm	PASS, %
3"	75.0	100
2"	50.0	100
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	99
#10	2.00	99
#20	0.850	96
#40	0.425	90
#60	0.250	82
#100	0.150	73
#200	0.075	65.6
	0.0440	61.0
	0.0317	56.0
	0.0205	50.0
	0.0121	43.0
	0.0087	40.0
	0.0062	37.0
	0.0031	31.3
	0.0013	28.0

D60	0.0413
D30	0.0022

SPECIFIC GRAVITY 2.70 ASSUMED



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL	PL	PI
B-3	Bulk	0 TO 5	SANDY LEAN CLAY (CL), trace gravel, brown	D422	xxxx	36	16	20

PROJECT: Levee Borrow Investigation LOCATION: Cedar Rapids, Iowa JOB NO. 06095137 DATE 2/10/2010

NOTES:

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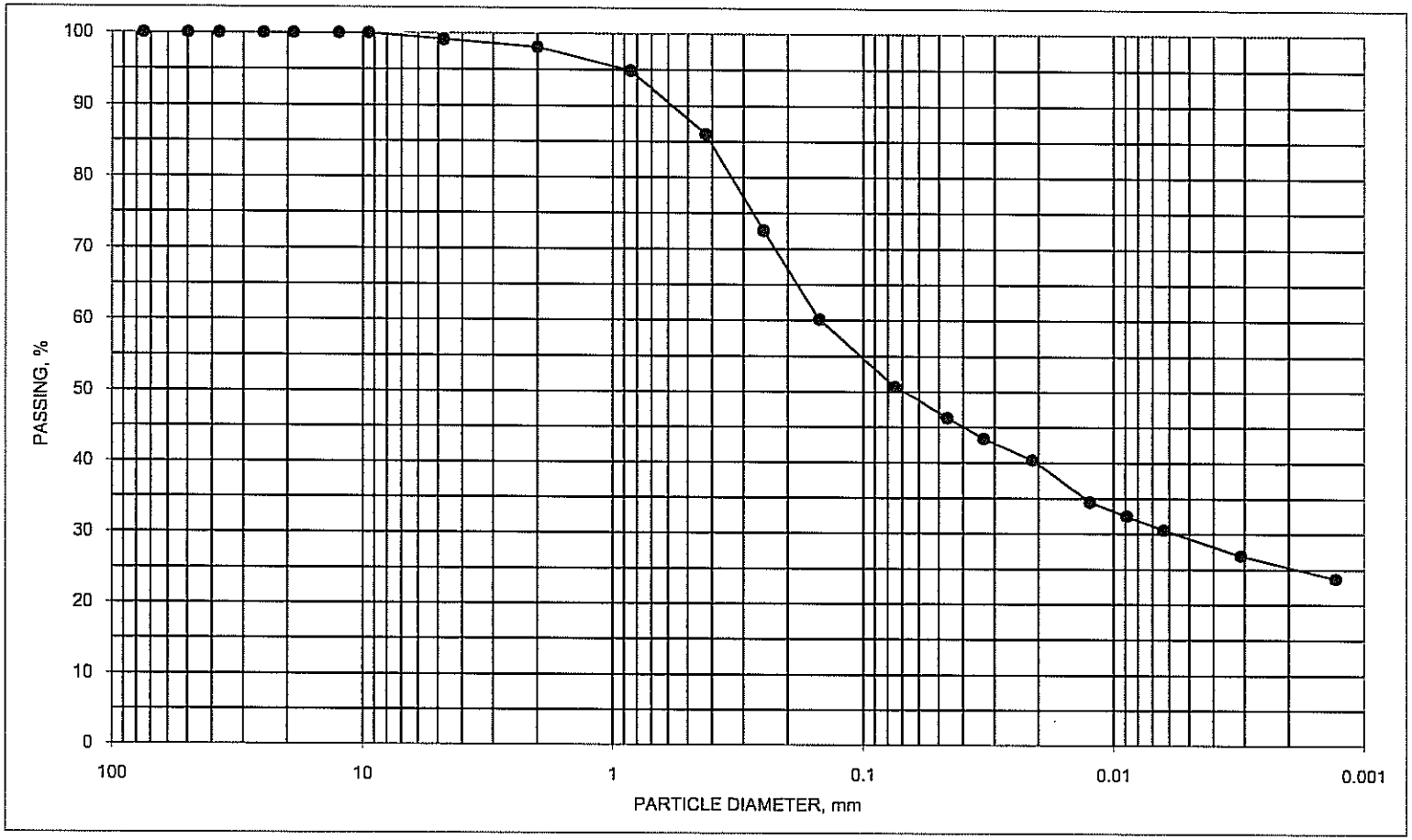
Terracon

APPENDIX G-A

SIEVE SIZE	DIAMETER, mm	PASS, %
3"	75.0	100
2"	50.0	100
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	99
#10	2.00	98
#20	0.850	95
#40	0.425	86
#60	0.250	73
#100	0.150	60
#200	0.075	50.7
	0.0464	46.3
	0.0332	43.4
	0.0212	40.4
	0.0125	34.5
	0.0089	32.5
	0.0063	30.5
	0.0031	26.9
	0.0013	23.7

D60	0.1481
D30	0.0057

SPECIFIC GRAVITY 2.70 ASSUMED



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL	PL	PI
B-7	Bulk	0 TO 5	SANDY LEAN CLAY (CL), trace gravel, brown	D422	xxxx	33	14	19

PROJECT: Levee Borrow Investigation LOCATION: Cedar Rapids, Iowa JOB NO. 06095137 DATE 2/10/2010

NOTES:

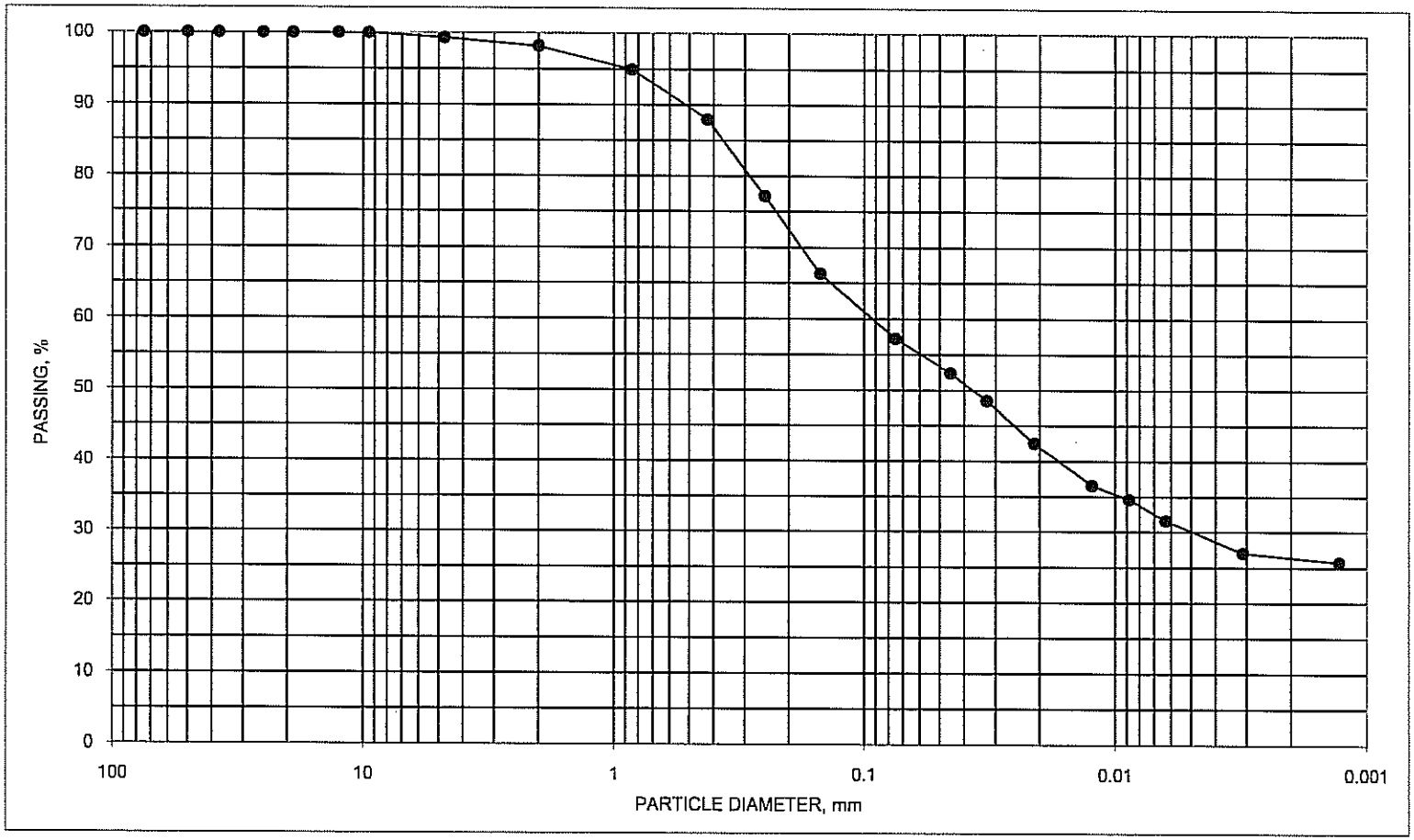
N:\Projects\2009\06095137\eng\[hydro B7.Bulk.xlsm]DATA

Terracon

APPENDIX G-A

SIEVE SIZE	DIAMETER, mm	PASS, %
3"	75.0	100
2"	50.0	100
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	99
#10	2.00	98
#20	0.850	95
#40	0.425	88
#60	0.250	77
#100	0.150	66
#200	0.075	57.2
	0.0454	52.4
	0.0326	48.5
	0.0210	42.5
	0.0124	36.6
	0.0088	34.6
	0.0063	31.6
	0.0031	27.0
	0.0013	25.8
	D60	0.0927
	D30	0.0049

SPECIFIC GRAVITY 2.70 ASSUMED



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL	PL	PI
B-9	Bulk	0 TO 5	SANDY LEAN CLAY (CL), trace gravel, brown	D422	xxxx	34	14	20

PROJECT: Levee Borrow Investigation LOCATION: Cedar Rapids, Iowa JOB NO. 06095137 DATE 2/10/2010

NOTES:

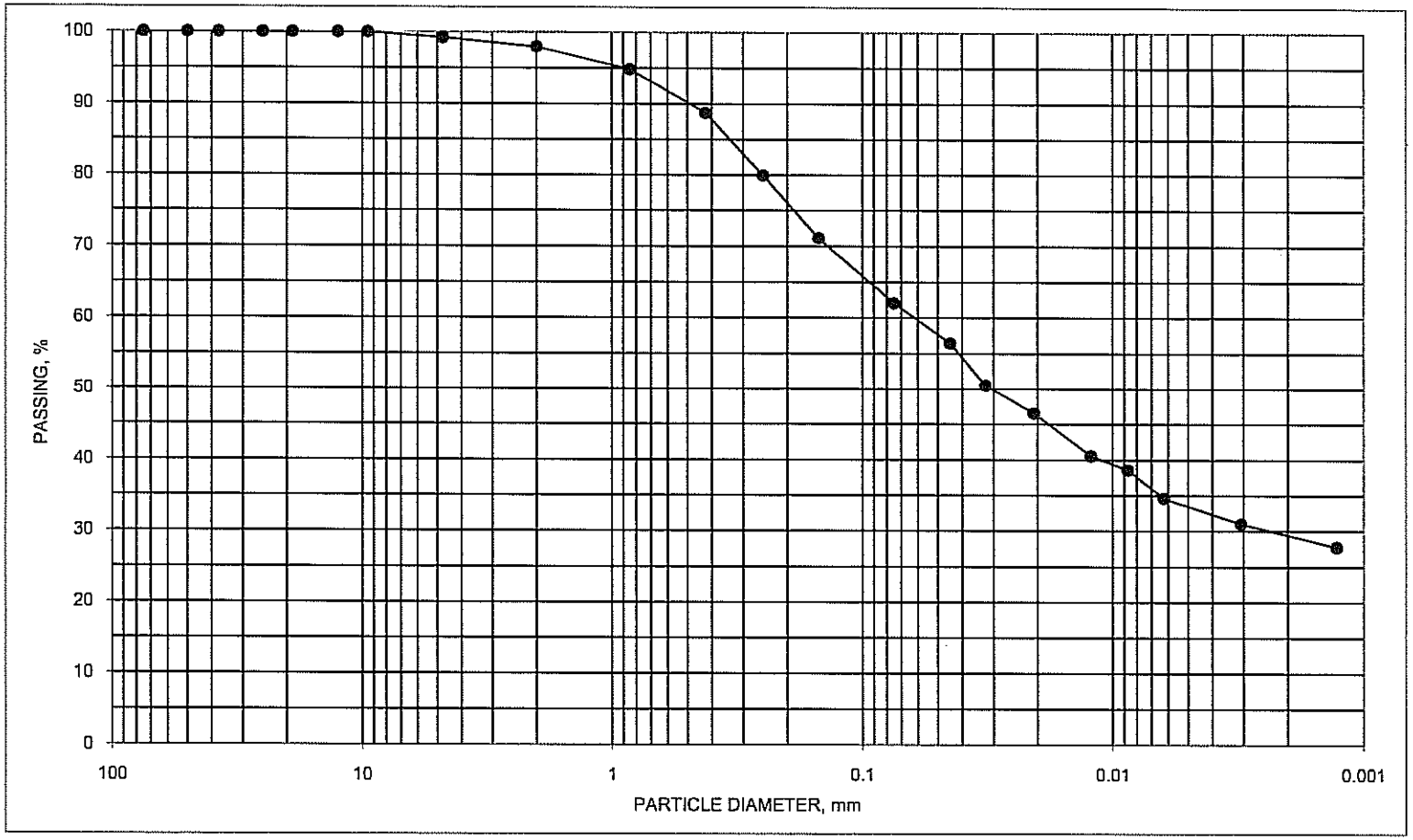
N:\Projects\2009\06095137\eng\[hydro B7.Bulk.xlsm]DATA

Terracon

APPENDIX G-A

SIEVE SIZE	DIAMETER, mm	PASS, %
3"	75.0	100
2"	50.0	100
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	99
#10	2.00	98
#20	0.850	95
#40	0.425	89
#60	0.250	80
#100	0.150	71
#200	0.075	62.1
	0.0447	56.5
	0.0323	50.5
	0.0207	46.5
	0.0122	40.6
	0.0087	38.6
	0.0062	34.6
	0.0031	31.0
	0.0013	27.8
	D60	0.0619
	D30	0.0023

SPECIFIC GRAVITY 2.70 ASSUMED



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL	PL	PI
B-16	2	3.5 TO 5	SANDY LEAN CLAY (CL), trace gravel, brown	D422	xxxx	37	15	22

PROJECT: Levee Borrow Investigation LOCATION: Cedar Rapids, Iowa JOB NO. 06095137 DATE 2/10/2010

NOTES:

N:\Projects\2009\06095137\eng\[hydro B16.S2.xlsm]DATA

Terracon

Subsurface Parameters & Reference Data

Corrected N-Value

Stanley Consultants INC.

Project No. 22263 Page No. 1 of 2

Subject CEDAR RAPIDS
CORRECTED N-VALUES COMP.

Computed by NKV Date 5-5-10

Checked by JRJ Date 5-5-10

Approved by _____ Date _____

Sheet No. _____ of _____

CORRECTED N-VALUES IN FILLS & SANDS

* A UNIT WEIGHT OF $\gamma = 120$ pcf WILL BE USED FOR A CALCULATIONS.

$$N' = C_N \cdot N$$

N = CORRECTED RESISTANCE

C_N = CORRECTION FACTOR = $\sqrt{1/\sigma'(tsf)}$

FILLS

N	depth	water ht.	σ'(tsf)	N'	Boring No.
4	3'	-	0.18	9	B11
21	8'	-	0.48	30	B11
12	8'	-	0.48	17	B12
5	10.5'	-	0.63	6	B12
14	8'	-	0.48	20	B13
4	15'	-	0.9	4	B13
6	5.5'	-	0.33	10	B15
4	15.5'	-	0.93	4	B15
17	3'	-	0.18	40	B16
3	10.5'	-	0.63	4	B16
14	3'	-	0.18	33	B17
5	6.5'	-	0.39	8	B17
5	5.5'	-	0.33	9	B18
9	10.5'	-	0.63	11	B19
4	5'	-	0.3	7	B21
2	20'	-	0.91	2	B24
4	4'	-	0.24	8	B8-06085076
9	2'	-	0.12	3	B1-06085088
1	12'	7'	0.50	1	B1-06085088
5	2'	-	0.12	14	B2-06085086
1	7'	2'	0.36	2	B2-06085086
2	10'	4'	0.48	3	B22-06085065
22	4'	-	0.24	45	B25-06085065
2	4'	-	0.24	4	BH-1 06075097

Stanley Consultants INC.

Project No. 22263 Page No. 2 of 2

Subject CEDAR RAPIDS
CORRECTED N-VALUES COMP.

Computed by NKV Date 5-5-10

Checked by JKS Date 5-5-10

Approved by _____ Date _____

Sheet No. _____ of _____

SANDS

N	depth	water ht.	σ' (tsf)	N'	Boring No.
35	15'	0.5'	0.98	37	B11
6	25'	6'	1.31	5	B13
4	20'	6'	1.01	4	B17
29	25'	11'	1.16	27	B17
9	17'	–	1.02	9	B18
18	25'	7.5'	1.27	16	B18
10	35'	17.5'	1.55	8	B18
9	10'	–	0.6	12	B19
8	15'	–	0.9	8	B19
7	15'	1.5'	0.85	8	B20
27	25'	11'	1.16	25	B21
7	25'	11'	1.16	6	B22
17	30'	16'	1.30	15	B23
41	25'	20'	0.88	44	B1-06085088
22	20'	15'	0.73	26	B2-06085088
9	25'	21'	0.84	10	B22-06085065
35	9'	–	2.1	24	B25-06085065
4	19'	–	1.14	4	B25-06085065
8	4'	4'	0.12	24	B6-06915072
23	14'	–	0.84	25	B4-06915067
6	9'	–	0.54	8	B1-06075119
9	29'	6'	1.55	7	B1-06075119
11	39'	30'	1.40	9	BH-106075097
37	59'	50'	1.98	26	BH-106075097
11	25'	2'	1.44	9	B5-06915078
~~85~~	~~39'~~	~~16'~~	1.84	63	B5-06915078

OBSTRUCTION (ANOMALY?)

Typical Shear Strength & Unit Weight Data

TABLE 3-1 REFERENCED FOR TYPICAL UNIT WEIGHTS AND FRICTION ANGLES OF GRANULAR MAT.

Table 3-1
Granular Soil Properties (after Teng 1962)

Compactness	Relative Density (%)	SPT N (blows per ft)	Angle of Internal Friction (deg)	Unit Weight	
				Moist (pcf)	Submerged (pcf)
Very Loose	0-15	0-4	<28	<100	<60
Loose	16-35	5-10	28-30	95-125	55-65
Medium	36-65	11-30	31-36	110-130	60-70
Dense	66-85	31-50	37-41	110-140	65-85
Very Dense	86-100	>51	>41	>130	>75

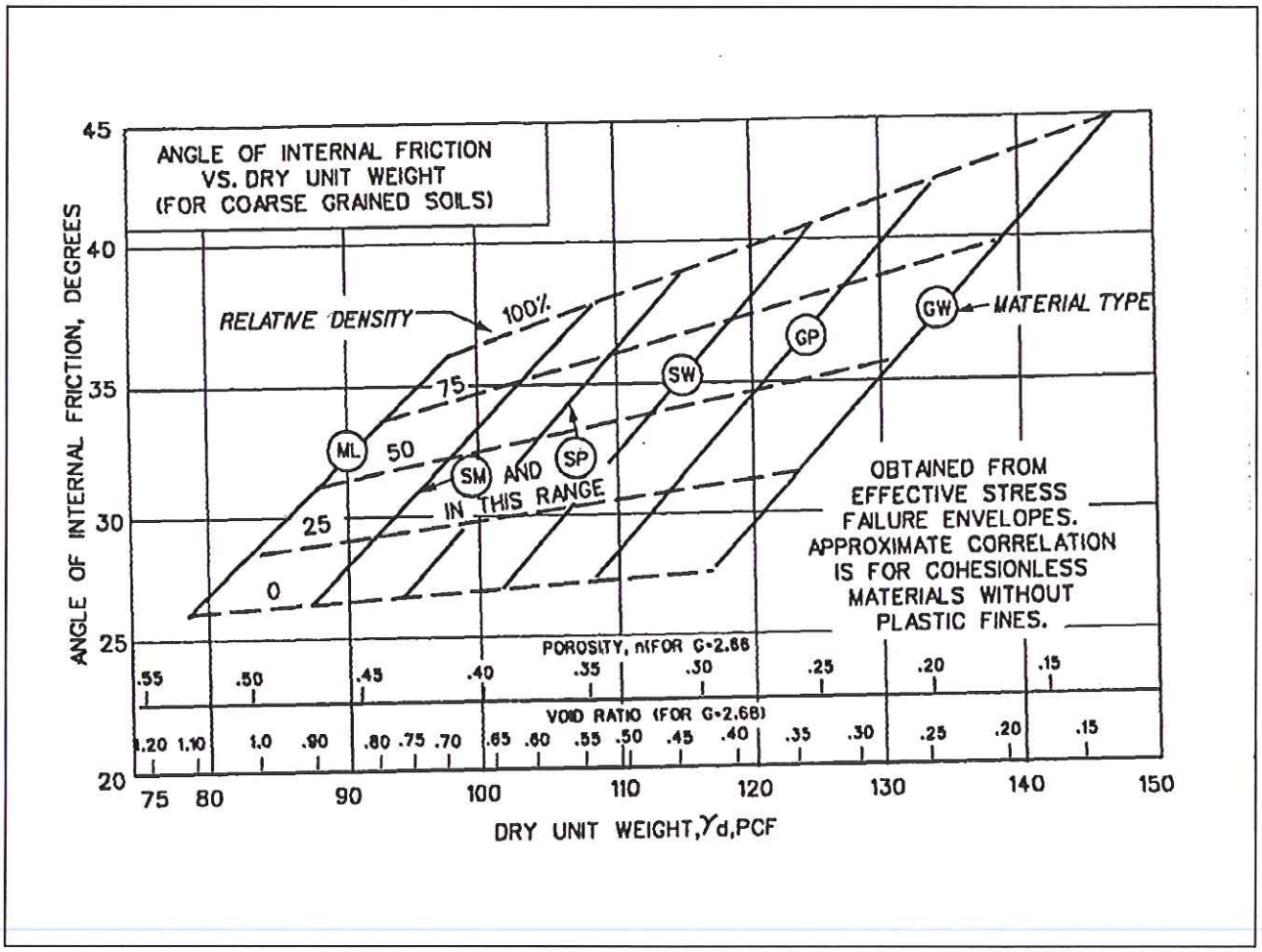


Figure 3-1. Cohesionless Soil Properties (after U.S. Department of the Navy 1971)

Table 3-2
Ratio of ϕ/δ (After Allen, Duncan, and Snaclo 1988)

Soil Type	Steel	Wood	Concrete
Sand	$\delta/\phi = 0.54$	$\delta/\phi = 0.76$	$\delta/\phi = 0.76$
Silt & Clay	$\delta/\phi = 0.54$	$\delta/\phi = 0.55$	$\delta/\phi = 0.50$

Table 3-3
Values of δ for Various Interfaces
(after U.S. Department of the Navy 1982)

Soil Type	δ (deg)
(a) Steel sheet piles	
Clean gravel, gravel sand mixtures, well-graded rockfill with spalls	22
Clean sand, silty sand-gravel mixture, single-size hard rockfill	17
Silty sand, gravel or sand mixed with silt or clay	14
Fine sandy silt, nonplastic silt	11
(b) Concrete sheet piles	
Clean gravel, gravel sand mixtures, well-graded rockfill with spalls	22-26
Clean sand, silty sand-gravel mixture, single-size hard rockfill	17-22
Silty sand, gravel or sand mixed with silt or clay	17
Fine sandy silt, nonplastic silt	14

Table 3-4
Correlation of Undrained Shear Strength of Clay (q_u=2c)

Consistency	q_u (psf)	SPT (blows/ft)	Saturated Unit Weight (psf)
Very Soft	0-500	0-2	<100-110
Soft	500-1,000	3-4	100-120
Medium	1,000-2,000	5-8	110-125
Stiff	2,000-4,000	9-16	115-130
Very Stiff	4,000-8,000	16-32	120-140
Hard	>8,000	>32	>130

(5) Since an undrained condition may be expected to occur under "fast" loading in the field, it represents a "short-term" condition; in time, drainage will occur, and the drained strength will govern (the "long-term" condition). To model these conditions in the laboratory, three types of tests are generally used; unconsolidated undrained (Q or UU), consolidated undrained (R or CU), and consolidated drained (S or CD). Undrained shear strength in the laboratory is determined from either Q or R tests and drained shear strength is established from S tests or from consolidated undrained tests with pore pressure measurements ($\bar{R}$).

(6) The undrained shear strength, S_u, of a normally consolidated clay is usually expressed by only a cohesion intercept; and it is labeled c_u to indicate that ϕ was taken as zero. c_u decreases dramatically with water content; therefore, in design it is common to consider the fully saturated condition even if a clay is partly saturated in the field. Typical undrained shear strength values are presented in Table 3-4. S_u increases with depth (or effective stress) and this is commonly expressed with the ratio "S_u/p" (p denotes the effective vertical stress). This ratio correlates roughly with plasticity index and overconsolidation ratio (Figures 3-2, 3-3, respectively). The undrained shear strength of many overconsolidated soils is further complicated due to the presence of fissures; this leads to a lower field strength than tests on small laboratory samples indicate.

(7) The drained shear strength of normally consolidated clays is similar to that of loose sands ($c' = O$), except that ϕ is generally lower. An empirical correlation of the effective angle of internal friction, ϕ', with plasticity index for normally consolidated clays is shown in Figure 3-4. The drained shear strength of over-consolidated clays is similar to that of dense sands (again with lower ϕ'), where there is a peak strength (c' nonzero) and a "residual" shear strength ($c' = O$).

(8) The general approach in solving problems involving clay is that, unless the choice is obvious, both undrained and drained conditions are analyzed separately. The more critical condition governs the design. Total stresses are used in an analysis with undrained shear strength (since pore pressures are "included" in the undrained shear strength) and effective stresses in a drained case; thus such analyses are usually called total and effective stress analyses, respectively.

(9) At low stress levels, such as near the top of a wall, the undrained strength is greater than the drained

TABLE 3-4 REFERENCED FOR TYPICAL UNIT WEIGHTS AND UNDRAINED SHEAR STRENGTHS OF CLAYS

FIGURE 3-4 REFERENCED FOR EMPERICAL CORRELATION BETWEEN FRICTION ANGLE AND PI OF CLAYS.

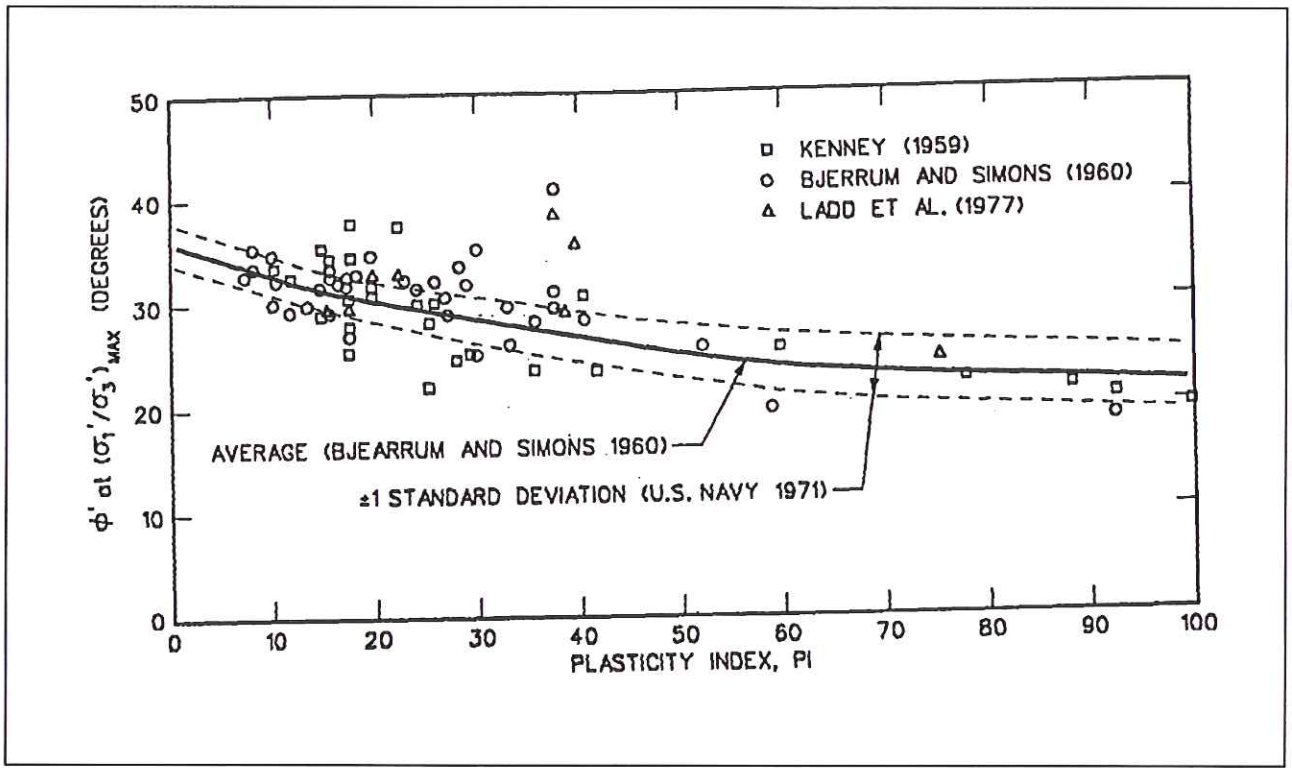


Figure 3-4. Empirical correlation between friction angle and PI from triaxial tests on normally consolidated clays

stress of 1 ton per square foot using an equation of the form:

$$N' = C_N N \qquad (3\text{-}1)$$

where

N' = corrected resistance

C_N = correction factor

N = measured resistance

Table 3-5 and Figure 3-5 summarize the some most commonly proposed values for C_N. Whitman and Liao (1984) developed the following expression for C_N:

$$C_N = \sqrt{\frac{1}{\sigma'_{vo}}} \qquad (3\text{-}2)$$

where effective stress due to overburden, σ'_{vo}, is expressed in tons per square foot. The drained friction angle ϕ' can be estimated from N' using Figure 3-6. The relative density of normally consolidated sands can be estimated from the correlation obtained by Marcuson and Bieganousky (1977):

$$D_r = 11.7 + 0.76[|222(N) + 1600 - 53(p'_{vo}) - 50(C_u)^2|]^{1/2} \qquad (3\text{-}3)$$

where

p'_{vo} = effective overburden pressure in pounds per square inch

C_u = coefficient of uniformity (D_{60}/D_{10})

Correlations have also been proposed between the SPT and the undrained strength of clays (see Table 3-4). However, these are generally unreliable and should be used for very preliminary studies only and for checking the reasonableness of SPT and lab data.

c. Cone penetration test. The CPT (ASTM D 3441-79 (1986a)) is widely used in Europe and is gaining

Seepage Calculation
Hydraulic Conductivity

Stanley Consultants INC.

Project No. 22263 Page No. 1

Subject CALCULATIONS FOR HYDRAULIC CONDUCT. CEDAR RAPIDS, FEASIBILITY STUDY

Computed by NKV Date 5-3-10

Checked by JRS Date 5-3-10

Approved by Date

Sheet No. of

DETERMINE HYDRAULIC CONDUCTIVITY, K FOR SP, SW:

$$k\ (cm/sec) = D_{10}^2$$

D_{10} - EFFECTIVE GRAIN SIZE AT 10% FINER BY WT.

FOR NON-LEVEE FILL: (SC, SW, SP)

USING GRADATION CURVE FOR BORING NO. 15 @ DEPTH 9-10.5,

$D_{10} = 0.075$ mm (#200 SIEVE)

THEREFORE, $k = (0.075\ mm)^2$

$\Rightarrow k = 5.625 \times 10^{-3}$ cm/s OR 1.84×10^{-4} ft/s

FOR SP/SW:

USING GRADATION CURVE FOR BORING NO. 19 @ DEPTH 1.5-3.0,

$D_{10} = 0.2$ mm

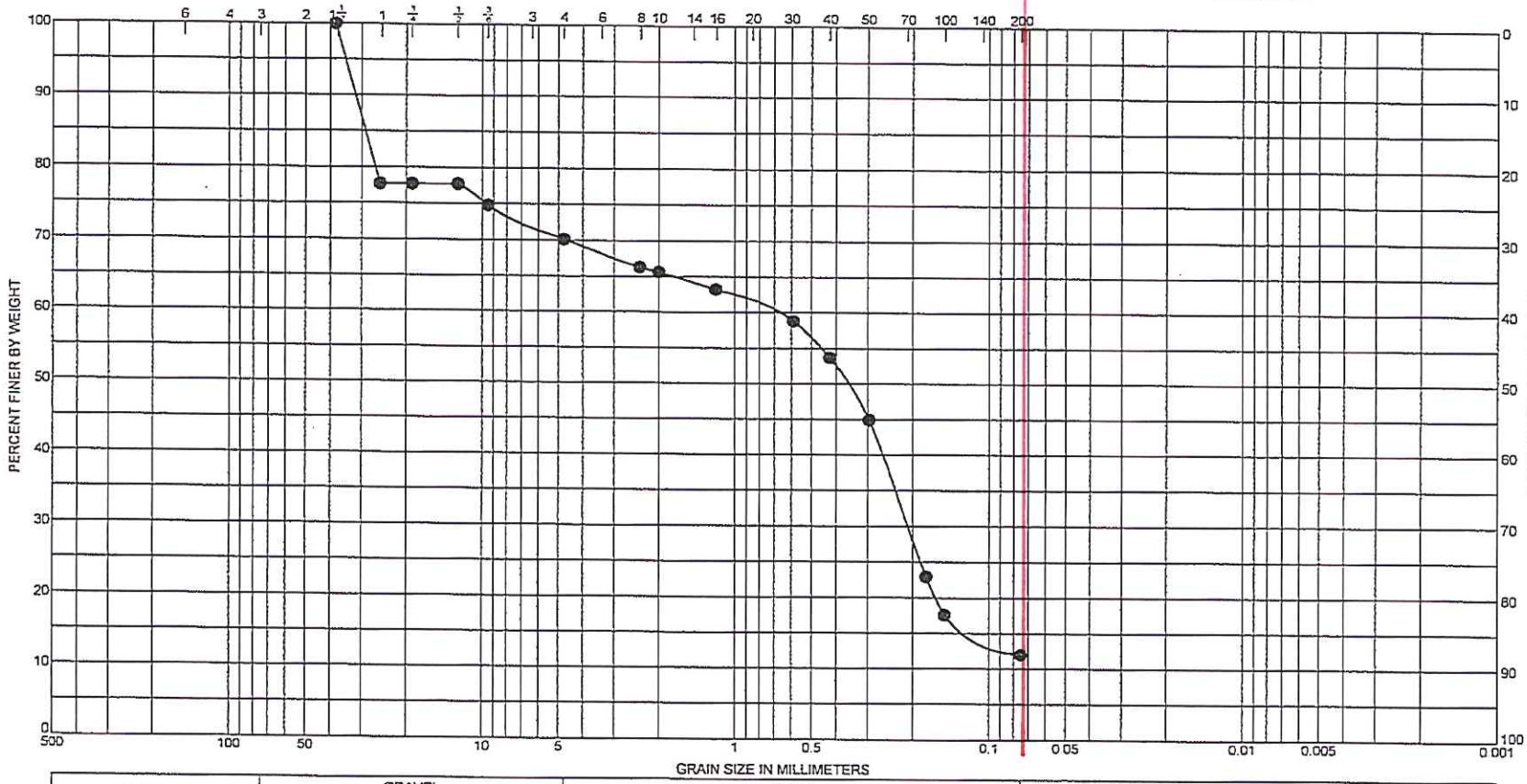
THEREFORE, $k = (0.2\ mm)^2$

$\Rightarrow k = 4.0 \times 10^{-2}$ cm/s OR 1.31×10^{-3} ft/s

SOURCE:

$\Rightarrow$ SEE REFERENCE USACE "EM 1110-2-1901"

NON-LEVEE FILL (SC, SW, SP)



Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
15	16.9 / 9.0 to 10.5	Gravelly Clayey Sand, fine to coarse	10.1			

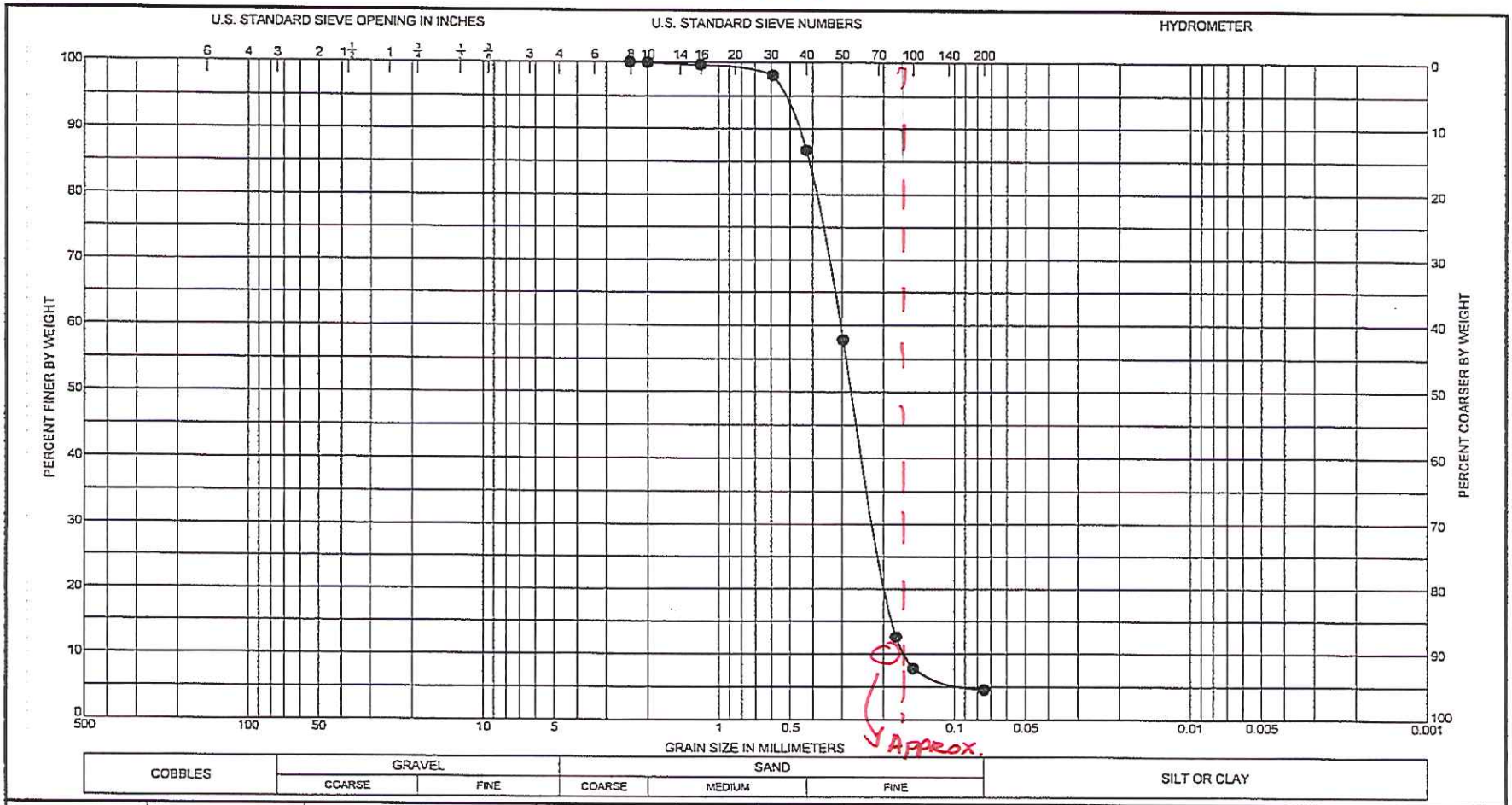
GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

ENG FORM 24 FEB 2009 2087-MVR

APPENDIX G-A

SP / SW



Boring No.	Elev / Depth	Classification	Nat w %	LL	PL	PI
● 19	720.1 / 1.5 to 3.0	Sand, trace Clay, fine to medium	10.1			

GRADATION CURVES

Project	Cedar Rapids Flood Damage Reduction Project
	Cedar Rapids, Iowa
Area	
Project No.	06095137
Date	4/21/10

ENG FORM 24 FEB 2009 2087-MVR

APPENDIX G-A

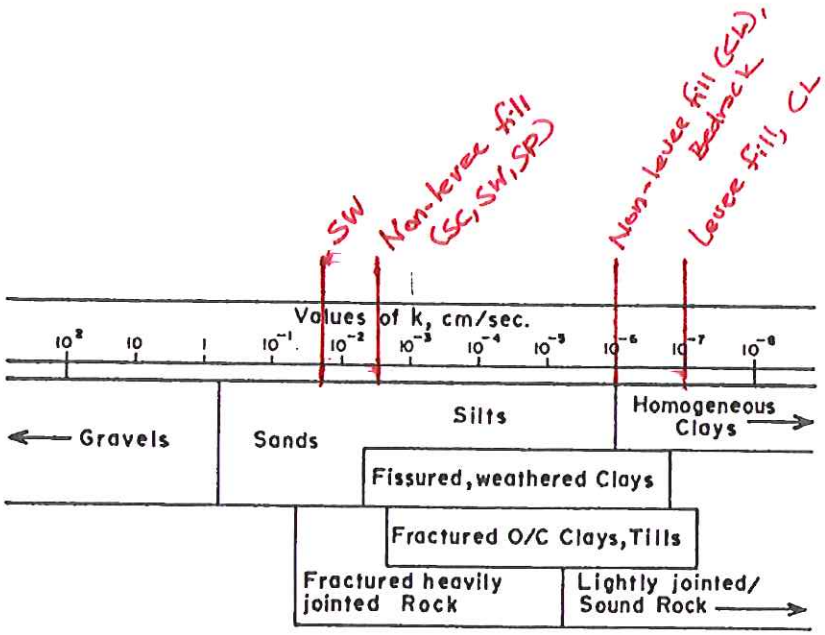


Figure 2-5. Approximate range in coefficient of permeability of soils and rocks (from Milligan[224])

ordinary gravel or soil and have tremendous influence on the watertightness of dam foundations and abutments as shown in figure 2-6 (Cedergren 1977). Figure 2-6a shows a soil profile surmised from several drill holes. The grain size analysis of soil samples taken at frequent intervals erroneously indicated that the deposit was composed of relatively uniform sandy gravels. Laboratory permeability tests on disturbed samples produced coefficients of permeability of about 1×10^{-6} cm/sec. Using this value of permeability, the probable seepage loss beneath the proposed dam was estimated to be 3 cu ft/day, which is an insignificant quantity. However, the design engineer had observed many openwork streaks in which the fines fraction of the material was almost completely absent along the banks of the river and noted that the ground-water table was level for several hundred feet away from the river and fluctuated rapidly with changes in river stage. Field pumping tests were conducted which indicated somewhat variable permeabilities but none approaching the magnitude of openwork gravels. Based upon the available data, the dam was designed with a cutoff trench to bedrock. During the excavation of the cutoff trench, streaks of openwork gravel were found throughout the foundation. A revised seepage computation based on a permeability of 30 cm/sec indicated that without the cutoff trench, the theoretical underseepage would be about 1,000,000 cu ft/day. If openwork gravel or other important discontinuities in earth dam foundations remain undetected, serious problems from excessive seepage and hydrostatic pressures will develop. This example illustrates the potential serious effects of deviations between the design assumptions and the as-built dam (Cedergren 1977). Also, thin continuous seams of cohesive soil can drastically alter the vertical flow through what would otherwise be a highly permeable site.

Computations

Global Stability Plates

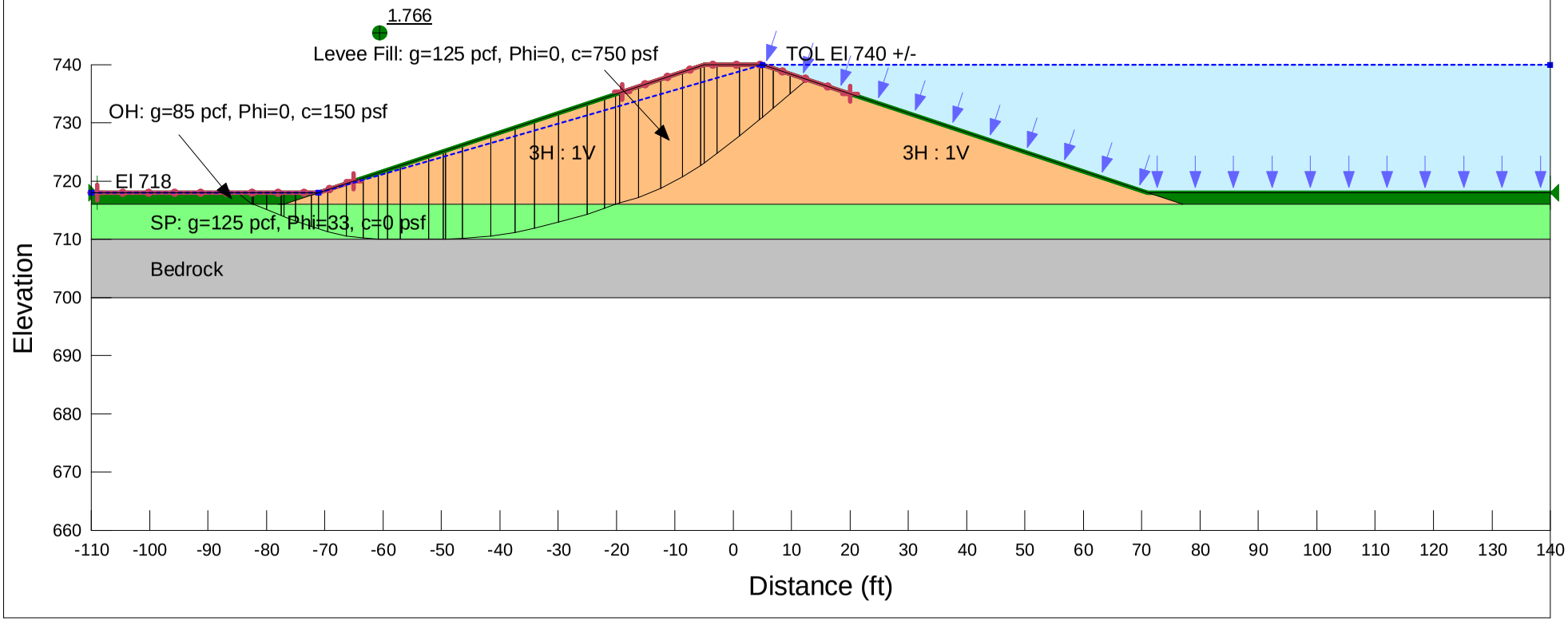
Global Stability Plates
Levee Section
Sta 144+00

Name: Cedar Rapids Sta144, Undrained, Flood.gsz
Computed: NKV Date: 4/29/2010
Checked: JRJ Date: 4/29/2010

Cedar Rapids Flood Protection

Levee - Sta 144+00 (Undrained Condition)

(Stratigraphy based on Pre-2010 soil borings B-7 06085076 and B-1 06085088)



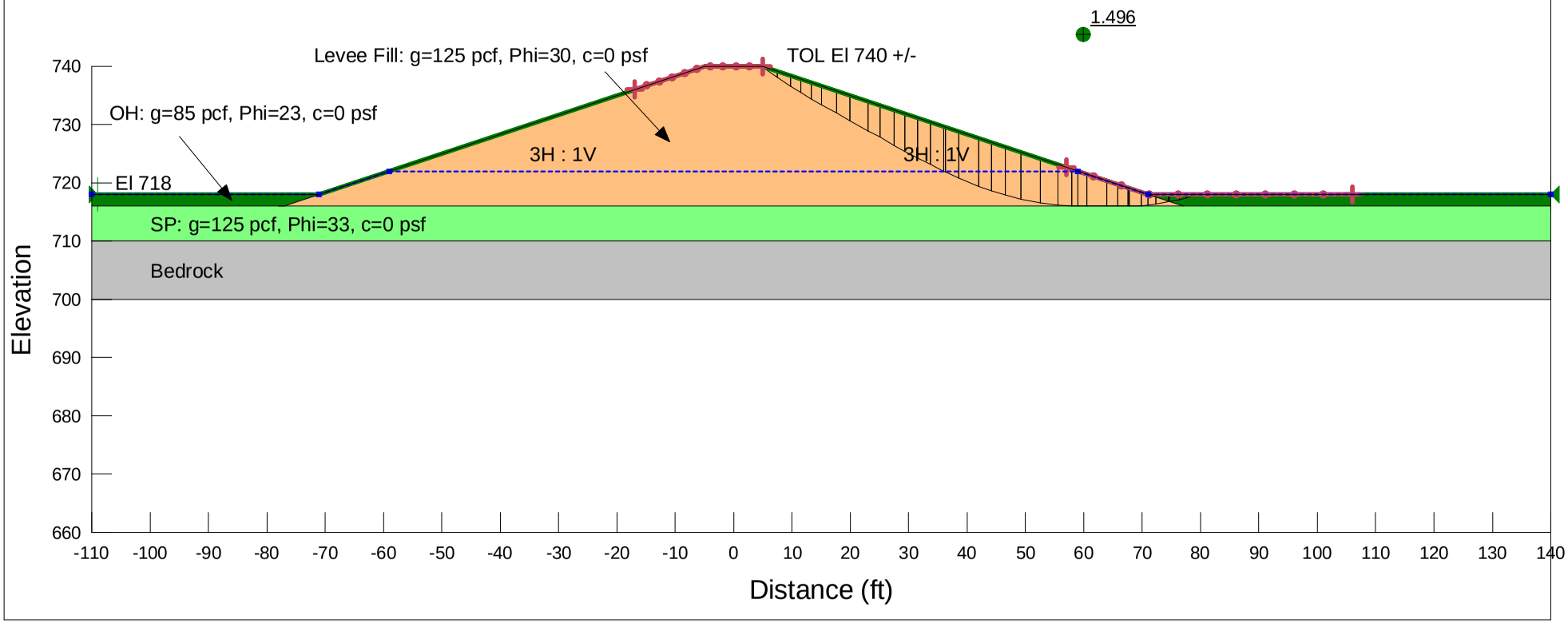
APPENDIX G-A

Name: Cedar Rapids Sta144, LTD.gsz
Computed: NKV Date: 5/3/2010
Checked: JRJ Date: 5/3/2010

Cedar Rapids Flood Protection

Levee - Sta 144+00 (Long-Term Drained)

(Stratigraphy based on Pre-2010 soil borings B-7 06085076 and B-1 06085088)



APPENDIX G-A

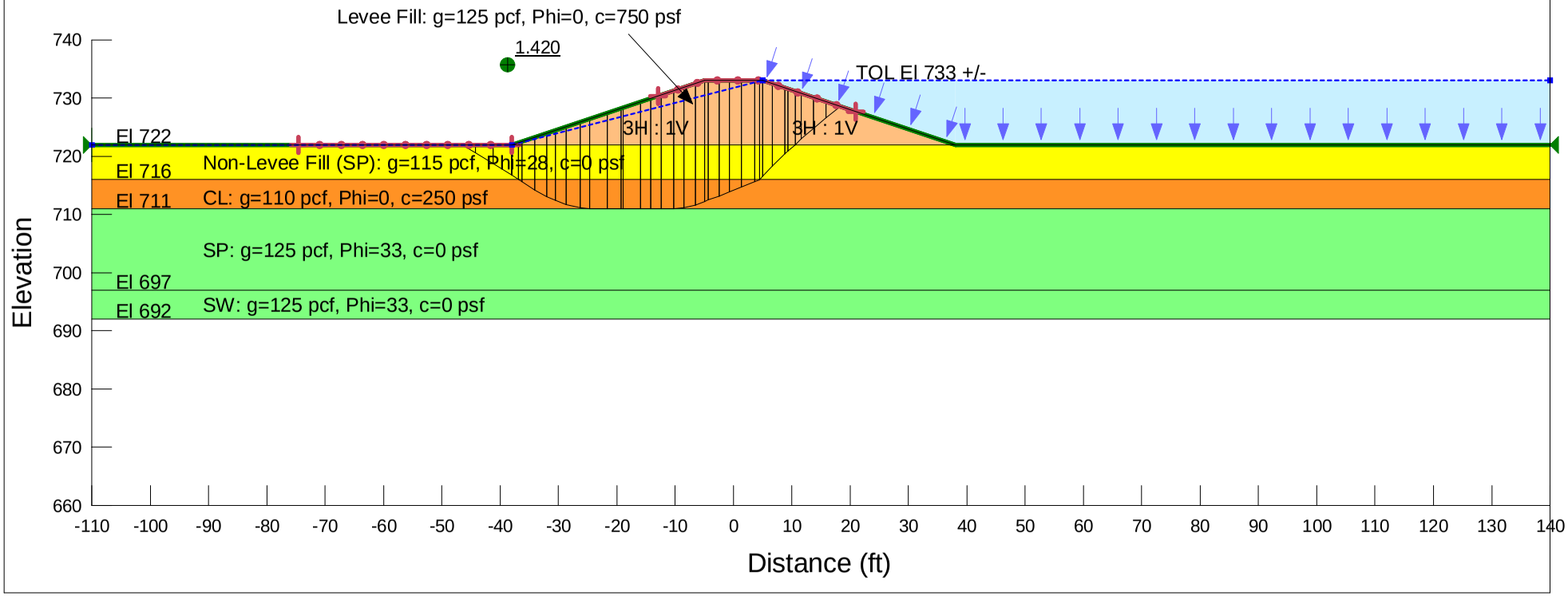
Global Stability Plates
Levee Section
Sta 230+00

Name: Cedar Rapids Sta230, Undrained, Flood.gsz
Computed: NKV Date: 4/29/2010
Checked: JRJ Date: 4/29/2010

Cedar Rapids Flood Protection

Levee - Sta 230+00 (Undrained Condition)

(Stratigraphy based on Terracon Consultants Inc. soil boring B-17 drilled 3/17/10)



APPENDIX G-A

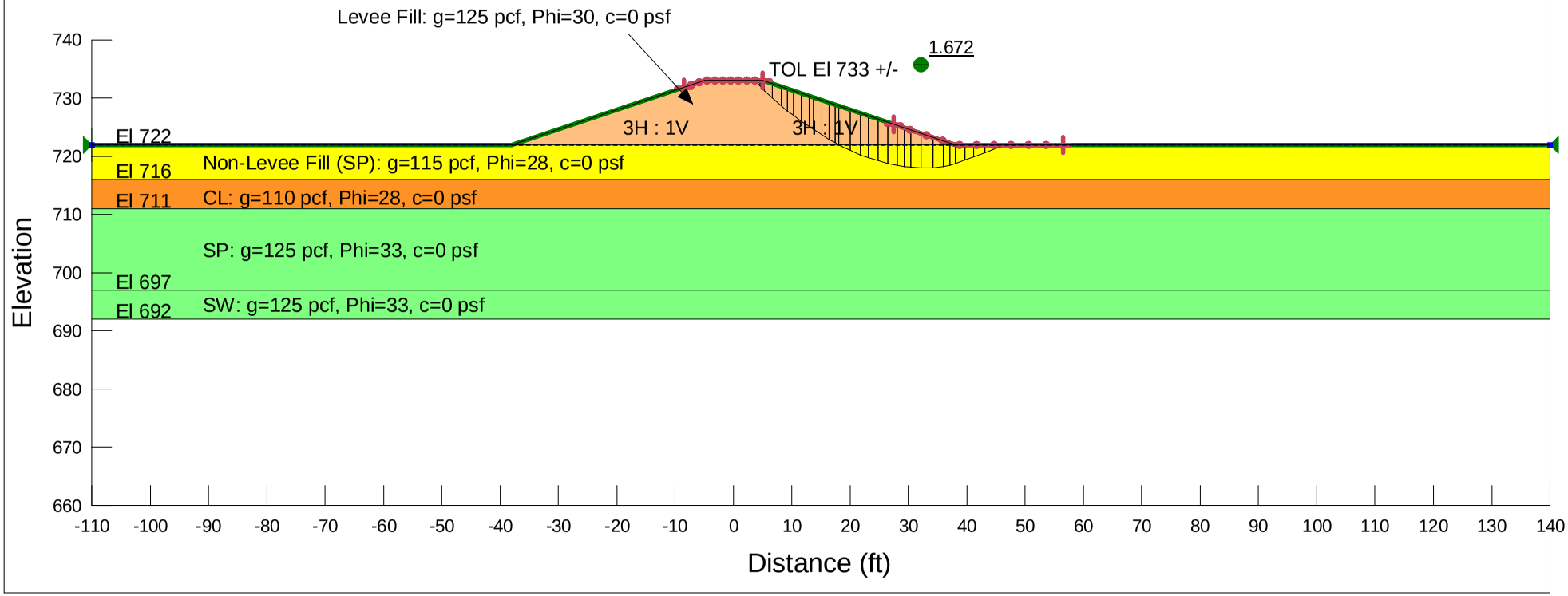
Name: Cedar Rapids Sta230, LTD.gsz
Computed: NKV Date: 5/3/2010
Checked: JRJ Date: 5/3/2010

Cedar Rapids Flood Protection

Levee - Sta 230+00 (Long-Term Drained)

(Stratigraphy based on Terracon Consultants Inc. soil boring B-17 drilled 3/17/10)

APPENDIX G-A



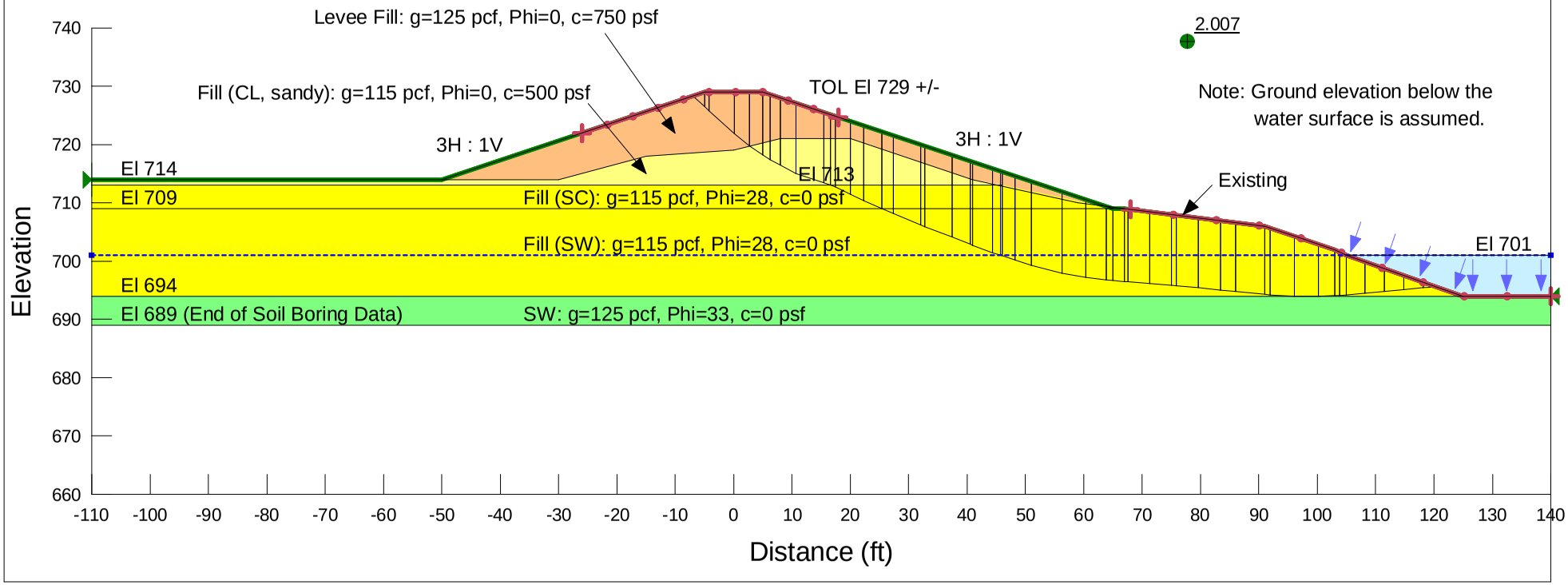
Global Stability Plates
Levee Section
Sta 265+50

Name: Cedar Rapids Sta265, EOC.gsz
Computed: JRJ Date: 4/27/2010
Checked: LDK Date: 4/27/2010

Cedar Rapids Flood Protection

Levee - Sta 265+50 (End of Construction)

(Stratigraphy based on Terracon Consultants Inc. Soil Boring B-24 drilled 3/24/10)



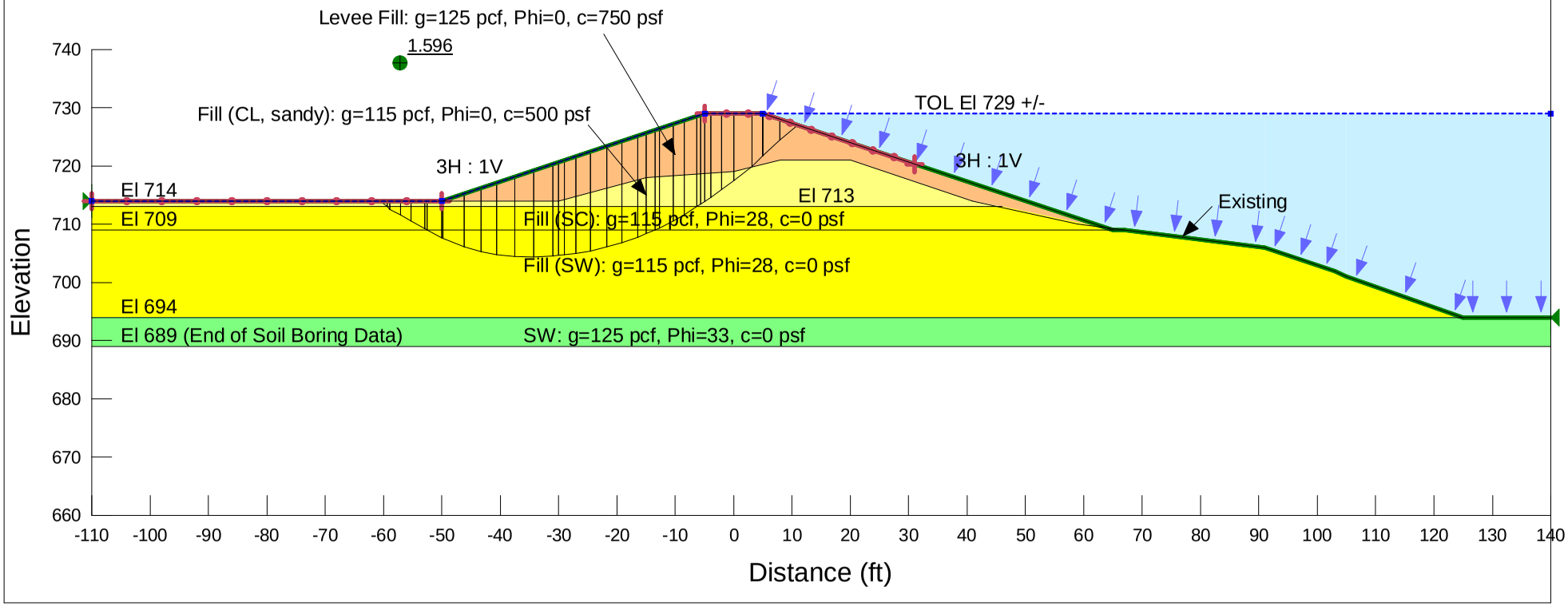
APPENDIX G-A

Name: Cedar Rapids Sta265, Undrained, Flood.gsz
Computed: JRJ Date: 4/27/2010
Checked: LDK Date: 4/27/2010

Cedar Rapids Flood Protection

Levee - Sta 265+50 (Undrained Condition)

(Stratigraphy based on Terracon Consultants Inc. Soil Boring B-24 drilled 3/24/10)



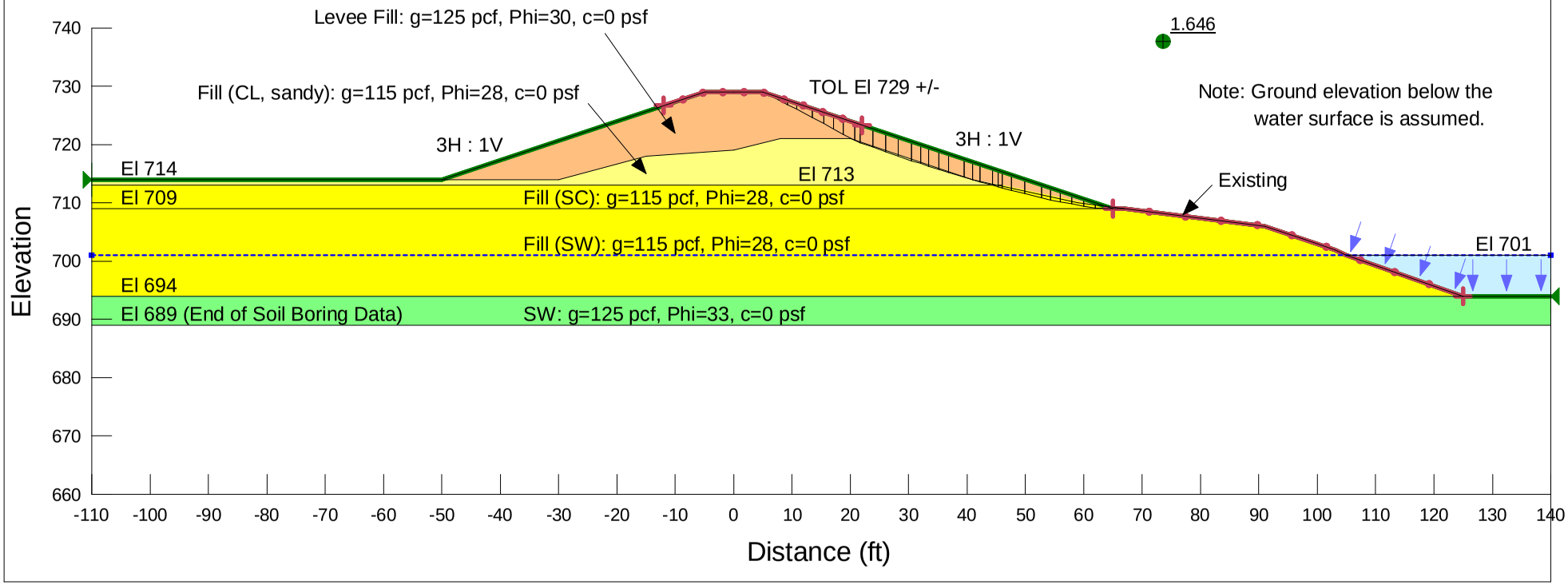
APPENDIX G-A

Name: Cedar Rapids Sta265, LTD.gsz
Computed: JRJ Date: 4/27/2010
Checked: LDK Date: 4/27/2010

Cedar Rapids Flood Protection

Levee - Sta 265+50 (Long Term, Drained)

(Stratigraphy based on Terracon Consultants Inc. Soil Boring B-24 drilled 3/24/10)



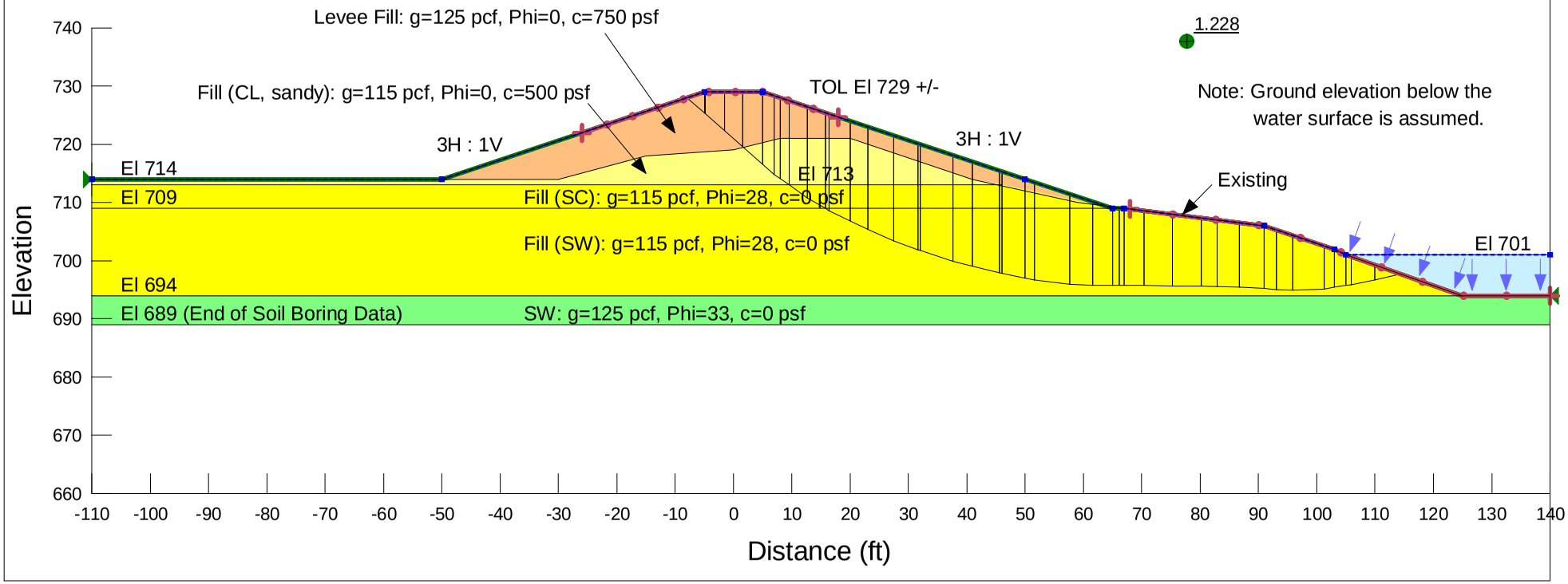
APPENDIX G-A

Name: Cedar Rapids Sta265, RD.gsz
Computed: JRJ Date: 5/10/2010
Checked: LDK Date: 5/10/2010

Cedar Rapids Flood Protection

Levee - Sta 265+50 (Rapid Drawdown)

(Stratigraphy based on Terracon Consultants Inc. Soil Boring B-24 drilled 3/24/10)



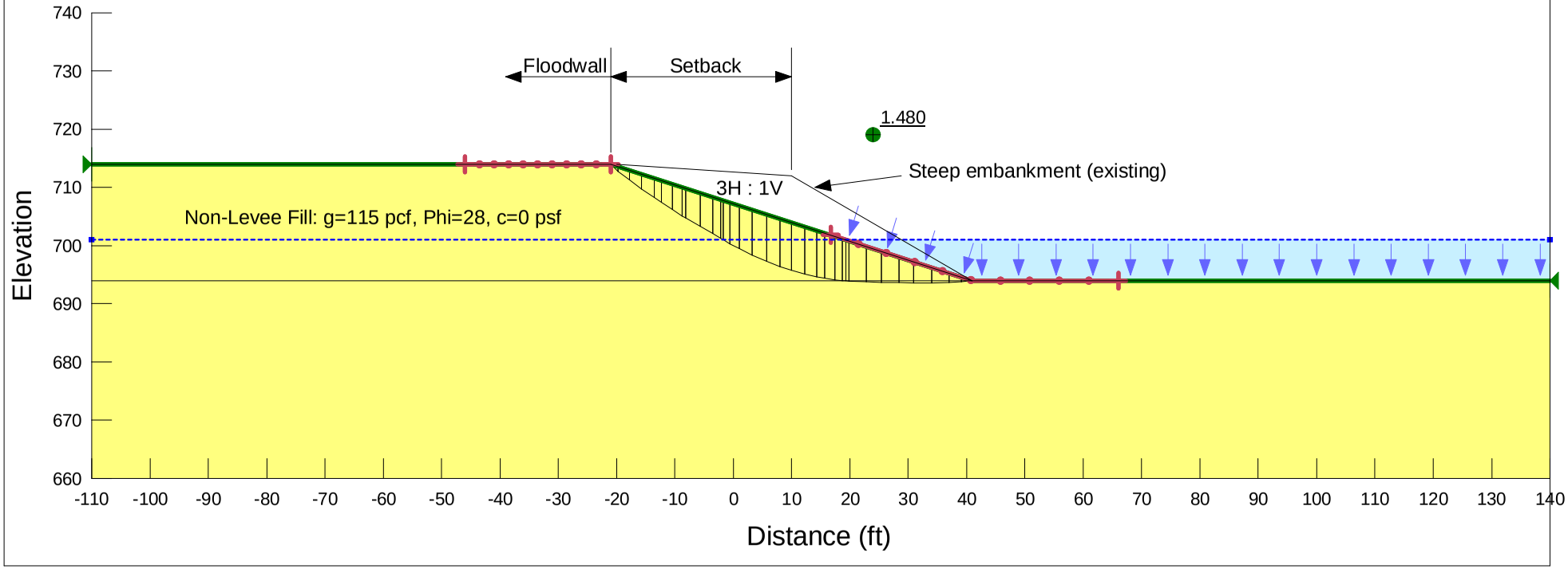
APPENDIX G-A

Global Stability Plates
Typical Floodwall Setback

Name: Copy of Cedar Rapids Floodwall Setback, LTD, (Phi 28).gsz
Computed: NKV Date: 4/29/2010
Checked: JRJ Date: 4/29/2010

Cedar Rapids Flood Protection

Floodwall - Setback (Long-Term Drained)



APPENDIX G-A

Seepage Analysis Plates

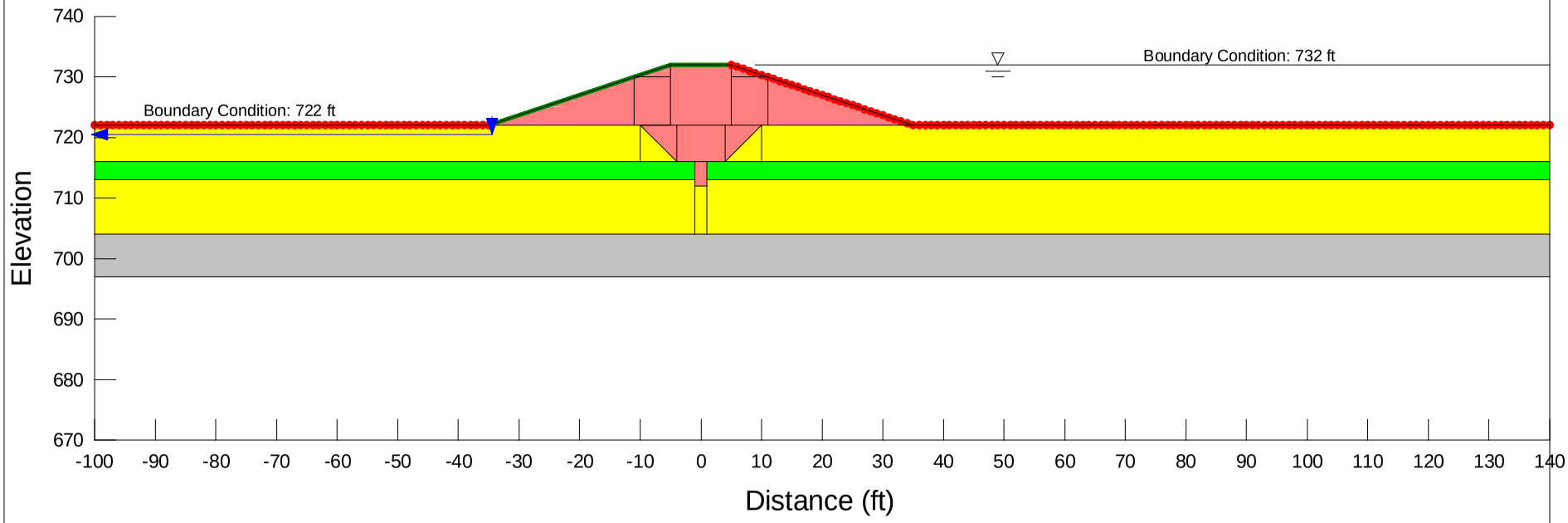
Seepage Analysis Plates
Levee Section
Sta 240+00

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 240+00

Finite Element Seepage Analysis

System



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- CL: k = 1.0 x 10^-7 cm/s = 3.28 x 10^-9 ft/s (CL designated very sandy in B-19, therefore Fill-CL parameter assigned)
- SP: k = 4.0 x 10^-2 cm/s = 1.31 x 10^-3 ft/s
- Bedrock: k = 1.0 x 10^-6 cm/s = 3.28 x 10^-8 ft/s

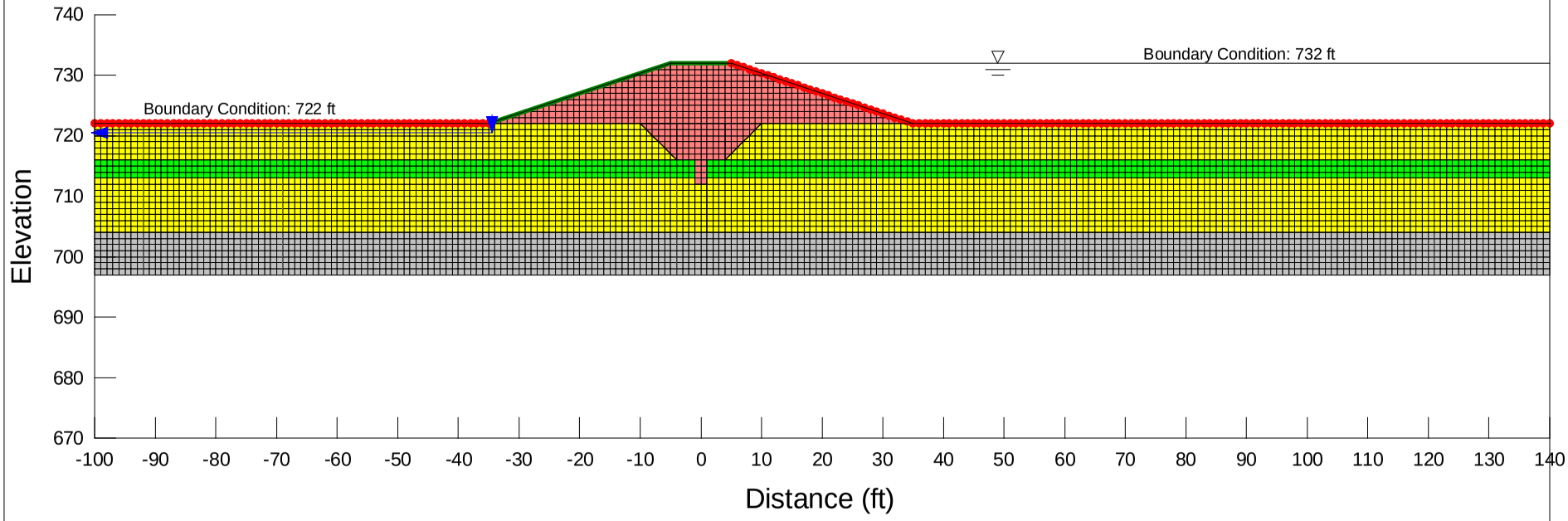
Computed: JRJ Date: 5/3/2010
Checked: LDK Date: 5/3/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 240+00

Finite Element Seepage Analysis

Mesh



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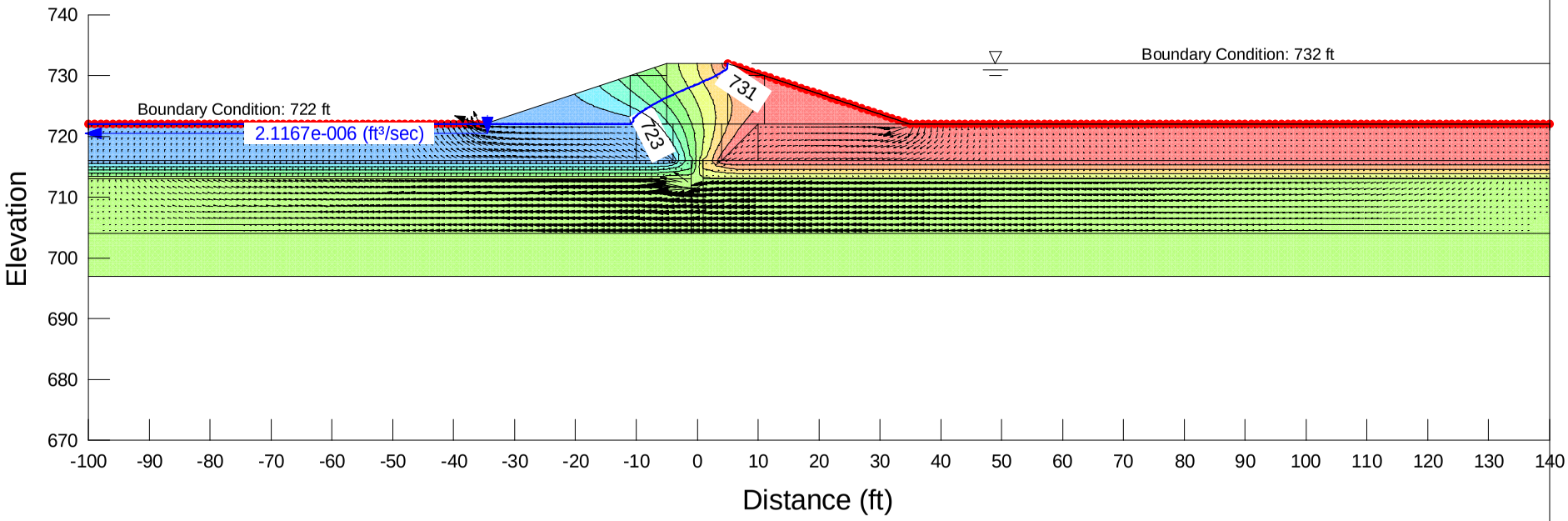
Computed: JRJ Date: 5/3/2010
Checked: LDK Date: 5/3/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 240+00

Finite Element Seepage Analysis

Total Head (ft)



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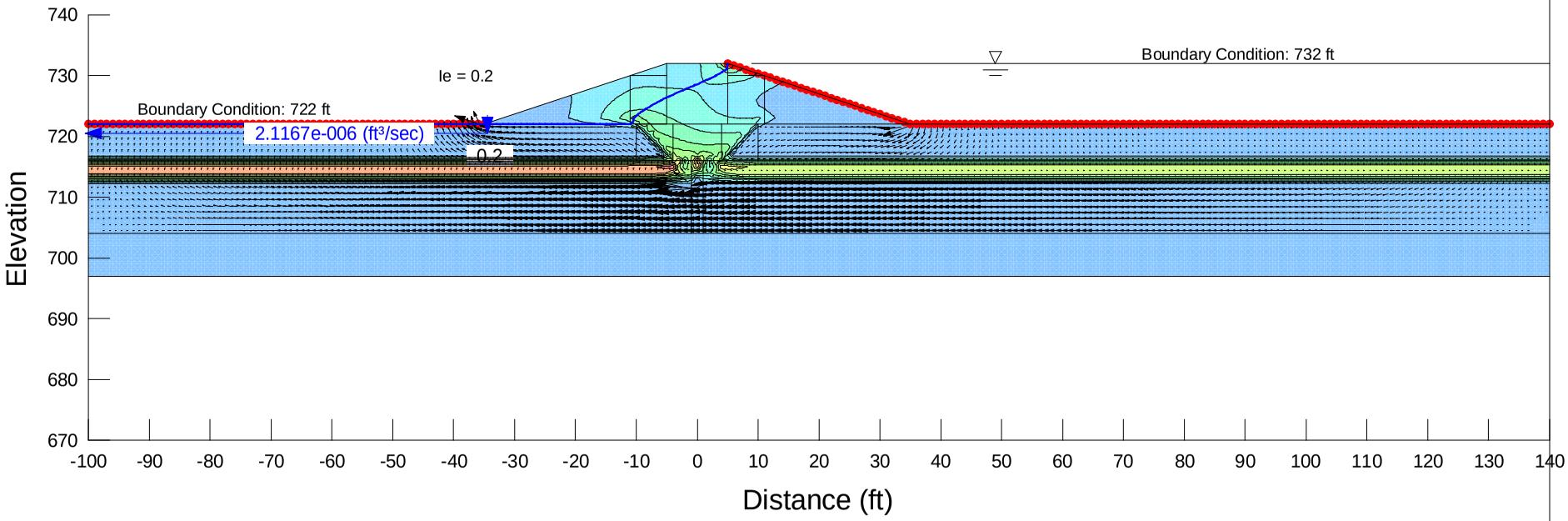
Computed: JRJ Date: 5/3/2010
Checked: LDK Date: 5/3/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 240+00

Finite Element Seepage Analysis

Gradient



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Computed: JRJ Date: 5/3/2010
Checked: LDK Date: 5/3/2010

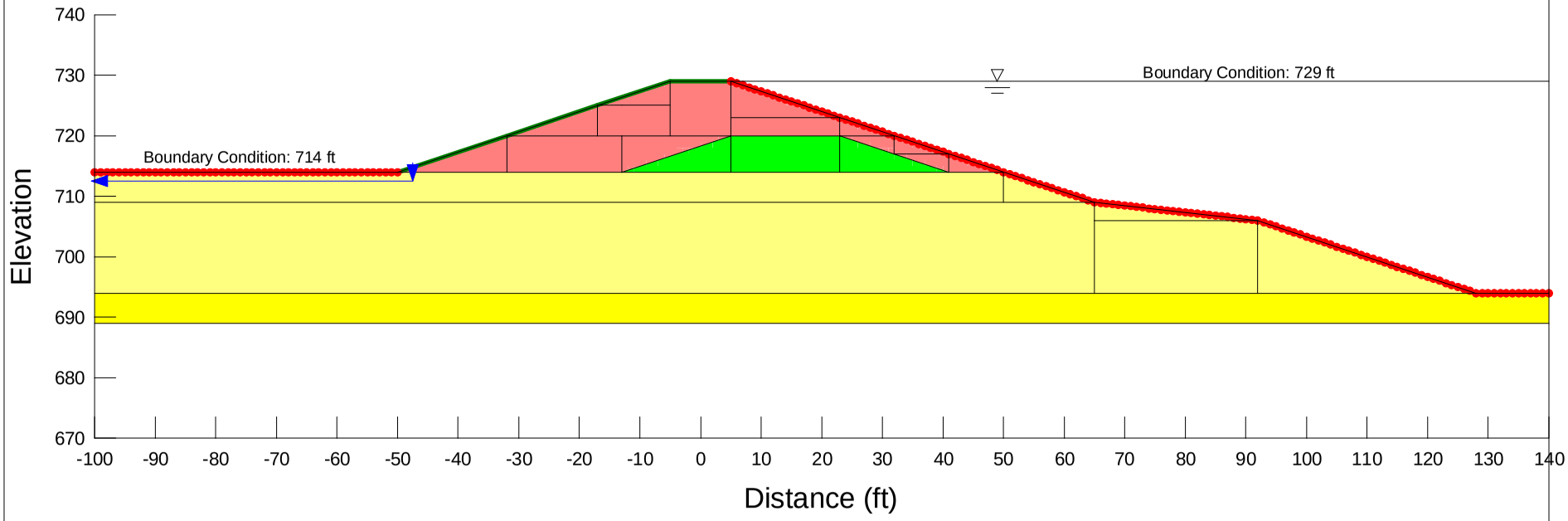
Seepage Analysis Plates
Levee Section
Sta 265+50

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 265+50

Finite Element Seepage Analysis

System



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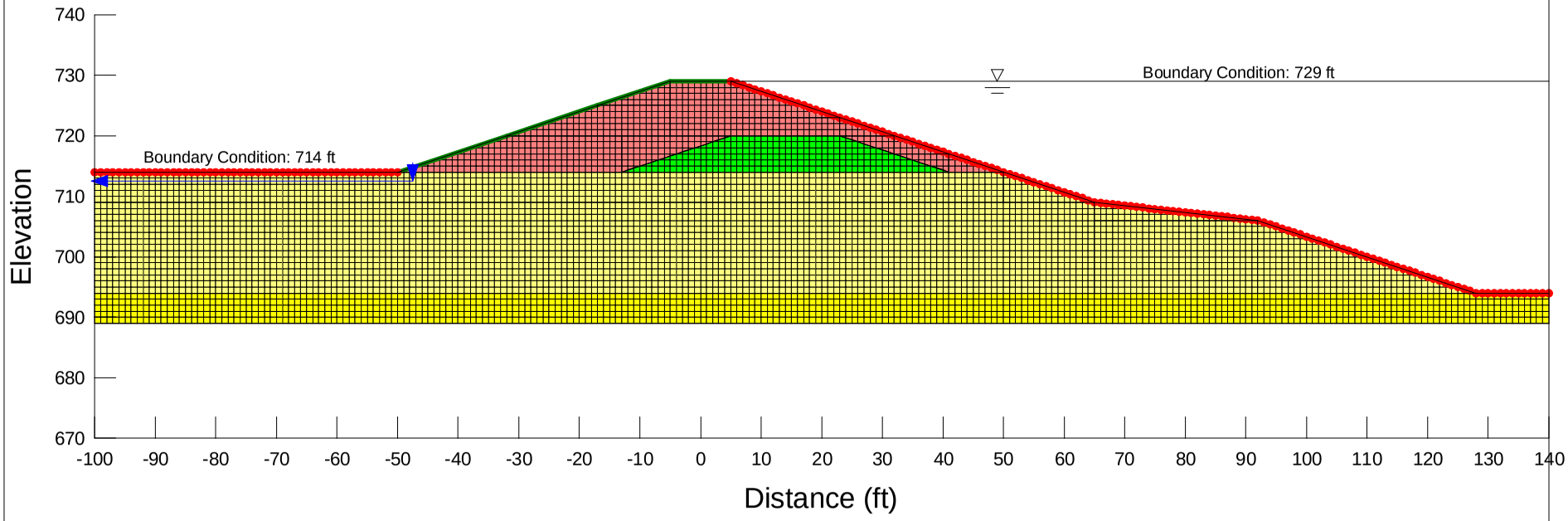
Computed: JRJ Date: 4/29/2010
Checked: LDK Date: 4/29/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 265+50

Finite Element Seepage Analysis

Mesh



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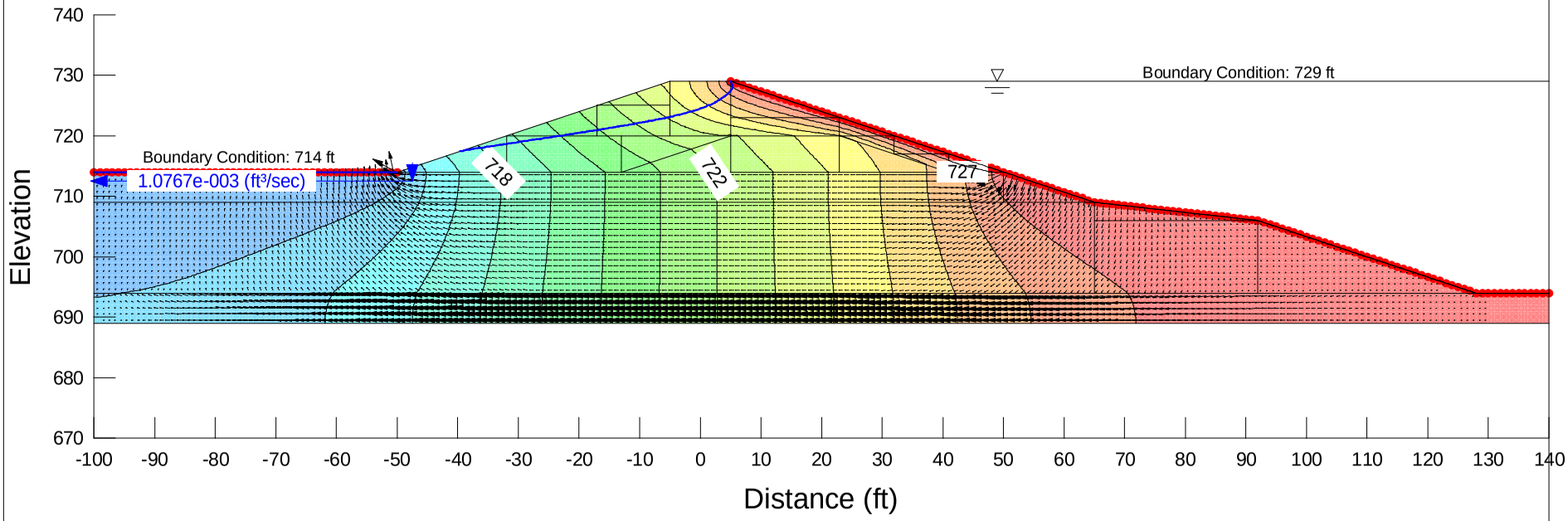
Computed: JRJ Date: 4/29/2010
Checked: LDK Date: 4/29/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 265+50

Finite Element Seepage Analysis

Total Head (ft)



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CL: k = 1.0 x 10^-7 cm/s = 3.28 x 10^-9 ft/s

SW: k = 4.0 x 10^-2 cm/s = 1.31 x 10^-3 ft/s

Bedrock: k = 1.0 x 10^-6 cm/s = 3.28 x 10^-8 ft/s

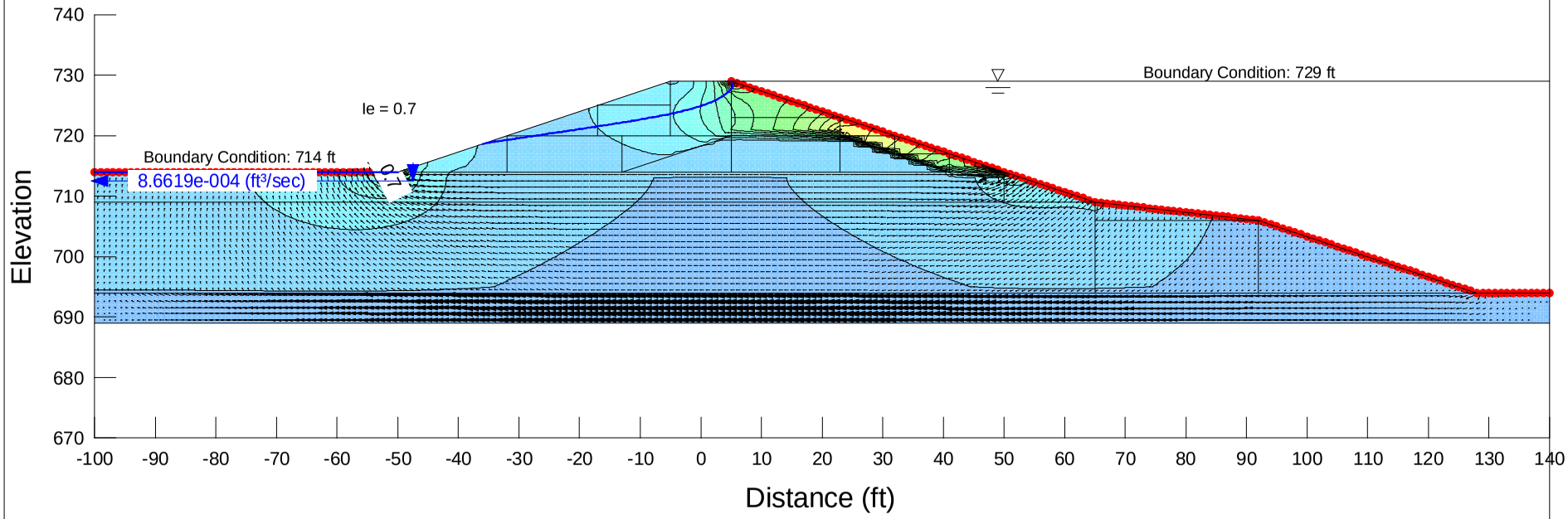
Computed: JRJ Date: 4/29/2010
Checked: LDK Date: 4/29/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 265+50

Finite Element Seepage Analysis

Gradient



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Bedrock: k = 1.0 x 10^-6 cm/s = 3.28 x 10^-8 ft/s

Computed: JRJ Date: 5/5/2010
Checked: LDK Date: 5/5/2010

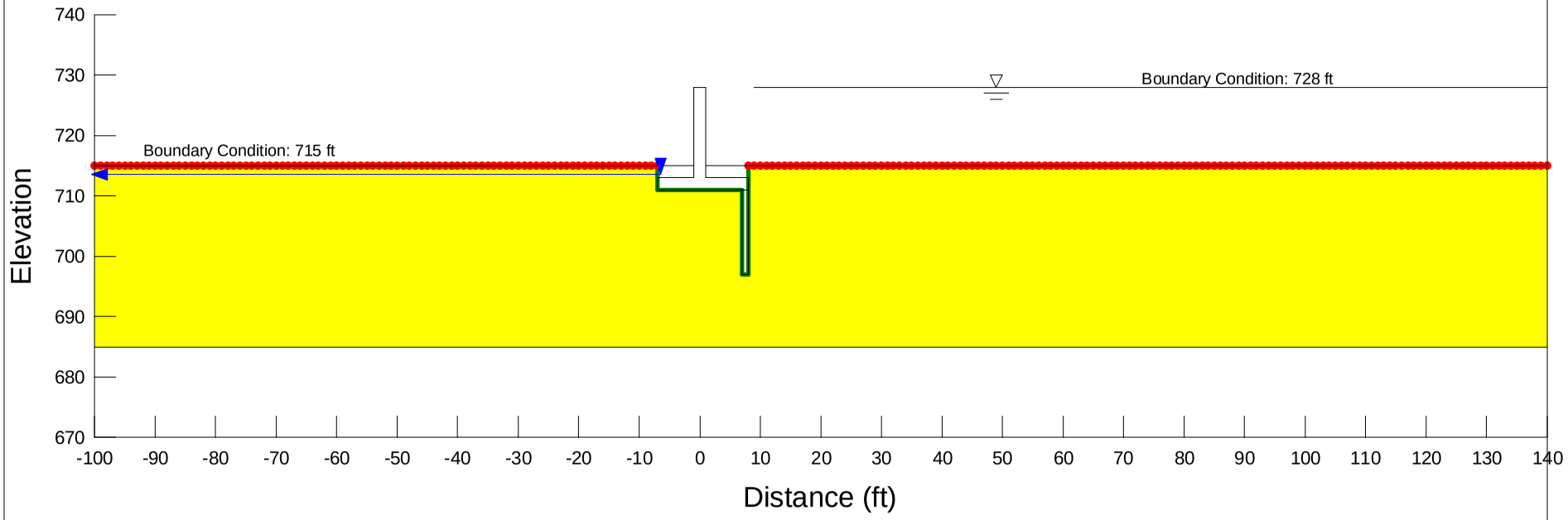
Seepage Analysis Plates
Floodwall Section
Sta 278+00

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 278+00

Finite Element Seepage Analysis

System



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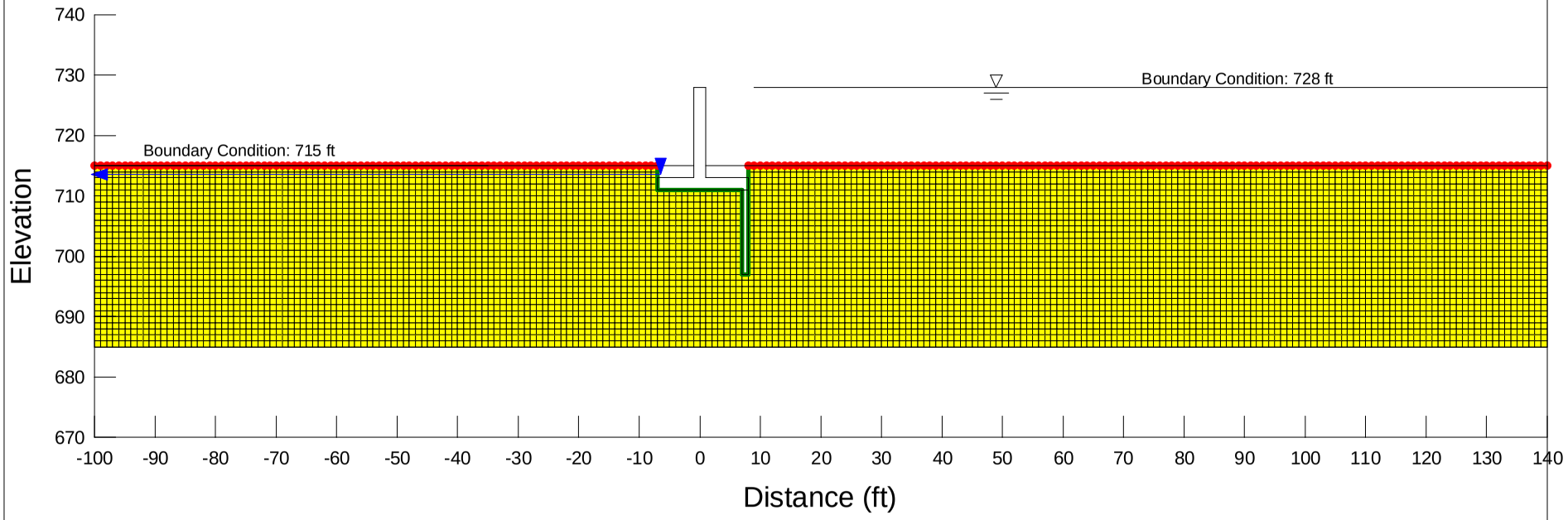
Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 278+00

Finite Element Seepage Analysis

Mesh



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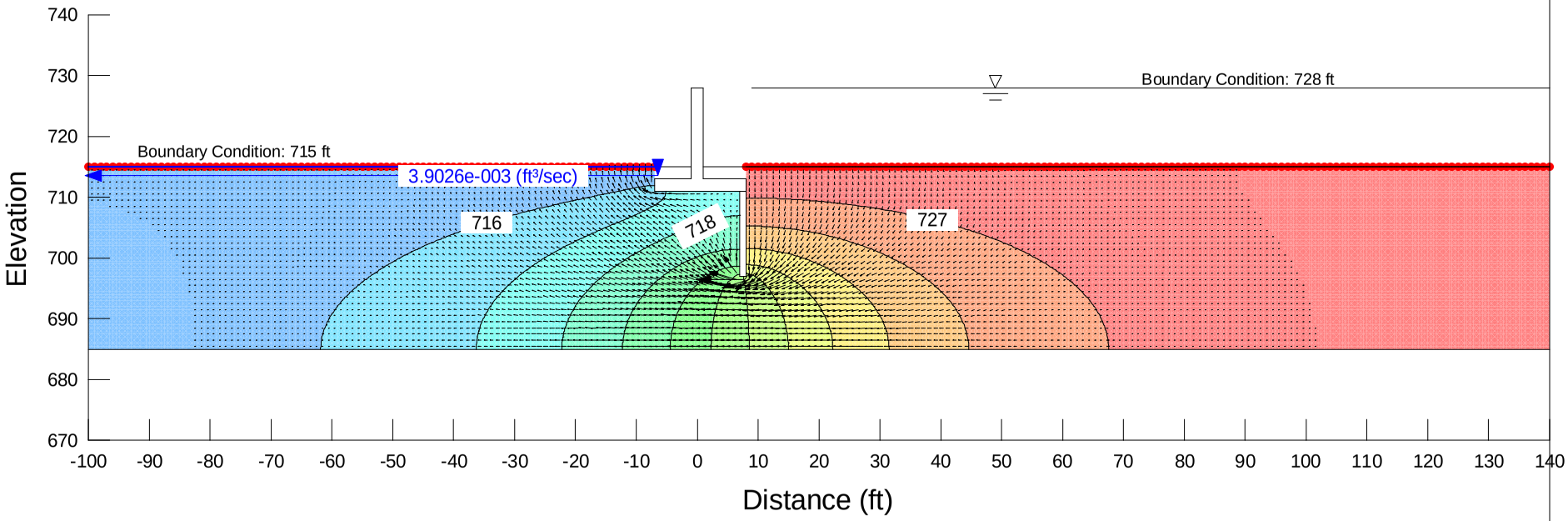
Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 278+00

Finite Element Seepage Analysis

Total Head (ft)



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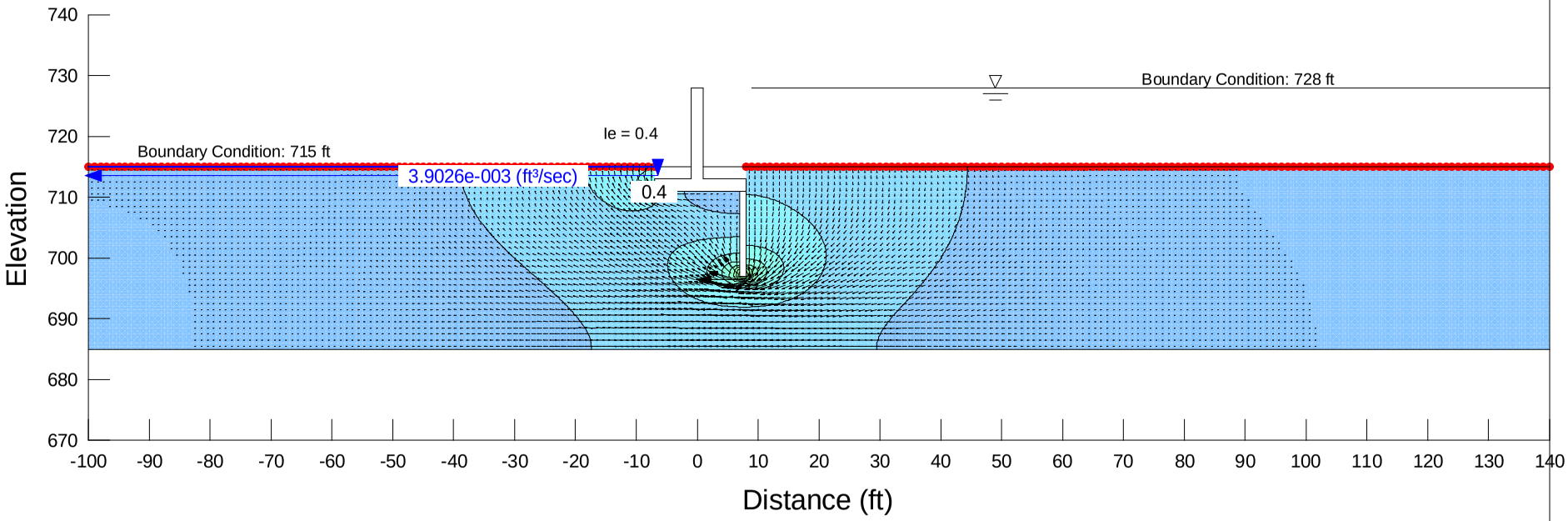
Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Sta 278+00

Finite Element Seepage Analysis

Gradient



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Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

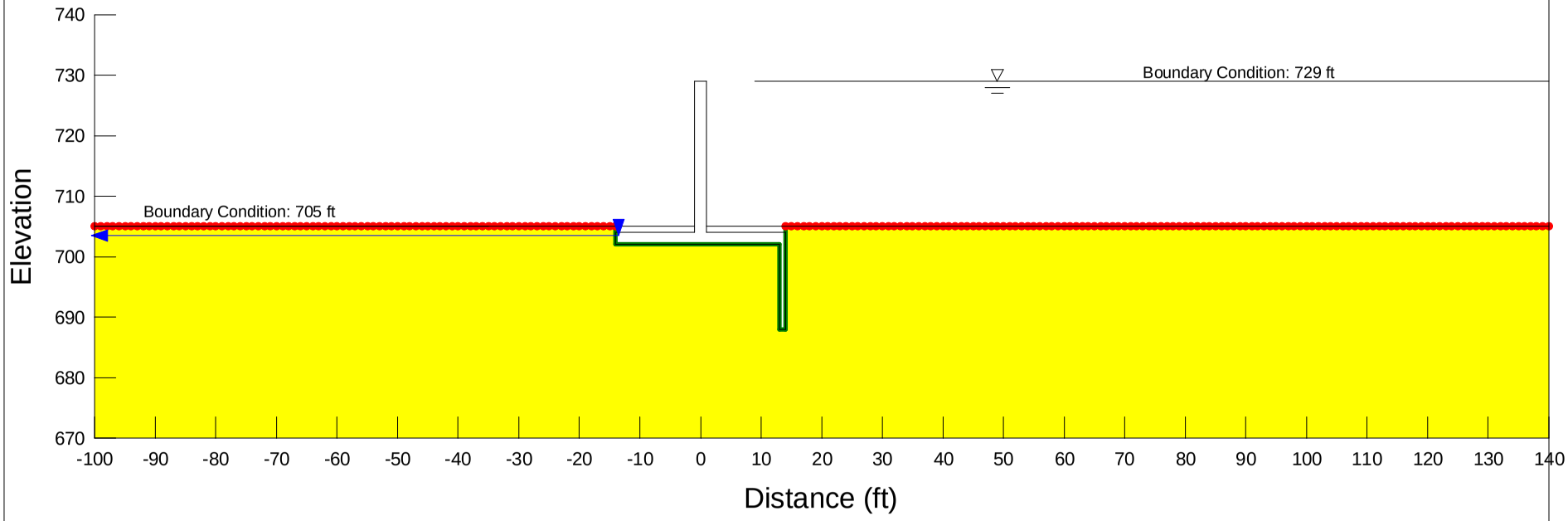
Seepage Analysis Plates
Typical 24-ft Floodwall Section

APPENDIX G-A

Cedar Rapids Flood Protection - Typical 24' Wall

Finite Element Seepage Analysis

System



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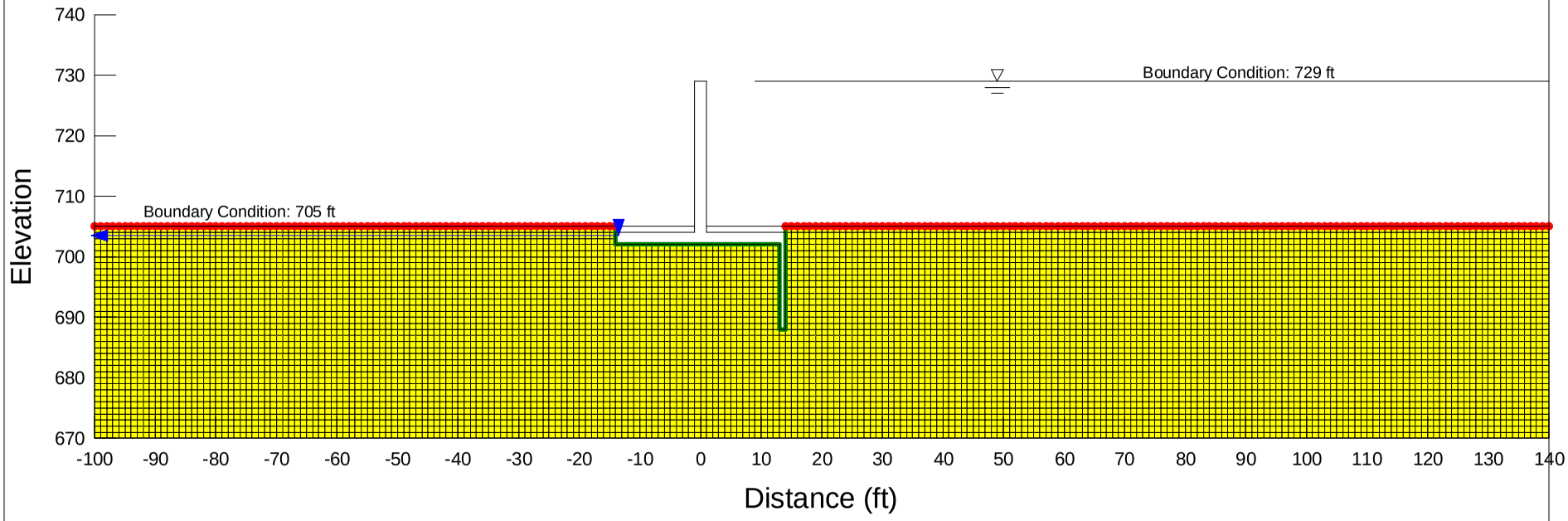
Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Typical 24' Wall

Finite Element Seepage Analysis

Mesh



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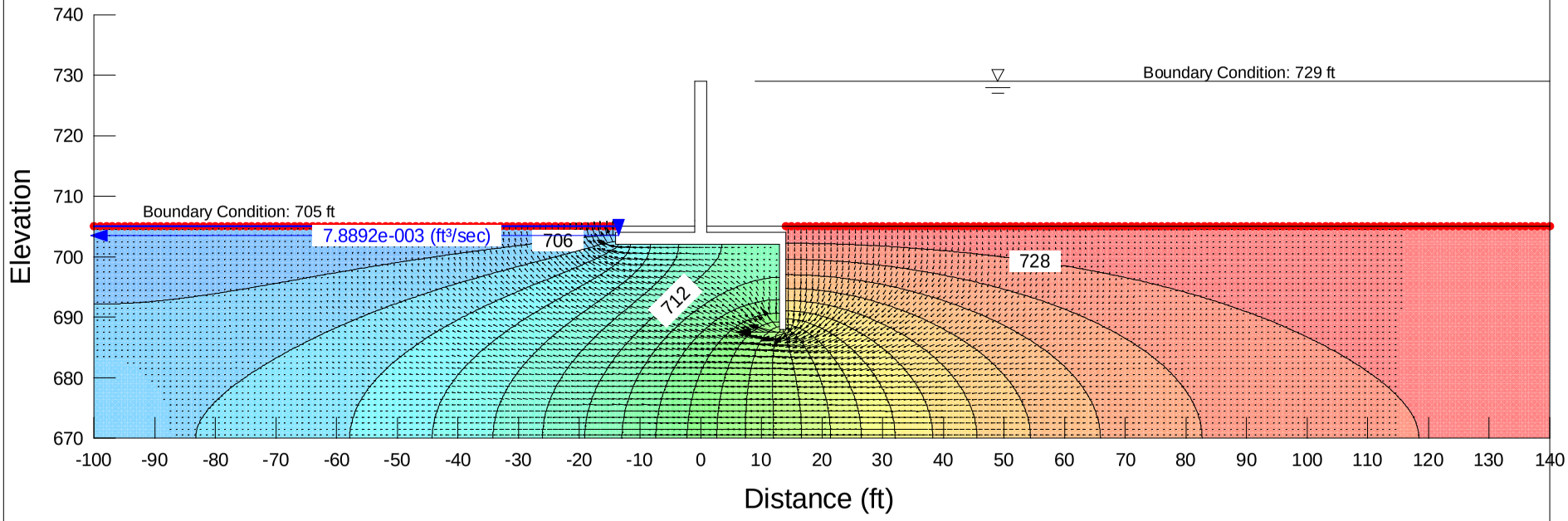
Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Typical 24' Wall

Finite Element Seepage Analysis

Total Head (ft)



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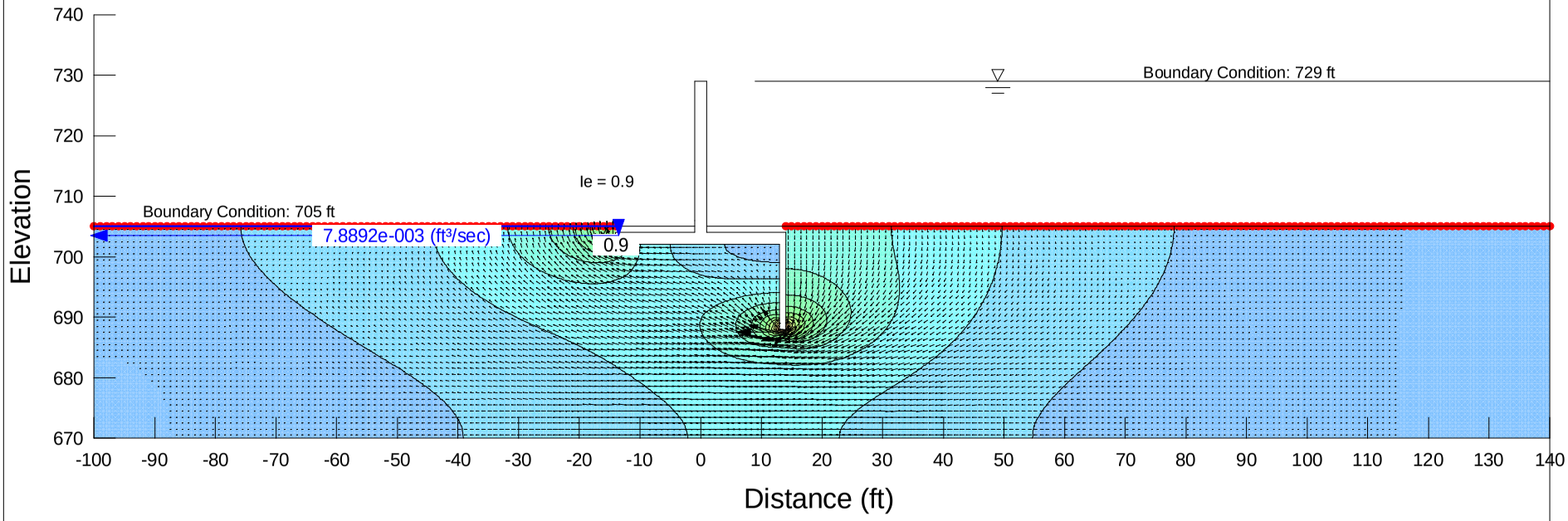
Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

APPENDIX G-A

Cedar Rapids Flood Protection - Typical 24' Wall

Finite Element Seepage Analysis

Gradient



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Computed: JRJ Date: 5/4/2010
Checked: LDK Date: 5/4/2010

Seepage Analysis Calculation
Exit Gradient Factor of Safety

Stanley Consultants INC.

Project No. 22263.03.00 Page No.

Subject CEDAR RAPIDS SEEPAGE COMP
FS FOR EXIT GRADIENT

Computed by NKV Date 5-4-10

Checked by JRS Date 5-4-10

Approved by _____ Date _____

Sheet No. _____ of _____

DETERMINE FACTOR OF SAFETY FOR EXIT GRADIENT, FS_g:

$$FS_g = \frac{\gamma' z_t}{\gamma_w h_o} = \frac{i_{cr}}{i_e}$$

$i_{cr} = \frac{\gamma'_m}{\gamma'_w}$ = CRITICAL HYDRAULIC GRADIENT

$i_e = \frac{h_o}{z_t}$ = RATE OF DISSIPATION OF HEAD / UNIT LENGTH IN AREA OF EXITING SEEPAGE, EXIT GRADIENT

FOR ALL CASES ANALYZED, $\gamma_m = 125$ pcf,

$\therefore \quad \gamma'_m = 125 \text{ pcf} - 62.4 \text{ pcf} = \underline{62.6 \text{ pcf}}$

NOTE: i_e DETERMINED BY FINITE ELEMENT SEEPAGE ANALYSIS

FOR STA 240+00:

$i_{cr} = \frac{62.6 \text{ pcf}}{62.4 \text{ pcf}} = 1.0$

$i_e = 0.2$

$\therefore \quad FS_g = \frac{1.0}{0.2} = \underline{5.0}$ ✓

FOR STA 265+50:

$i_{cr} = 1.0$

$i_e = 0.7$

$\therefore \quad FS_g = \frac{1.0}{0.7} = \underline{1.43}$ ✓

Stanley Consultants INC.

Project No. 22263.03.00 Page No.

Subject CEDAR RAPIDS SEEPAGE COMP
FS FOR EXIT GRADIENT

Computed by NKV Date 5-4-10

Checked by JRS Date 5-4-10

Approved by Date

Sheet No. of

FOR STA 278+00 :

$i_{cr} = 1.0$

$i_e = 0.4$

$\therefore \quad FS_g = \frac{1.0}{0.4} = \underline{\underline{2.5}}$ ✓

FOR ~~SEA~~ TYP. 24-Ft WALL :

$i_{cr} = 1.0$

$i_e = 0.9$

$\therefore \quad FS_g = \frac{1.0}{0.9} = \underline{\underline{1.11}}$

NEED REMEDIATION MEASURES.

A $FS_g > 1.5$ IS RECOMMENDED, THEREFORE AN EXIT GRADIENT LESS THAN OR $i_e = 0.67$ IS NEEDED.

SOURCE :

USACE, EM 1110-2-1901 "SEEPAGE PRINCIPLES"

unit weight of the soil and is the gradient at which upward drag forces on the soil particles equal the submerged weight of the soil particles, figure 4-16. The critical gradient is dependent on the specific gravity and density of the soil particles and can be defined in terms of specific gravity of solids, G_s, void ratio, e, and porosity, n :

$$i_{cr} = \frac{\gamma'_m}{\gamma_w} \quad \frac{G_s(1 - n)\gamma_w + n\gamma_w - \gamma_w}{\gamma_w}$$

$$= G_s(1 - n) + n - 1 = G_s (1 - n) - (1 - n)$$

$$i_{cr} = (G_s - 1)(1 - n)$$

or, since $e = \frac{n}{1-n}$ and $n = \frac{e}{1 + e}$

$$i_{cr} = (G_s - 1)\left(\frac{n}{e}\right) = (G_s - 1)\frac{\frac{e}{1 + e}}{e}$$

$$i_{cr} = \frac{G_s - 1}{1 + e}$$

If typical values of G_s, e, and n for sand are used in the above equations, i_{cr} will be approximately 1. Investigators have recommended ranges for factor of safety for escape gradient, $FS_G = \frac{i_{cr}}{i_e}$ from 1.5 and 15, depending on knowledge of soil and possible seepage conditions. Generally, factors of safety in the range of 4-5 (Harr 1962, 1977) or 2.5-3 (Cedergren 1977) have been proposed.

c. Heave. In some cases, movement of soil at the downstream seepage exit may not occur as flotation followed by particle-by-particle movement. A mass of soil may be lifted initially, followed by piping. This phenomenon is called heave and occurs when the upward seepage force due to differential head equals the overlying buoyant weight of soil. Heave occurs under conditions of critical hydraulic gradient. For field conditions, the point at which minimum differential head offsets the overlying buoyant weight must be determined by judgment and calculations. Terzaghi and Peck (1967) have evaluated the factor of safety with respect to heave for a row of sheet piles. Resistance to heave

Global Stability Output Files

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 94
Last Edited By: Jacks, Jason
Date: 4/29/2010
Time: 1:38:51 PM
File Name: Cedar Rapids Sta144, Undrained, Flood.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 4/29/2010
Last Solved Time: 1:38:58 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Undrained (Phi=0)
Unit Weight: 125 pcf
Cohesion: 750 psf
Pore Water Pressure
Piezometric Line: 1

OH

Model: Undrained (Phi=0)
Unit Weight: 85 pcf
Cohesion: 150 psf
Pore Water Pressure
Piezometric Line: 1

Bedrock

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-109, 718) ft
Left-Zone Right Coordinate: (-65, 720) ft

Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (-19, 735.33333) ft
Right-Zone Right Coordinate: (20, 735) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-109, 718) ft
Right Coordinate: (140, 718) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	718
	-71	718
	5	740
	140	740

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.766	(-50.134, 792.978)	45.01668	(12.6565, 737.448)	(-84.9784, 718)
2	698	1.782	(-50.134, 792.978)	83.48	(12.3026, 737.566)	(-86.8377, 718)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal	Frictional Strength	Cohesive

					Stress (psf)	(psf)	Strength (psf)
1	Optimized	-83.72976	717.046	59.625441	183.24824	0	150
2	Optimized	-82.36514	716.046	122.12591	228.88938	0	150
3	Optimized	-81.1126	715.54935	153.1639	267.55938	74.289291	0
4	Optimized	-78.72349	714.6021	212.3685	413.46343	130.59257	0
5	Optimized	-77.235475	714.01235	249.22288	504.09287	165.5145	0
6	Optimized	-75.973565	713.5132	280.42252	599.73737	207.36549	0
7	Optimized	-73.62529	712.6391	335.0553	761.2624	276.78213	0
8	Optimized	-71.651725	711.9662	377.11254	880.18543	326.69936	0
9	Optimized	-70.264515	711.53025	417.66624	992.54103	373.32805	0
10	Optimized	-67.89103	710.9466	497.07609	1142.3768	419.06316	0
11	Optimized	-64.83593	710.40425	586.25285	1315.9915	473.8978	0
12	Optimized	-62.112375	710.1072	654.08041	1449.1001	516.29184	0
13	Optimized	-60.021705	710	698.59713	1506.7306	524.80802	0
14	Optimized	-58.14977	710	732.4955	1587.5869	555.30284	0
15	Optimized	-54.64753	710	795.85176	1738.8756	612.40686	0
16	Optimized	-50.95752	710	862.60966	1898.2901	672.57872	0
17	Optimized	-49.495215	710	889.07041	1961.4524	696.41299	0
18	Optimized	-47.87041	710.05825	914.83158	1992.7778	700.02645	0

19	Optimized	-43.998315	710.34275	967.09212	2080.0979	722.7944	0
20	Optimized	-39.47579	710.88785	1014.8553	2153.5854	739.49997	0
21	Optimized	-35.73588	711.5382	1041.8621	2189.5163	745.29533	0
22	Optimized	-31.988725	712.3786	1057.1439	2206.8191	746.60784	0
23	Optimized	-27.48433	713.58335	1063.3255	2207.8163	743.24103	0
24	Optimized	-23.537505	714.819	1057.499	2172.9095	724.35606	0
25	Optimized	-21.064325	715.6794	1048.4914	2173.9669	730.89235	0
26	Optimized	-19.787905	716.11705	1044.2222	2170.642	0	750
27	Optimized	-17.854195	716.72575	1041.1651	2200.4187	0	750
28	Optimized	-14.34808	717.99165	1025.4804	2118.1217	0	750
29	Optimized	-10.580435	719.7245	985.33556	1982.8414	0	750
30	Optimized	-7.134265	721.6993	924.2632	1806.8886	0	750
31	Optimized	-5.271	722.9162	881.90861	1674.5588	0	750
32	Optimized	-3.878785	723.94725	842.67398	1569.7733	0	750
33	Optimized	-0.84141	726.2487	753.78434	1298.0887	0	750
34	Optimized	2.788915	729.11205	640.50474	957.57599	0	750
35	Optimized	4.75154	730.71815	575.62267	757.10526	0	750
36	Optimized	5.94819	731.74815	515.75521	626.21995	0	750
37	Optimized	8.321305	733.78835	388.21291	358.16201	0	750

38	Optimized	11.20137	736.2301	235.6165	44.00434	0	750

Slices of Slip Surface: 698

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	698	-84.63554	717	62.499108	148.36303	0	150
2	698	-81.07502	715.45785	158.8846	281.68812	79.749539	0
3	698	-78.35834	714.42765	223.27362	432.28889	135.7361	0
4	698	-75.5	713.4611	283.68576	593.50093	201.19632	0
5	698	-72.5	712.56535	339.6728	763.03543	274.93491	0
6	698	-69.533995	711.7978	414.15566	953.76882	350.42888	0
7	698	-66.601985	711.15245	507.55668	1166.2435	427.75625	0
8	698	-63.669975	710.61645	594.075	1357.1982	495.578	0
9	698	-60.737965	710.18775	673.92635	1528.0986	554.70598	0
10	698	-57.74899	710	739.73929	1604.399	561.51661	0
11	698	-54.70305	710	794.86188	1735.9513	611.15061	0
12	698	-51.657115	710	849.95164	1867.4707	660.78461	0
13	698	-48.61118	710	905.07423	1999.023	710.41861	0
14	698	-45.56524	710	960.164	2130.5424	760.05261	0
15	698	-42.5193	710	1015.2866	2262.0946	809.68661	0
16	698	-39.341945	710.21575	1059.2834	2258.7917	778.96978	0
17	698	-36.033175	710.71505	1087.9263	2299.7716	786.98158	0
18	698	-32.724405	711.35145	1108.0065	2322.7466	788.86141	0
19	698	-29.415635	712.12825	1119.3362	2327.9371	784.87461	0
20	698	-26.106865	713.04955	1121.6085	2315.3436	775.22061	0
21	698	-22.79809	714.1204	1114.5556	2284.9089	760.03632	0
22	698	-19.489315	715.34695	1097.7615	2236.5379	739.53007	0
23	698	-16.230565	716.7132	1071.3055	2165.9058	0	750
24	698	-13.021835	718.2229	1035.0065	2077.6615	0	750
25	698	-9.8131015	719.9047	987.96633	1968.729	0	750
26	698	-6.6043665	721.77075	929.37895	1837.9112	0	750
27	698	-3.3333335	723.88035	856.71535	1617.851	0	750
28	698	0	726.2616	768.18565	1307.7144	0	750
29	698	3.3333335	728.9048	663.30282	970.94155	0	750

30	698	6.8256585	732.00095	499.94706	550.84239	0	750
31	698	10.476974	735.63605	272.74794	42.366182	0	750

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 104
Last Edited By: Jacks, Jason
Date: 5/3/2010
Time: 5:03:29 PM
File Name: Cedar Rapids Sta144, LTD.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 5/3/2010
Last Solved Time: 5:03:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

OH

Model: Mohr-Coulomb
Unit Weight: 85 pcf
Cohesion: 0 psf
Phi: 23 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Bedrock

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-17, 736) ft
Left-Zone Right Coordinate: (5, 740) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (57, 722.66667) ft
Right-Zone Right Coordinate: (106, 718) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-109, 718) ft
Right Coordinate: (140, 718) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	718
	-71	718
	-59	722
	59	722
	71	718
	140	718

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.496	(66.674, 806.872)	37.56646	(4.86925, 740)	(79.5031, 718)

2	1280	1.549	(66.674, 806.872)	90.97	(5, 740)	(86.0971, 718)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	4.934625	739.95365	-1122.1085	4.215956	2.4340833	0
2	Optimized	6.261245	739.01325	-1063.3275	51.520185	29.745193	0
3	Optimized	8.657475	737.35725	-959.81905	132.02724	76.225963	0
4	Optimized	10.634825	736.0494	-878.09485	194.53278	112.31355	0
5	Optimized	12.372675	734.92525	-807.80771	245.96811	142.00976	0
6	Optimized	14.157085	733.82355	-738.95673	302.63976	174.72915	0
7	Optimized	16.317635	732.6283	-664.27546	360.4547	208.10862	0
8	Optimized	18.743855	731.28065	-580.03838	401.61678	231.87356	0
9	Optimized	21.447535	729.7461	-484.14557	470.99036	271.92641	0
10	Optimized	24.044915	728.3511	-396.94409	535.82909	309.36107	0
11	Optimized	26.29654	727.1177	-319.85869	563.14947	325.1345	0
12	Optimized	28.42808	725.8938	-243.36175	617.07111	356.26617	0
13	Optimized	30.42371	724.815	-175.933	676.24609	390.43086	0
14	Optimized	32.593185	723.71345	-107.08803	721.90528	416.79221	0
15	Optimized	34.84967	722.58195	-36.371709	758.1887	437.74045	0
16	Optimiz	36.146355	721.9283	4.4819475	780.91971	448.27655	0

	ed						
17	Optimized	37.41513	721.30965	43.149123	811.39677	443.54798	0
18	Optimized	40.27673	720.05395	121.63031	882.64875	439.3742	0
19	Optimized	43.08938	718.97095	189.31572	930.6456	428.007	0
20	Optimized	45.37328	718.2384	235.10111	953.7784	414.92853	0
21	Optimized	47.90539	717.54785	278.26046	959.88592	393.53664	0
22	Optimized	50.873195	716.896	319.00877	947.49163	362.85474	0
23	Optimized	54.023545	716.3767	351.46445	911.34289	323.24597	0
24	Optimized	56.727645	716.09535	369.0396	860.57651	283.78897	0
25	Optimized	58.46171	716.01255	374.21174	823.9309	259.64548	0
26	Optimized	59.74065	716.0098	358.95425	765.94728	234.97754	0
27	Optimized	62.215435	716.00575	307.64582	656.75319	201.55723	0
28	Optimized	64.897045	716.00245	251.99596	538.11418	165.19043	0
29	Optimized	66.71954	716.0008	214.12617	457.23448	140.35865	0
30	Optimized	67.667015	715.99995	194.44061	419.00378	145.83303	0
31	Optimized	68.80995	716.00935	170.04321	365.191	112.66863	0
32	Optimized	70.440215	716.09885	130.48195	305.1122	100.82282	0
33	Optimized	71.67093	716.27485	107.81904	240.65445	76.692563	0
34	Optimized	73.43672	716.55945	90.032557	172.08572	47.373417	0
35	Optimiz	74.60115	716.76225	77.362874	123.74821	26.780584	0

	ed						
36	Optimized	75.521095	716.94975	65.638278	100.79362	14.922556	0
37	Optimized	76.92756	717.23605	47.744715	73.28816	10.842549	0
38	Optimized	78.493365	717.6745	20.342575	33.336051	5.5154036	0

Slices of Slip Surface: 1280

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1280	6.3149345	738.8335	-1052.0932	60.880718	35.149499	0
2	1280	8.9448045	736.58695	-911.69138	180.92491	104.45705	0
3	1280	11.574675	734.50575	-781.60146	293.20265	169.28063	0
4	1280	14.204545	732.57595	-660.98992	397.47606	229.48291	0
5	1280	16.83441	730.786	-549.13631	493.59924	284.97965	0
6	1280	19.464275	729.1262	-445.37284	581.39308	335.66745	0
7	1280	22.094145	727.58835	-349.2773	660.70352	381.45735	0
8	1280	24.724015	726.16555	-260.34857	731.39848	422.27311	0
9	1280	27.353885	724.8517	-178.23063	793.2943	458.00868	0
10	1280	29.983755	723.64165	-102.60409	846.29498	488.60863	0
11	1280	32.613625	722.531	-33.188563	890.1643	513.9366	0
12	1280	35.321415	721.48855	31.96544	925.97335	516.15571	0
13	1280	38.10713	720.51635	92.727812	951.71426	495.93606	0
14	1280	40.892845	719.64395	147.25424	965.07897	472.17133	0
15	1280	43.67856	718.86835	195.73187	965.87821	444.6442	0
16	1280	46.46428	718.187	238.31616	953.89463	413.13942	0
17	1280	49.249995	717.59775	275.14238	928.83849	377.41163	0
18	1280	52.03571	717.09875	306.32718	890.45015	337.24355	0
19	1280	54.821425	716.68855	331.96413	838.2832	292.32345	0
20	1280	57.60714	716.366	352.12503	771.844	242.32486	0
21	1280	60.72865	716.11325	331.91802	682.6832	202.51437	0
22	1280	63.86277	715.95655	276.40869	584.22244	199.89659	0
23	1280	66.67371	715.9131	220.56315	475.14338	165.32633	0
24	1280	69.53959	715.95915	157.98014	347.23054	122.90064	0

25	1280	72.22233	716.0799	120.00949	246.42101	72.983725	0
26	1280	74.66699	716.2624	108.59945	185.11863	44.178368	0
27	1280	77.16529	716.51835	92.601026	136.17294	18.495181	0
28	1280	79.71723	716.8514	71.78735	107.05859	14.971754	0
29	1280	82.26917	717.25835	46.353794	70.14259	10.097745	0
30	1280	84.82111	717.7402	16.236634	24.947241	3.6974335	0

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 100
Last Edited By: Jacks, Jason
Date: 4/29/2010
Time: 4:07:54 PM
File Name: Cedar Rapids Sta230, Undrained, Flood.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 4/29/2010
Last Solved Time: 4:08:00 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Undrained (Phi=0)
Unit Weight: 125 pcf
Cohesion: 750 psf
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Sand)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

SP/SW

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

CL (soft)

Model: Undrained (Phi=0)
Unit Weight: 110 pcf
Cohesion: 250 psf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-74.56748, 722) ft
Left-Zone Right Coordinate: (-38, 722) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (-12.87457, 730.37514) ft
Right-Zone Right Coordinate: (21, 727.66667) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 722) ft
Right Coordinate: (140, 722) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	722
	-38	722
	5	733
	140	733

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.420	(-16.838, 753.379)	28.51451	(18.3363, 728.555)	(-46.4609, 722)
2	1073	1.487	(-16.838, 753.379)	42.374	(17.6639, 728.779)	(-45.3135, 722)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	-45.35545	721.3097	43.143862	94.313419	27.207336	0
2	Optimized	-42.735975	719.6811	144.93006	316.3371	91.138742	0
3	Optimized	-39.611	717.7494	265.65856	579.26563	166.74784	0
4	Optimized	-37.992515	716.7514	328.15837	715.68933	206.05387	0
5	Optimized	-37.398065	716.3734	361.28948	803.12106	234.92602	0
6	Optimized	-36.546405	715.8316	408.76651	909.75133	0	250
7	Optimized	-35.15646	714.93365	487.10831	1073.0178	0	250
8	Optimized	-33.02416	713.6481	601.56049	1286.7918	0	250
9	Optimized	-31.256695	712.73485	686.91178	1445.181	0	250
10	Optimized	-29.58968	712.05045	756.30322	1566.4021	0	250
11	Optimized	-27.495515	711.42765	828.72274	1697.0349	0	250
12	Optimized	-25.457	711.06795	883.80568	1780.0329	0	250
13	Optimized	-23.134755	711.00465	924.86551	1865.3295	0	250
14	Optimized	-20.465855	711.0059	967.47258	1976.4029	0	250
15	Optimized	-19.09583	711.0082	989.24545	2030.6862	0	250
16	Optimized	-17.40505	711.0051	1016.4532	2104.9574	0	250
17	Optimiz	-15.029895	711.00075	1054.6833	2203.3794	0	250

	ed						
18	Optimized	-13.3163	711.00185	1082.0526	2274.6915	0	250
19	Optimized	-11.346505	711.00355	1113.4367	2356.4785	0	250
20	Optimized	-9.354005	711.0959	1139.5348	2401.9461	0	250
21	Optimized	-7.50978	711.40825	1149.4845	2410.8662	0	250
22	Optimized	-5.77253	711.9176	1145.4349	2389.1071	0	250
23	Optimized	-4.637905	712.34085	1137.0998	2374.9576	0	250
24	Optimized	-3.385825	712.83055	1126.5128	2315.1835	0	250
25	Optimized	-1.60586	713.53985	1110.6547	2238.3234	0	250
26	Optimized	0.31949	714.30575	1093.5691	2155.6319	0	250
27	Optimized	2.513455	715.1944	1073.1009	2055.6262	0	250
28	Optimized	4.06565	715.82465	1058.5249	1993.2531	0	250
29	Optimized	4.729625	716.2619	1041.8048	1711.8141	356.25024	0
30	Optimized	5.823605	717.41265	974.21474	1588.3327	326.5323	0
31	Optimized	7.71876	719.31945	855.04106	1388.2658	283.52064	0
32	Optimized	9.078035	720.6165	773.97088	1252.4923	254.43437	0
33	Optimized	9.97631	721.43655	722.72755	1152.0671	228.28387	0
34	Optimized	11.097725	722.47145	658.03177	693.98732	0	750
35	Optimized	12.641085	723.85875	571.31264	513.92778	0	750
36	Optimiz	14.79704	725.71925	455.06044	268.98606	0	750

	ed						
37	Optimized	17.12839	727.60925	336.93247	22.23637	0	750

Slices of Slip Surface: 1073

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1073	-44.09458	720.9747	64.082361	148.03233	44.636988	0
2	1073	-41.656745	719.0677	183.26795	406.8448	118.87792	0
3	1073	-39.218915	717.42715	285.80274	614.91187	174.99043	0
4	1073	-37.3979	716.33415	363.7433	776.84636	219.6508	0
5	1073	-35.73594	715.4716	444.24029	946.4066	0	250
6	1073	-33.61622	714.486	539.73016	1132.3937	0	250
7	1073	-31.4965	713.63785	626.6028	1303.2205	0	250
8	1073	-29.37678	712.91845	705.48517	1459.9073	0	250
9	1073	-27.25706	712.321	776.71164	1603.0823	0	250
10	1073	-25.13734	711.84025	840.61992	1733.2842	0	250
11	1073	-23.01762	711.4722	897.5351	1850.9824	0	250
12	1073	-20.8979	711.21385	947.58176	1956.4448	0	250
13	1073	-18.77818	711.0632	990.88196	2049.9089	0	250
14	1073	-16.65846	711.01905	1027.5322	2131.3945	0	250
15	1073	-14.53874	711.0811	1057.5416	2201.0054	0	250
16	1073	-12.41902	711.24985	1080.8658	2258.5717	0	250
17	1073	-10.2993	711.5266	1097.4956	2303.967	0	250
18	1073	-8.17958	711.9135	1107.1684	2336.8526	0	250
19	1073	-6.05986	712.41365	1109.8367	2356.8632	0	250
20	1073	-3.984911	713.0157	1105.3606	2321.7688	0	250
21	1073	-1.9547333	713.71985	1093.8369	2231.6689	0	250
22	1073	0.0754442	714.54285	1074.8561	2128.1707	0	250
23	1073	2.105622	715.49245	1047.9314	2010.437	0	250
24	1073	4.0603555	716.53295	1014.1578	1817.3933	427.08791	0
25	1073	6.1064005	717.77895	951.31916	1650.4119	371.71419	0
26	1073	8.3192015	719.30895	855.68679	1434.8577	307.95065	0
27	1073	10.532001	721.06295	746.05634	1201.47	242.14776	0
28	1073	12.642645	722.9737	626.65547	600.99015	0	750

29	1073	14.65113	725.0642	495.99779	235.66803	0	750
30	1073	16.659615	727.47985	345.01588	-184.18409	0	750

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 109
Last Edited By: Jacks, Jason
Date: 5/3/2010
Time: 5:07:14 PM
File Name: Cedar Rapids Sta230, LTD.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 5/3/2010
Last Solved Time: 5:07:22 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Sand)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

SP/SW

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

CL (soft)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-8.5, 731.83333) ft
Left-Zone Right Coordinate: (5, 733) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (27.5, 725.5) ft
Right-Zone Right Coordinate: (56.5, 722) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 722) ft
Right Coordinate: (140, 722) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	722
	140	722

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.672	(32.349, 750.885)	21.33762	(3.89897, 733)	(46.7757, 722)
2	1293	1.704	(32.349,	32.678	(5, 733)	(47.6296,

			750.885)			722)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	4.2479245	732.5734	-660.84131	32.311325	18.654952	0
2	Optimized	4.79844	731.9156	-619.72171	84.478755	48.773832	0
3	Optimized	5.16929	731.49025	-593.13551	113.21767	65.366252	0
4	Optimized	6.00899	730.646	-540.35271	168.46668	97.264284	0
5	Optimized	7.435305	729.34425	-459.0138	248.25882	143.3323	0
6	Optimized	8.740985	728.2461	-390.38238	312.73937	180.56016	0
7	Optimized	9.80805	727.3907	-336.91541	360.67207	208.23412	0
8	Optimized	10.996715	726.47985	-279.99103	414.74652	239.45401	0
9	Optimized	12.30501	725.55325	-222.07939	476.86978	275.32089	0
10	Optimized	13.30317	724.88505	-180.31979	507.01386	292.72459	0
11	Optimized	14.39584	724.19285	-137.05247	553.5941	319.6177	0
12	Optimized	15.77269	723.33875	-83.673472	588.04312	339.50686	0
13	Optimized	16.929535	722.6261	-39.131287	627.79183	362.45578	0
14	Optimized	17.724405	722.15945	-9.965075	659.55682	380.79531	0
15	Optimized	18.22278	721.8791	7.5563513	675.03918	354.90692	0
16	Optimized	19.2255	721.3743	39.106824	714.83507	359.29108	0

17	Optimized	20.90625	720.6073	87.045969	752.67285	353.92009	0
18	Optimized	22.45999	719.9836	126.0221	783.40752	349.53803	0
19	Optimized	23.93898	719.4836	157.27277	797.81022	340.5798	0
20	Optimized	25.580825	719.00465	187.20781	804.79121	328.37492	0
21	Optimized	27.260665	718.60575	212.14246	803.45043	314.40402	0
22	Optimized	28.69832	718.33245	229.22271	793.54421	300.05506	0
23	Optimized	29.824145	718.1687	239.4531	777.74883	286.21692	0
24	Optimized	31.280255	718.038	247.62398	753.47642	268.96651	0
25	Optimized	33.20696	717.99255	250.46622	702.74765	240.4823	0
26	Optimized	35.09661	718.1088	243.20021	633.86744	207.72145	0
27	Optimized	36.549685	718.3394	228.79425	566.1867	179.39475	0
28	Optimized	37.56404	718.60795	212.00484	503.16587	154.81307	0
29	Optimized	38.015315	718.75155	203.02511	458.15277	135.65378	0
30	Optimized	38.86811	719.04715	184.55098	423.74363	127.18099	0
31	Optimized	40.42991	719.59185	150.51235	346.31846	104.11195	0
32	Optimized	42.14883	720.212	111.75301	259.93931	78.792057	0
33	Optimized	44.08691	720.93745	66.409889	155.69105	47.471635	0
34	Optimized	45.903045	721.64835	21.977689	52.256998	16.099794	0

Slices of Slip Surface: 1293

	Slip	X (ft)	Y (ft)	PWP (psf)	Base	Frictional	Cohesiv

	Surface				Normal Stress (psf)	Strength (psf)	e Strength (psf)
1	1293	5.7542645	731.9411	-621.31246	57.554571	33.229147	0
2	1293	7.2627935	729.9772	-498.59182	173.85355	100.3744	0
3	1293	8.7713225	728.2853	-392.82783	281.19222	162.3464	0
4	1293	10.279854	726.80705	-300.44015	379.27393	218.97391	0
5	1293	11.788385	725.50465	-219.04081	468.12666	270.27306	0
6	1293	13.29691	724.352	-146.99951	547.8828	316.32028	0
7	1293	14.805435	723.33015	-83.13338	618.67741	357.19357	0
8	1293	16.313965	722.42495	-26.560908	680.68463	392.99346	0
9	1293	17.765955	721.65195	21.753837	734.61845	379.03684	0
10	1293	19.161405	720.99605	62.748608	771.6793	376.94514	0
11	1293	20.55686	720.41815	98.868631	800.29191	372.95338	0
12	1293	21.952315	719.91385	130.38238	820.52857	366.95724	0
13	1293	23.347765	719.47965	157.52561	832.57729	358.93135	0
14	1293	24.743215	719.11265	180.46146	836.448	348.79423	0
15	1293	26.138665	718.8105	199.34317	832.08571	336.43518	0
16	1293	27.534115	718.57145	214.28111	819.43103	321.76392	0
17	1293	28.929565	718.39405	225.3702	798.27076	304.61663	0
18	1293	30.325015	718.2773	232.66676	768.37964	284.84359	0
19	1293	31.72047	718.2206	236.2097	729.5217	262.29864	0
20	1293	33.115925	718.2236	236.03059	681.13303	236.66516	0
21	1293	34.511375	718.28625	232.10999	622.78069	207.72329	0
22	1293	35.906825	718.40895	224.44064	553.7537	175.09886	0
23	1293	37.302275	718.5924	212.97348	473.22089	138.376	0
24	1293	38.68783	718.83545	197.78109	416.39925	116.24134	0
25	1293	40.06349	719.13865	178.83102	385.71895	110.00426	0
26	1293	41.43915	719.50505	155.93307	345.1921	100.63081	0
27	1293	42.814805	719.93695	128.94292	293.61111	87.555632	0
28	1293	44.19046	720.4371	97.680677	229.43238	70.053626	0
29	1293	45.56612	721.0089	61.945703	150.57812	47.126693	0
30	1293	46.94178	721.6566	21.463501	54.227175	17.420755	0

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 82
Last Edited By: Jacks, Jason
Date: 4/27/2010
Time: 2:11:04 PM
File Name: Cedar Rapids Sta265, EOC.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 4/27/2010
Last Solved Time: 2:11:14 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Undrained (Phi=0)
Unit Weight: 125 pcf
Cohesion: 750 psf
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Clay)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 500 psf
Pore Water Pressure
Piezometric Line: 1

SW

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Sand)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-26, 722) ft
Left-Zone Right Coordinate: (18, 724.66667) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (68, 708.875) ft
Right-Zone Right Coordinate: (140, 694) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 714) ft
Right Coordinate: (140, 694) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	701
	140	701

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	2.007	(96.96, 882.445)	60.11305	(-6.99107, 728.336)	(120.549, 695.558)
2	564	2.077	(96.96, 882.445)	187.242	(-8.60527, 727.798)	(118.132, 696.404)

Slices of Slip Surface: Optimized

	Slip	X (ft)	Y (ft)	PWP (psf)	Base	Frictional	Cohesi

	Surface				Normal Stress (psf)	Strength (psf)	ve Strength (psf)
1	Optimized	-5.9955335	727.4078	-1650.4815	-95.443427	0	750
2	Optimized	-4.617505	726.12255	-1570.1536	74.124633	0	750
3	Optimized	-2.02825	723.81395	-1425.863	334.08455	0	750
4	Optimized	1.46996	720.8191	-1238.6981	684.24328	0	750
5	Optimized	3.880705	718.9987	-1124.9312	978.54079	0	500
6	Optimized	5.622845	717.7887	-1049.2614	1074.1182	0	500
7	Optimized	7.122845	716.89685	-993.53751	1179.4786	0	500
8	Optimized	9.36381	715.7236	-920.21939	1215.0391	0	500
9	Optimized	13.076175	714.23575	-827.23588	1321.0782	0	500
10	Optimized	16.029245	713.23095	-764.43805	1288.7564	0	500
11	Optimized	17.03589	712.84635	-740.3941	1276.3653	678.65548	0
12	Optimized	18.71901	712.08805	-692.99406	1244.6926	661.81479	0
13	Optimized	21.16153	710.9351	-620.93498	1274.4135	677.61767	0
14	Optimized	23.889955	709.6934	-543.34441	1322.8773	703.38634	0
15	Optimized	26.4149	708.57605	-473.50378	1350.3317	717.98411	0
16	Optimized	29.686475	707.18765	-386.73534	1394.637	741.54165	0
17	Optimized	32.401545	706.0558	-315.98422	1417.4638	753.6789	0
18	Optimiz	35.12735	704.9947	-249.66202	1452.1921	772.14421	0

	ed						
19	Optimized	38.99555	703.4917	-155.7314	1467.816	780.45159	0
20	Optimized	40.769745	702.7963	-112.26878	1491.1476	792.85724	0
21	Optimized	42.700215	702.07425	-67.13942	1497.2022	796.07652	0
22	Optimized	45.05126	701.21915	-13.697413	1525.551	811.14983	0
23	Optimized	45.851045	700.94985	3.1349312	1525.0131	809.19697	0
24	Optimized	47.08974	700.53275	29.204336	1524.8766	795.26308	0
25	Optimized	49.590995	699.70025	81.235009	1527.9502	769.2321	0
26	Optimized	53.66361	698.57185	151.75883	1552.1746	744.61429	0
27	Optimized	58.33087	697.55735	215.16642	1535.0689	701.80458	0
28	Optimized	62.115195	696.99135	250.53942	1486.1794	657.00141	0
29	Optimized	64.44668	696.7302	266.85816	1445.628	626.76304	0
30	Optimized	66	696.59885	275.06828	1438.4661	618.5896	0
31	Optimized	67.288305	696.48995	281.87152	1446.7538	619.37891	0
32	Optimized	69.45281	696.3106	293.0802	1436.9296	608.19551	0
33	Optimized	73.205215	696.00065	312.46838	1417.7008	587.66249	0
34	Optimized	75.46251	695.81775	323.88274	1411.0987	578.08297	0
35	Optimized	77.7423	695.60405	337.2531	1388.2206	558.80931	0
36	Optimized	81.5397	695.23255	360.47398	1375.588	539.74569	0
37	Optimiz	84.70857	694.9322	379.23969	1368.1186	525.79626	0

	ed						
38	Optimized	88.48937	694.5584	402.59892	1348.9431	503.18013	0
39	Optimized	91.464595	694.2512	421.80456	1329.6874	482.72989	0
40	Optimized	93.991145	694.103	431.07175	1275.8978	449.20197	0
41	Optimized	98.15705	694.0112	436.79808	1144.6106	376.35059	0
42	Optimized	101.6305	694.02595	435.87787	1002.0189	301.02254	0
43	Optimized	103.4394	694.03435	435.34885	918.58175	256.93949	0
44	Optimized	104.4394	694.0931	431.68264	881.40529	239.12178	0
45	Optimized	106.59925	694.31155	418.03092	788.84322	197.1644	0
46	Optimized	109.82715	694.63985	397.49804	688.5283	154.74353	0
47	Optimized	113.1278	694.95165	378.02357	585.55073	110.34415	0
48	Optimized	116.47185	695.2422	359.85079	488.07315	68.177035	0
49	Optimized	119.3463	695.4727	345.45392	404.86433	31.589075	0

Slices of Slip Surface: 564

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	564	-6.8026335	726.59805	-1599.8823	39.212644	0	750
2	564	-2.7777872	723.99905	-1437.4348	414.27004	0	750
3	564	1.6666383	721.2862	-1267.8807	738.64158	0	750
4	564	4.4444255	719.65645	-1165.9905	975.85785	0	500
5	564	6.5	718.513	-1094.5763	1040.526	0	500
6	564	10.321355	716.4735	-967.09963	1117.7716	0	500
7	564	14.96407	714.13085	-820.68777	1201.8023	0	500

8	564	18.642715	712.37495	-710.94155	1236.8449	657.64209	0
9	564	21.60396	711.04475	-627.80604	1276.8719	678.92482	0
10	564	24.81188	709.6698	-541.85645	1318.2959	700.95034	0
11	564	29.20792	707.9161	-432.25898	1362.3178	724.3572	0
12	564	34.25	706.0324	-314.5194	1400.251	744.52667	0
13	564	38.75	704.4966	-218.53803	1419.156	754.57865	0
14	564	43.5	703.0157	-125.98113	1421.1811	755.65537	0
15	564	48.364215	701.6354	-39.71418	1405.6308	747.38714	0
16	564	53.107025	700.42695	35.816254	1375.8175	712.49128	0
17	564	57.864215	699.346	103.37501	1330.4759	652.46109	0
18	564	62.621405	698.3943	162.85491	1268.6193	587.94534	0
19	564	66	697.78285	201.06868	1254.5404	560.14084	0
20	564	69	697.31315	230.4269	1286.8567	561.7137	0
21	564	73	696.75305	265.42463	1303.7916	552.10949	0
22	564	77	696.28055	294.95951	1310.6135	540.03283	0
23	564	81	695.895	319.05948	1307.1749	525.39029	0
24	564	85	695.5959	337.75878	1293.4031	508.12507	0
25	564	89	695.3828	351.08227	1269.1764	488.15931	0
26	564	93	695.2554	359.04466	1184.7849	439.05387	0
27	564	97	695.2135	361.65	1038.675	359.98058	0
28	564	101	695.25705	358.94137	879.72003	276.90292	0
29	564	104	695.33785	353.88463	732.48177	201.30367	0
30	564	107.18875	695.49525	344.04653	616.12682	144.66766	0
31	564	111.5662	695.78625	325.86065	504.45997	94.962947	0
32	564	115.94365	696.1806	301.21844	378.148	40.904174	0

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 85
Last Edited By: Jacks, Jason
Date: 4/27/2010
Time: 2:37:19 PM
File Name: Cedar Rapids Sta265, Undrained, Flood.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 4/27/2010
Last Solved Time: 2:37:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Undrained (Phi=0)
Unit Weight: 125 pcf
Cohesion: 750 psf
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Clay)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 500 psf
Pore Water Pressure
Piezometric Line: 1

SW

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Sand)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-110, 714) ft
Left-Zone Right Coordinate: (-50, 714) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (-5, 729) ft
Right-Zone Right Coordinate: (31, 720.33333) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 714) ft
Right Coordinate: (140, 694) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	714
	-50	714
	-5	729
	5	729
	140	729

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.596	(-32.842, 756.468)	33.34515	(11.0436, 726.986)	(-60.54, 714)
2	1018	1.626	(-32.842,	51.514	(9.7079,	(-62, 714)

			756.468)		727.431)	

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	-59.961925	713.5	31.249755	383.59941	0	500
2	Optimized	-59.13009	712.78055	76.216634	190.4298	60.728219	0
3	Optimized	-57.985625	712.06035	121.22947	267.36542	77.701862	0
4	Optimized	-56.204175	711.0589	183.81862	405.40798	117.82116	0
5	Optimized	-54.09213	709.884	257.25041	565.28784	163.78641	0
6	Optimized	-52.67568	709.1049	305.9503	668.82054	192.94153	0
7	Optimized	-51.240275	708.33325	354.17338	774.2494	223.35838	0
8	Optimized	-49.88696	707.6057	401.98162	879.31045	253.80024	0
9	Optimized	-48.002065	706.8041	491.35936	1039.6834	291.54906	0
10	Optimized	-44.753895	705.64505	631.47886	1291.5028	350.94096	0
11	Optimized	-41.916835	704.99335	731.29817	1455.7154	385.17948	0
12	Optimized	-39.023625	704.599	816.24799	1602.5458	418.08196	0
13	Optimized	-35.9045	704.38855	894.36874	1729.5224	444.05906	0
14	Optimized	-32.661125	704.42155	959.86728	1826.3522	460.71819	0
15	Optimized	-30.502205	704.5573	996.41493	1875.3075	467.31549	0
16	Optimized	-29.50769	704.6626	1010.4835	1903.0015	474.56023	0

17	Optimized	-27.995395	704.8523	1030.1405	1926.443	476.57245	0
18	Optimized	-25.75924	705.20625	1054.6384	1952.6293	477.47023	0
19	Optimized	-23.1469	705.74055	1075.6544	1969.7343	475.39072	0
20	Optimized	-20.47224	706.42225	1088.7543	1970.057	468.59695	0
21	Optimized	-17.809775	707.2551	1092.2001	1955.018	458.7684	0
22	Optimized	-15.7129	708.03205	1087.338	1911.3891	438.15575	0
23	Optimized	-14.23567	708.66995	1078.1935	1898.1443	435.97555	0
24	Optimized	-13.10227	709.1594	1071.2384	1888.877	434.74616	0
25	Optimized	-11.556775	709.9168	1056.1036	1839.079	416.31538	0
26	Optimized	-9.449225	711.0525	1029.0352	1775.2473	396.76801	0
27	Optimized	-7.4208775	712.2951	993.61527	1700.8319	376.03377	0
28	Optimized	-6.0041275	713.20525	966.25449	1615.6684	0	500
29	Optimized	-5.3423	713.6418	952.74842	1579.563	0	500
30	Optimized	-4.46019	714.2379	922.64785	1527.7182	0	500
31	Optimized	-3.00674	715.27115	858.03642	1391.5763	0	500
32	Optimized	-1.010795	716.72675	767.06095	1234.4484	0	500
33	Optimized	1.602945	718.68545	644.6522	1003.3859	0	500
34	Optimized	4.06719	720.7853	513.41419	552.13018	0	750
35	Optimized	5.01569	721.7292	454.43436	443.0272	0	750

36	Optimized	6.443445	723.08685	369.56987	278.71096	0	750
37	Optimized	9.449575	725.7072	205.80244	-19.62052	0	750

Slices of Slip Surface: 1018

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1018	-61.24356	713.5	31.249966	297.87053	0	500
2	1018	-59.215045	712.24145	109.90988	241.72612	70.087938	0
3	1018	-56.67089	710.81885	198.82122	426.598	121.11106	0
4	1018	-54.126735	709.5774	276.41125	580.42462	161.64677	0
5	1018	-51.42733	708.4476	347.01067	714.17814	195.22641	0
6	1018	-48.75	707.4892	432.97553	880.10333	237.74207	0
7	1018	-46.25	706.74615	531.49541	1072.4142	287.61163	0
8	1018	-43.75	706.1382	621.57013	1243.3748	330.61941	0
9	1018	-41.25	705.6604	703.51251	1394.6335	367.47557	0
10	1018	-38.75	705.3092	777.5527	1527.5287	398.76929	0
11	1018	-36.25	705.082	843.82662	1643.0312	424.94464	0
12	1018	-33.75	704.97705	902.45994	1741.9696	446.37523	0
13	1018	-31.25	704.99365	953.50384	1824.927	463.34389	0
14	1018	-28.75	705.13195	996.95725	1889.0073	474.31143	0
15	1018	-26.25	705.39295	1032.713	1934.5914	479.53724	0
16	1018	-23.75	705.7785	1060.7106	1965.2734	480.96458	0
17	1018	-21.25	706.2915	1080.7322	1980.9786	478.66952	0
18	1018	-18.75	706.93595	1092.5606	1981.5983	472.7097	0
19	1018	-16.25	707.71705	1095.7906	1966.8415	463.14599	0
20	1018	-13.91502	708.57125	1091.0547	1941.2433	452.0533	0
21	1018	-11.557965	709.5774	1077.277	1901.9402	438.48122	0
22	1018	-9.013812	710.81885	1052.7141	1842.9117	420.15553	0
23	1018	-6.4696575	712.24145	1016.7939	1764.9656	397.80999	0
24	1018	-5.0987905	713.06315	994.01052	1679.1439	0	500
25	1018	-3.75	713.98225	938.59542	1562.8955	0	500
26	1018	-1.25	715.8095	824.41619	1325.7115	0	500
27	1018	1.69362	718.3138	667.89733	1002.3166	0	500

28	1018	4.19362	720.68135	519.91574	554.47051	0	750
29	1018	6.176975	722.88335	382.29944	219.13975	0	750
30	1018	8.5309255	725.84075	197.45343	-244.75935	0	750

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 87
Last Edited By: Jacks, Jason
Date: 4/27/2010
Time: 2:21:21 PM
File Name: Cedar Rapids Sta265, LTD.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 4/27/2010
Last Solved Time: 2:21:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Clay)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

SW

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Sand)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-12, 726.66667) ft
Left-Zone Right Coordinate: (22, 723.33333) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (65, 709) ft
Right-Zone Right Coordinate: (125, 694) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 714) ft
Right Coordinate: (140, 694) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	701
	140	701

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.646	(83.965, 865.467)	29.92206	(5.01204, 728.996)	(65, 709)
2	607	1.654	(83.965,	157.612	(5.25659,	(65,

			865.467)		728.914)	709)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	6.363053	728.3168	-1707.2959	23.35219	13.482393	0
2	Optimized	8.476805	727.2429	-1640.2061	60.547842	34.957313	0
3	Optimized	10.002275	726.45345	-1590.8363	88.987861	51.377166	0
4	Optimized	12.142005	725.34595	-1521.6092	128.89145	74.415515	0
5	Optimized	14.49397	724.09695	-1443.5497	172.91141	99.830451	0
6	Optimized	16.28586	723.1059	-1381.6353	211.31491	122.00272	0
7	Optimized	17.919695	722.1963	-1324.7891	247.48684	142.88659	0
8	Optimized	19.759615	721.2403	-1265.0244	291.83519	168.49113	0
9	Optimized	21.22593	720.5219	-1220.0799	316.07017	168.05749	0
10	Optimized	22.75088	719.91585	-1182.2526	349.59057	185.88061	0
11	Optimized	24.91416	719.13815	-1133.619	355.36307	188.9499	0

				2			
12	Optimized	27.125045	718.3643	-1085.272	362.98106	193.00045	0
13	Optimized	29.38354	717.59435	-1037.1567	364.74824	193.94008	0
14	Optimized	31.256395	716.9647	-997.79262	367.82026	195.5735	0
15	Optimized	32.707825	716.4871	-967.91163	367.17568	195.23077	0
16	Optimized	34.273405	715.9878	-936.74273	368.80174	196.09536	0
17	Optimized	35.98891	715.455	-903.45265	364.7045	193.91682	0
18	Optimized	38.195445	714.78455	-861.53293	360.18831	191.51552	0
19	Optimized	40.272115	714.1647	-822.77506	353.21437	187.80741	0
20	Optimized	41.584835	713.7755	-798.46556	347.3799	184.70517	0
21	Optimized	43.254135	713.30105	-768.82957	340.46009	181.02584	0
22	Optimized	44.80922	712.86935	-741.83141	329.25583	175.06843	0
23	Optimized	45.63992	712.64405	-727.75164	325.58194	173.11499	0
24	Optimized	46.78649	712.3426	-708.90982	315.50484	167.7569	0

25	Optimized	48.713725	711.83855	-677.4035	298.77265	158.86024	0
26	Optimized	51.308855	711.1802	-636.25368	275.49194	146.48166	0
27	Optimized	53.55455	710.64745	-602.96785	254.2387	135.18112	0
28	Optimized	55.13717	710.30415	-581.50959	231.90359	123.30532	0
29	Optimized	56.95932	709.95775	-559.84754	206.8667	109.99298	0
30	Optimized	59.021	709.6082	-537.99307	165.72099	88.115416	0
31	Optimized	61.0109	709.28705	-517.95633	125.51035	66.735039	0
32	Optimized	62.727465	709.10555	-506.59911	83.98153	44.653772	0
33	Optimized	64.242475	709.0352	-502.20124	27.994063	14.884707	0

Slices of Slip Surface: 607

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	607	6.220724	728.36775	-1710.4894	22.634651	13.068122	0
2	607	8.1490025	727.292	-1643.2543	66.679488	38.49742	0
3	607	10.077281	726.2513	-	107.87276	62.280364	0

				1578.2156			
4	607	12.00556	725.2448	-1515.2955	146.2005	84.4089	0
5	607	13.93384	724.2718	-1454.4943	181.64569	104.87319	0
6	607	15.86212	723.33165	-1395.7099	214.19936	123.66806	0
7	607	17.7904	722.42365	-1338.967	243.84561	140.78433	0
8	607	19.718675	721.5472	-1284.1871	270.56579	156.21123	0
9	607	21.64695	720.7018	-1231.3788	294.34293	169.93897	0
10	607	23.57523	719.88685	-1180.4453	315.16544	181.96085	0
11	607	25.47195	719.11415	-1132.1273	333.70872	177.43607	0
12	607	27.33711	718.38235	-1086.4023	347.14039	184.57782	0
13	607	29.202265	717.67775	-1042.3375	357.96323	190.33242	0
14	607	31.06742	716.99995	-999.99697	366.15041	194.68562	0
15	607	32.9	716.35945	-959.98646	371.64327	197.60623	0
16	607	34.7	715.75505	-922.1874	374.511	199.13103	0

				3			
17	607	36.5	715.17465	-885.92433	374.8769	199.32558	0
18	607	38.3	714.61795	-851.1342	372.72946	198.18377	0
19	607	40.1	714.08475	-817.80407	368.04385	195.69239	0
20	607	41.7556	713.61395	-788.39907	360.63233	191.75161	0
21	607	43.2668	713.20195	-762.6014	350.85801	186.55452	0
22	607	45.0112	712.7478	-734.2295	337.1184	179.24903	0
23	607	46.95	712.26605	-704.10862	319.22012	169.73235	0
24	607	48.85	711.8194	-676.19708	298.74992	158.84815	0
25	607	50.75	711.3975	-649.85947	275.26547	146.36124	0
26	607	52.65	711.0001	-625.02224	248.74513	132.26013	0
27	607	54.55	710.62705	-601.71253	219.14911	116.52365	0
28	607	56.45	710.27815	-579.90332	186.43969	99.131744	0
29	607	58.35	709.9532	-559.56556	150.58156	80.065635	0
30	607	60.25	709.65215	-540.7725	111.53142	59.302306	0

				8			
31	607	62.15	709.3748	-523.43904	69.253247	36.822605	0
32	607	64.05	709.121	-507.56206	23.688074	12.595172	0

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 123
Last Edited By: Jacks, Jason
Date: 4/29/2010
Time: 5:33:32 PM
File Name: Copy of Cedar Rapids Floodwall Setback, LTD, (Phi 28).gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 4/29/2010
Last Solved Time: 5:33:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
FOS Distribution
    FOS Calculation Option: Constant
Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Non-Levee Fill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-46, 714) ft
Left-Zone Right Coordinate: (-21.04582, 714) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (16.65837, 701.85214) ft
Right-Zone Right Coordinate: (66, 694) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 714) ft
Right Coordinate: (140, 694) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	701
	140	701

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.480	(30.038, 766.705)	32.01789	(-21.0458, 714)	(41.0198, 694)
2	1269	1.490	(30.038, 766.705)	73.399	(-21.0458, 714)	(40.7255, 694.088)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	-21.02291	713.9772	-811.07982	1.7612656	0.93648151	0
2	Optimized	-20.381595	713.3396	-771.23977	35.638376	18.94926	0
3	Optimized	-18.791795	711.98665	-686.66682	110.44455	58.724408	0
4	Optimized	-16.755735	710.50205	-593.88237	185.25946	98.504201	0
5	Optimized	-14.63127	709.0362	-502.2607	255.62325	135.9173	0
6	Optimiz	-12.91194	707.8763	-429.76825	310.26455	164.97059	0

	ed						
7	Optimized	-11.360965	706.80965	-363.1037	354.95221	188.73144	0
8	Optimized	-9.611085	705.61965	-288.72747	417.48839	221.98251	0
9	Optimized	-8.475215	704.8969	-243.55865	466.19259	247.879	0
10	Optimized	-6.94267	704.04205	-190.12713	503.53797	267.73589	0
11	Optimized	-4.59193	702.6885	-105.53088	547.41455	291.06548	0
12	Optimized	-2.805265	701.6156	-38.474729	592.34921	314.95766	0
13	Optimized	-1.941766	701.10015	-6.2590445	619.51127	329.39999	0
14	Optimized	-1.173466	700.654	21.623983	639.99675	328.79463	0
15	Optimized	0.22457	699.8753	70.292735	687.18362	328.0067	0
16	Optimized	2.11114	698.8981	131.37031	738.7494	322.94919	0
17	Optimized	4.46611	697.8003	199.98391	797.78531	317.85664	0
18	Optimized	6.88348	696.8083	261.98412	840.10515	307.3924	0
19	Optimized	9.006195	696.0367	310.20555	865.19485	295.09305	0
20	Optimized	11.11823	695.39145	350.53302	885.38199	284.38424	0
21	Optimized	13.273005	694.84965	384.39494	886.5643	267.00819	0
22	Optimized	14.96861	694.48345	407.28529	874.60559	248.47861	0
23	Optimized	16.542105	694.21755	423.89923	866.72036	235.45217	0
24	Optimized	18.034195	694.0442	434.73783	853.96875	222.90903	0
25	Optimiz	18.964855	693.9751	439.06221	826.28976	205.89254	0

	ed						
26	Optimized	19.540165	693.9324	441.72962	814.50906	198.21034	0
27	Optimized	21.32474	693.8459	447.14011	804.85221	190.19889	0
28	Optimized	24.137575	693.7341	454.11998	774.84442	170.53221	0
29	Optimized	26.929645	693.6564	458.97836	740.9597	149.93214	0
30	Optimized	29.68803	693.6077	462.01047	703.66503	128.49001	0
31	Optimized	32.470335	693.60205	462.36466	661.57789	105.92355	0
32	Optimized	35.50615	693.6617	458.65691	608.81165	79.83869	0
33	Optimized	38.026535	693.7679	452.00777	555.7762	55.174654	0
34	Optimized	40.029335	693.91055	443.09223	508.81552	34.945692	0
35	Optimized	41.00989	693.9991	437.55588	447.28729	5.174281	0

Slices of Slip Surface: 1269

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1269	-21.02291	713.9778	-811.11759	1.732577	0.92122755	0
2	1269	-19.98202	713.00735	-750.45697	52.615728	27.976279	0
3	1269	-17.946055	711.1794	-636.22617	149.30504	79.386897	0
4	1269	-15.91009	709.48225	-530.12404	239.80051	127.50419	0
5	1269	-13.874125	707.9046	-431.55372	324.04308	172.29676	0
6	1269	-11.83816	706.43705	-339.81622	402.00178	213.74814	0
7	1269	-9.802198	705.0717	-254.48307	473.66504	251.85217	0
8	1269	-7.766234	703.8019	-175.11865	538.99176	286.587	0
9	1269	-5.73027	702.6219	-101.36672	597.99291	317.95847	0
10	1269	-3.694306	701.52685	-32.927803	650.65192	345.95776	0
11	1269	-1.6774004	700.5213	29.917956	698.92823	355.71907	0

12	1269	0.3204471	699.60025	87.483198	741.97102	347.99735	0
13	1269	2.318295	698.7504	140.60068	777.36597	338.57411	0
14	1269	4.3161425	697.9691	189.42869	805.28758	327.45798	0
15	1269	6.31399	697.25405	234.11881	825.74165	314.57144	0
16	1269	8.311838	696.60325	274.79481	838.7371	299.85343	0
17	1269	10.309686	696.0149	311.57193	844.32878	283.27184	0
18	1269	12.307535	695.4874	344.53515	842.51653	264.7814	0
19	1269	14.30538	695.0195	373.78092	833.18829	244.27123	0
20	1269	16.303225	694.60995	399.37968	816.31288	221.68732	0
21	1269	18.301075	694.2578	421.38529	791.83911	196.97379	0
22	1269	19.63518	694.048	434.49678	779.06406	183.20967	0
23	1269	20.977125	693.87475	445.32619	783.12434	179.61046	0
24	1269	22.990655	693.6524	459.22713	784.72394	173.06972	0
25	1269	25.004185	693.48605	469.62218	779.47482	164.75157	0
26	1269	27.017715	693.37535	476.53972	767.30467	154.60247	0
27	1269	29.031245	693.3201	479.9977	748.01934	142.50963	0
28	1269	31.04477	693.3201	479.9977	721.30259	128.30409	0
29	1269	33.058295	693.37535	476.53972	687.01631	111.91239	0
30	1269	35.071825	693.48605	469.62218	644.80583	93.146797	0
31	1269	37.085355	693.6524	459.22713	594.40094	71.873192	0
32	1269	39.098885	693.87475	445.32619	535.37317	47.878827	0
33	1269	40.415595	694.04425	434.72901	492.69926	30.823332	0

SLOPE/W

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File Information

Title: Cedar Rapids
Created By: JRJ
Revision Number: 86
Last Edited By: Jacks, Jason
Date: 5/10/2010
Time: 4:32:20 PM
File Name: Cedar Rapids Sta265, RD.gsz
Directory: \\mnp-fs1\Mnp-Projects-1\19651.02\Active\Cedar_Rapids\Stability Comps\
Last Solved Date: 5/10/2010
Last Solved Time: 4:32:26 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.5 pcf
View: 2D

Analysis Settings

SLOPE/W

Kind: SLOPE/W
Method: Spencer
Settings
    Apply Phreatic Correction: No
    PWP Conditions Source: Piezometric Line
    Use Staged Rapid Drawdown: No
SlipSurface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: Yes
    Tension Crack
        Tension Crack Option: (none)
FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 16
Ending Optimization Points: 40
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Levee Fill

Model: Undrained (Phi=0)
Unit Weight: 125 pcf
Cohesion: 750 psf
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Clay)

Model: Undrained (Phi=0)
Unit Weight: 115 pcf
Cohesion: 500 psf
Pore Water Pressure
Piezometric Line: 1

SW

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Non-Levee Fill (Sand)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-26, 722) ft
Left-Zone Right Coordinate: (18, 724.66667) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (68, 708.875) ft
Right-Zone Right Coordinate: (140, 694) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-110, 714) ft
Right Coordinate: (140, 694) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	-110	714
	-50	714
	-5	729
	5	729
	50	714
	65	709
	67	709
	91	706
	103	702
	105	701
	140	701

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Levee Fill	1,2,3,4,5,6,7,8,9,10,11,12	544
Region 2	Non-Levee Fill (Clay)	12,11,10,9,8,7,6,5,13,14,1	456.5
Region 3	Non-Levee Fill (Sand)	13,5,4,15	662
Region 4	Non-Levee Fill (Sand)	15,4,16,17,18,19,20,21	3184
Region 5	SW	21,20,22,23,24	1250

Points

	X (ft)	Y (ft)
Point 1	-50	714
Point 2	-5	729
Point 3	5	729
Point 4	65	709
Point 5	46	713
Point 6	41	714
Point 7	32	717
Point 8	20	721
Point 9	8	721
Point 10	0	719
Point 11	-15	718
Point 12	-30	714
Point 13	-110	713
Point 14	-110	714
Point 15	-110	709
Point 16	67	709
Point 17	91	706
Point 18	103	702
Point 19	105	701
Point 20	125	694
Point 21	-110	694
Point 22	140	694
Point 23	140	689
Point 24	-110	689

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.228	(78.164, 824.632)	57.97327	(-7.97968, 728.007)	(114.303, 697.744)
2	554	1.265	(78.164, 824.632)	130.022	(-8.60527, 727.798)	(111.124, 698.857)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	-6.489839	726.70755	112.23928	-205.05788	0	750
2	Optimized	-4.89678	725.3183	230.10453	6.4418899	0	750
3	Optimized	-3.16559	723.77165	326.77405	166.98504	0	750
4	Optimized	0.023405	720.94715	503.29859	494.1442	0	750
5	Optimized	3.292215	718.0808	682.45768	934.59137	0	500
6	Optimized	5.995505	715.7088	809.94954	1136.7382	0	500
7	Optimized	7.495505	714.4733	855.96032	1287.403	0	500
8	Optimized	8.774343	713.55565	886.65821	1334.0006	0	500
9	Optimized	11.125913	711.86825	943.11728	1508.828	300.7937	0
10	Optimized	14.21286	709.86825	1003.8055	1647.8212	342.42921	0
11	Optimized	16.044005	708.81515	1031.464	1687.3501	348.74079	0
12	Optimized	18.182715	707.7367	1054.3141	1753.4373	371.7304	0
13	Optimized	21.522855	706.09425	1087.3847	1802.5259	380.24733	0

14	Optimized	25.26746	704.39225	1115.7408	1878.5677	405.60225	0
15	Optimized	29.5601	702.6577	1134.7202	1936.3344	426.22581	0
16	Optimized	31.815495	701.81635	1140.3169	1974.0388	443.29779	0
17	Optimized	34.815185	700.84245	1138.6935	1971.2218	442.66312	0
18	Optimized	39.315185	699.4953	1129.1579	1993.1134	459.3733	0
19	Optimized	43.30031	698.47065	1110.1713	1957.2411	450.39499	0
20	Optimized	45.80031	697.83975	1097.5114	1967.0358	462.33433	0
21	Optimized	48	697.4056	1078.8133	1931.3175	453.28449	0
22	Optimized	50.80642	696.8517	1054.9565	1885.8192	441.77751	0
23	Optimized	54.64057	696.3307	1007.651	1842.0802	443.67389	0
24	Optimized	59.62944	695.8603	933.12866	1737.2699	427.56948	0
25	Optimized	63.29529	695.75	863.63612	1634.4413	409.84436	0
26	Optimized	65.53983	695.74775	828.26924	1565.3988	391.93872	0
27	Optimized	66.53983	695.7467	828.33473	1565.5075	391.96174	0
28	Optimized	68.70304	695.7444	815.15947	1540.5971	385.72202	0
29	Optimized	72.80812	695.71395	785.00598	1477.8677	368.4011	0
30	Optimized	77.70109	695.6506	750.73113	1412.3676	351.79837	0
31	Optimized	81.527195	695.5856	724.92417	1359.5838	337.45451	0
32	Optimized	84.778065	695.50805	704.36059	1320.138	327.41463	0

33	Optimized	88.84688	695.3175	684.46698	1264.5956	308.45986	0
34	Optimized	92.04511	695.10465	659.1899	1217.895	297.06876	0
35	Optimized	94.474685	694.99215	615.60986	1151.2634	284.81202	0
36	Optimized	98.545775	695.04695	527.35877	1010.2115	256.73734	0
37	Optimized	102.1162	695.28725	437.95645	880.61562	235.36606	0
38	Optimized	104	695.5911	369.30762	742.55434	198.4588	0
39	Optimized	105.43825	695.82305	323.55789	641.64167	169.12815	0
40	Optimized	107.9215	696.27095	295.55416	539.53301	129.72586	0
41	Optimized	112.1347	697.1961	237.74886	342.29218	55.586669	0

Slices of Slip Surface: 554

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	554	-6.8026335	726.2415	134.84938	-131.24281	0	750
2	554	-3.313369	723.32825	354.47411	288.45345	0	750
3	554	0.0598925	720.70415	518.49977	611.70602	0	750
4	554	3.3732615	718.2925	669.22416	996.08029	0	500
5	554	6.5	716.1574	771.4185	1176.1094	0	500
6	554	9.750315	714.0832	833.32625	1288.7821	0	500
7	554	13.302595	711.96265	891.86798	1460.4434	302.31693	0
8	554	16.906525	709.96265	941.78809	1546.7146	321.64512	0
9	554	19.354245	708.6725	971.40075	1599.0443	333.72398	0
10	554	22	707.38695	996.64778	1650.4301	347.62225	0
11	554	26	705.55275	1027.9439	1720.5522	368.26641	0
12	554	30	703.87885	1049.2396	1774.9879	385.88719	0
13	554	34.25	702.2736	1061.0233	1815.3772	401.09709	0
14	554	38.75	700.7502	1062.497	1839.8983	413.35156	0

15	554	43.5	699.34265	1051.4965	1841.3044	419.94829	0
16	554	48	698.1739	1030.8052	1821.8861	420.62514	0
17	554	51.875	697.30965	1004.073	1789.0608	417.38543	0
18	554	55.625	696.59245	970.77995	1743.2229	410.71518	0
19	554	59.375	695.98855	930.39505	1683.577	400.47396	0
20	554	63.125	695.4963	883.04489	1609.9981	386.52789	0
21	554	66	695.18395	863.49587	1584.5692	383.40148	0
22	554	69	694.94865	862.57396	1596.0947	390.01992	0
23	554	73	694.7278	845.13235	1581.5506	391.56052	0
24	554	77	694.6304	819.9672	1552.2629	389.36853	0
25	554	81	694.65615	787.11267	1507.8161	383.20483	0
26	554	85	694.8051	746.56582	1447.6447	372.77023	0
27	554	89	695.07765	698.26202	1371.1377	357.77433	0
28	554	93	695.47465	616.17335	1225.765	324.12562	0
29	554	97	695.99725	500.16635	1008.5946	270.33609	0
30	554	101	696.64695	376.23315	769.47272	209.08919	0
31	554	104	697.20655	268.34008	554.90926	152.37153	0
32	554	106.53095	697.7516	203.02685	391.23306	100.07102	0
33	554	109.5929	698.4753	157.79695	233.7371	40.378098	0

CEDAR RIVER
CEDAR RAPIDS, IA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX G-B

EXISTING LEVEE EVALUATION
MEMORANDUM FOR RECORD

CEMVR-ED-G 26 February 2010

Memorandum For Record

Subject: Evaluation of Existing Levees at Cedar Rapids, Iowa

A discussion in connection with the evaluation of the levee's performance at Cedar Rapids, Iowa, is presented in this memorandum. Based on the cursory site visits and various references, the conclusions drawn herein are presented in the following text.

1. Existing levee embankment and surrounding ground is covered with a growth of trees and vegetation encouraging considerable rodent burrowing activity throughout, thereby, comprising the levee integrity. The root system is likely to rot upon the demise of the trees resulting in a potential seepage path through the levee embankment. The extensive vegetation present also hinders the visibility required for the periodic inspection of the levees.

2. Permanent tie-offs to high ground do not exist for the Time Check Levee.

3. Existing levees do not have a permanent pump stations. Gravity storm drains that pass underneath the existing levees have no permanent closure gates.

4. The existing side slopes of the levees are not safe. For example, the landside slope at Cedar River Levee along the Time Check neighborhood averages 1H:1V and the riverside slope averages ½ H: 1V

5. The levees do not meet the minimum Public Law 84-99 levee eligibility standards for levees, as outlined by the US Army Corps of Engineers.

6. These non-federal levees are not accredited by FEMA.

7. Seepage cutoff trenches were likely not provided in the original construction.

Based on the above discussion, it is concluded that all levees in Cedar Rapids that exist do not meet the minimum standards set by the U.S. Army Corps of Engineers.

For the purposes of the Cedar Rapids feasibility, no measurable level of flood protection shall be taken into account.

Padmakar Srivastava, Ph.D., P.E.
Geotechnical Branch

CEDAR RIVER
CEDAR RAPIDS, IA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX G-C

LEVEE INSPECTION MEMORANDUM FOR RECORD

MEMORANDUM FOR RECORD

SUBJECT: Cedar River Levee Inspection

Observations

1. On 24 September Andy Barnes and Ben Ferrell, ED-G, traveled to Cedar Rapids to inspect the referenced levee. They were met on site by Ken Bickner, Stormwater Management Project Engineer for the City of Cedar Rapids. The weather was clear and windy, with a temperature in the mid-70's.

2. The subject levee is located on the west bank of the Cedar River along First Street NW. The levee is about ½ mile long, extending approximately from just south of K Avenue to just west of Fifth Street NW, where First Street NW becomes Penn Avenue. Figure 1 shows the approximate limits of the levee.



Figure 1. Cedar River Levee Location

3. The levee appears to be constructed of predominantly clayey material. The levee height, measured from the landside toe, ranges from about 5-8 feet. The crown width averages approximately 20 feet. The landside slope averages 1H:1V, and the riverside slope averages ½ H:1V. Table 1 summarizes the levee section at each cross street.

Table 1. Approximate Levee Sections

Cross Street	Crown Width, ft	Landside Height, ft	Landside Slope, H:V	Riverside Slope, H:V
K Ave	23	5	1:1	½ :1
L Ave	20	5	1.5:1	½ :1
M Ave	21	7	¾ :1	½ :1
N Ave	12	7	½ :1	< ½ :1
O Ave	16	8	1:1	½ :1
4th St NW	15	6	1:1	½ :1
5th St NW	19	5	1:1	½ :1
Penn Ave	8	4	2:1	½ :1

4. The levee ties into high ground at the railroad bridge abutment at the downstream end. Photo 1 shows the downstream end of the levee. The levee does not tie into high ground at the upstream end, transitioning to lower ground at the transition of First Street NW to Penn Avenue. Photo 2 shows the upstream end of the levee.

5. First street NW is located immediately at the landside toe. The crown and landside slope have a solid cover of turfgrass that had recently been mowed. It appears that there is regular maintenance of vegetation in those areas. There is a hard surfaced recreational trail (ACC) located on the crown of the levee. The riverside slope, as noted previously, is very steep, and is heavily vegetated by noxious brush and woody vegetation. The riverside slope of the levee extends directly into the Cedar River, precluding a visual inspection of the toe. Photo 3 shows a typical section.



Photo 1. Downstream end looking north.



Photo 2. Upstream end looking southeast.



Photo 3. Looking north from about L Avenue.

6. There are 9 stormwater drains through the levee. The drains are composed of 12-inch diameter corrugated metal pipes with concrete headwalls coming off the curb and gutter. Photo 4 shows a typical drain headwall. The bolts around the perimeter of the opening are for steel closure plates that can be installed during higher stages.



Photo 4. Stormdrain at landside toe.

7. Ken Bickner indicated there is a 4.5 foot by 8 foot box culvert running beneath N Avenue that extends through the levee. This culvert drains a 220 acre upland area. There may also be some local drainage in the vicinity of the levee tied into this box. The riverside slope is nearly vertical in this area, likely due to erosive action from both the river and flow from the culvert itself. Bickner indicated there was a contract to extend the riverside slope out, but there were no plans to extend the culvert outlet. There is no mechanism for closure of this culvert. A visual inspection of the riverside toe was attempted at this location, but the steepness of the slope, along with the vegetation and proximity to the river hindered the inspection.

8. There are some areas that appear to have experienced sloughing of the riverside slope due to erosion of the toe. The proliferation of noxious vegetation on the riverside slope makes a good assessment very difficult. There does appear to be some random, intermittent rock revetment, but nothing that would provide any significant protection from toe erosion. Photo 5 shows a combination sloughing/erosional feature encroaching on the crown near 4th Street NW. There is another similar feature at O Avenue.



Photo 5. Sloughing/erosional feature near 4th St NW.

9. There was no evidence of burrowing animals noted, but the riverside toe, as noted previously, could not be inspected satisfactorily. A more complete survey of the riverside toe could be made by boat.

10. Barnes asked Bickner if there was any history of seepage or boils along the landside slope and toe during higher stages when the storm drains were blocked off. Bickner indicated he was not aware of any occurrences, but that he would check with other city employees.

Analysis

11. EP 500-1-1 indicates that for a clay levee, the maximum slope is 2.5H:1V, and the minimum crown width is 10 feet for a levee of this height. In reality, a slope of 3H:1V is preferred for maintenance and improved stability. The subject levee has a crown width that generally exceeds this requirement, but the slopes are significantly steeper. The minimum levee template will not fit within the section of the subject levee, even with the additional crown width.

12. The rate of erosion of the riverside toe of the levee is difficult to gauge. While it is apparent that erosion has and is occurring, there are no records of construction or as-builts available. Bickner indicated that there were some sections surveyed of the levee in the past, but could not locate them. He indicated he would continue trying to find this information.

13. The stormwater drains through the levee can be closed at the landside toe. It would be preferable to achieve closure closer to the riverside toe. The large box culvert,

which may have ties to the local stormwater system directly behind the levee, has no closure capability.

14. The levee does not tie into high ground at the upstream end. Therefore, the levee offers no protection beyond the elevation of the natural ground at the upstream end. Any event on the Cedar River above that elevation would flank the levee. Bickner indicated he has topographic survey of the area that he would send to Rock Island District.

15. A subsurface investigation and any related seepage analysis was beyond the scope of this work. If there is interest and funding, this work could be performed.

16. Even though the levee section does not meet the minimum required by EP-500-1-1, it would most likely perform against a high head for a short period of time. A complete investigation of the materials in the levee section and foundation, mentioned above, would be required to confirm this. The larger problem of levee flanking should probably be addressed before any significant work is initiated.

17. If there are any questions or comments concerning this report, please contact the undersigned at (309)794-5402.

/ s /

ANDREW G. BARNES, P.E.
Geotechnical Branch

CF(electronic): ED-DM (Sunderman)
PM-M (Zukowski)
ED-G (Mech, Ferrell)

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

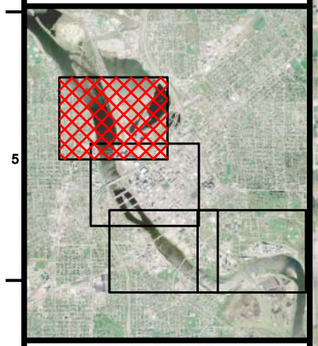
FINAL

APPENDIX G
GEOTECHNICAL

EXHIBITS 1 THROUGH 7

N

KEYPLAN



LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- DRAINAGE EASEMENT
- RWRC — REMOVABLE WALL AT ROAD CROSSING
- 2010 TERRACON SOIL BORINGS
- PRE 2010 SOIL BORINGS

200 0 200 400
SCALE IN FEET

STA 144+12.00
END LEVEE
BEGIN FLOODWALL

STA 142+58.00
END FLOODWALL
BEGIN LEVEE

STA 142+05.00
END RWRC
BEGIN FLOODWALL

B-8 06085076

STA 136+97.00
BEGIN FLOODWALL

STA 148+90.00
END FLOODWALL
BEGIN GATE - ROLLER

B-7 06085076

STA 140+00.00
END FLOODWALL
BEGIN RWRC

B-6 06085076

B-1 06085088

B-2 06085088

STA 149+30.00
END GATE - ROLLER
BEGIN FLOODWALL

B-22 06085065

STA 160+15.00
END FLOODWALL
BEGIN RWRC

B-25 06085065

STA 162+86.00
END RWRC
BEGIN FLOODWALL

B-3 075073

STA 172+99.00
END FLOODWALL
BEGIN GATE - ROLLER

STA 173+37.00
END GATE - ROLLER
BEGIN FLOODWALL

B-1 06055099

B-2 06055099

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Rock Island District

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	Revisions		

Date:	28-APR-2010
Designed By:	
Drawn By:	
Checked By:	
Reviewed By:	
Scale:	
Project Code:	
Solicitation Number:	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Stanley Consultants INC.

CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
500 YR FLOOD LEVEL
SOIL BORING-SHEET 1

EXHIBIT 1

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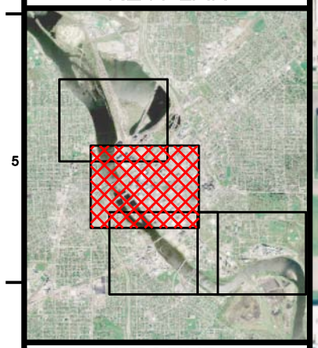

LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- DRAINAGE EASEMENT
- RWRC — REMOVABLE WALL AT ROAD CROSSING
- 2010 TERRACON SOIL BORINGS
- PRE 2010 SOIL BORINGS

200 0 200 400
SCALE IN FEET

STA 172+99.00
END FLOODWALL
BEGIN GATE - ROLLER

STA 173+37.00
END GATE - ROLLER
BEGIN FLOODWALL

B-1 06055009

B-2 06055009

175

180

185

STA 185+85.00
END FLOODWALL
BEGIN RWRC

STA 187+85.00
END RWRC
BEGIN FLOODWALL

B-11

190

STA 194+42.00
END FLOODWALL
BEGIN GATE - ROLLER

B-12

195

STA 195+50.00
END GATE - ROLLER
BEGIN FLOODWALL

STA 198+50.00
END FLOODWALL
BEGIN GATE - ROLLER

B-13

200

5000 GPM
STORMWATER

STA 199+50.00
END GATE - ROLLER
BEGIN FLOODWALL

B-4 06955004

STA 203+50.00
END GATE - ROLLER
BEGIN FLOODWALL

STA 202+25.00
END FLOODWALL
BEGIN GATE - ROLLER

B-4 06915072

B-3 06915072

B-3 06915072

B-4 06915072

B-5 06915072

B-6 06915072

B-4 06955007

205

210

1500 GPM
STORMWATER

215

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CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
500 YR FLOOD LEVEL
SOIL BORING-SHEET 2

EXHIBIT 2

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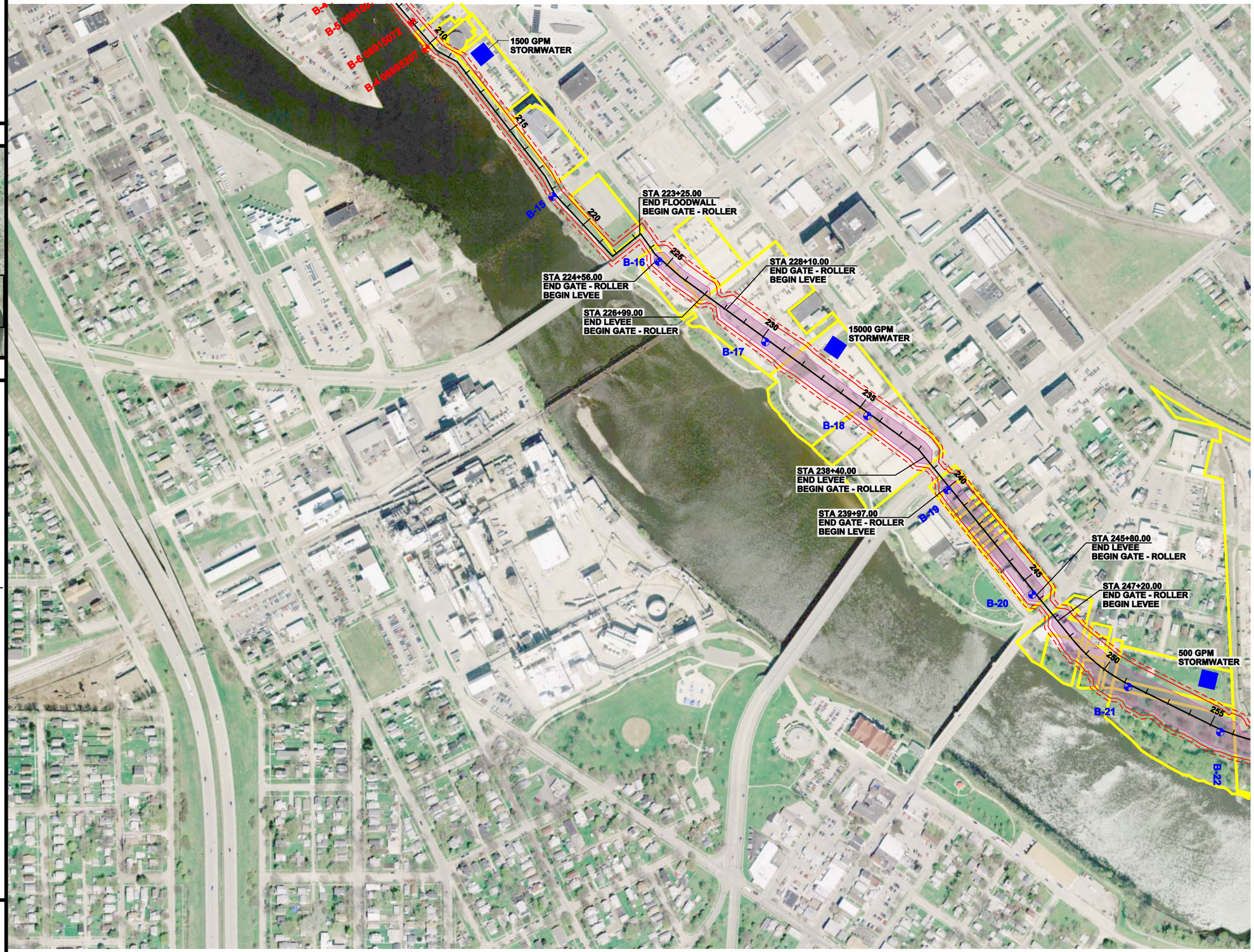

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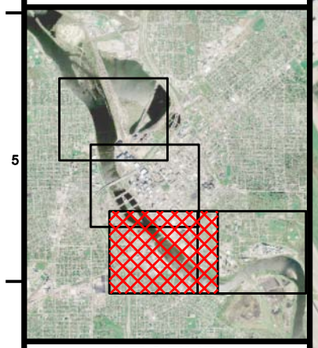

LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- DRAINAGE EASEMENT
- RWRC — REMOVABLE WALL AT ROAD CROSSING
- 2010 TERRACON SOIL BORINGS
- PRE 2010 SOIL BORINGS

200 0 200 400
SCALE IN FEET

US Army Corps of Engineers ®
Rock Island District

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	Revisions		

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Checked By:
Reviewed By:
Date: 28-APR-2010
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Project Code:
Solicitation Number:

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CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
500 YR FLOOD LEVEL
SOIL BORING-SHEET 3

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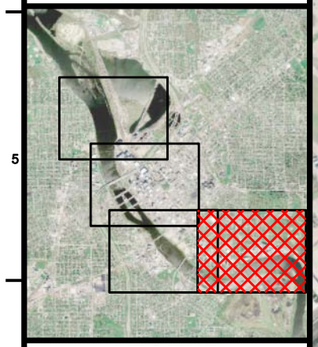

LEGEND

- LEVEE
- PERMANENT EASEMENT
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- PARCEL BOUNDARY
- PUMP STATION
- DRAINAGE EASEMENT
- RWRC — REMOVABLE WALL AT ROAD CROSSING
- 2010 TERRACON SOIL BORINGS
- PRE 2010 SOIL BORINGS

200 0 200 400
SCALE IN FEET

STA 297+71.00
END GATE - SWING

STA 293+75.00
END FLOODWALL
BEGIN GATE - SWING

1500 GPM
STORMWATER

9000 GPM
SANITARY

STA 266+60.00
END LEVEE
BEGIN FLOODWALL

500 GPM
STORMWATER

STA 247+20.00
END GATE - ROLLER
BEGIN LEVEE

STA 245+80.00
END LEVEE
BEGIN GATE - ROLLER

B-1 06075119
B-3 06075119
BH-1 06075077
B-5 06915078
B-3 06915078
F-2 06005144
B-21
B-22
B-23
B-24

245 250 255 260 265 270 275 280 285 290 295

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GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
500 YR FLOOD LEVEL
SOIL BORING-SHEET 4

EXHIBIT
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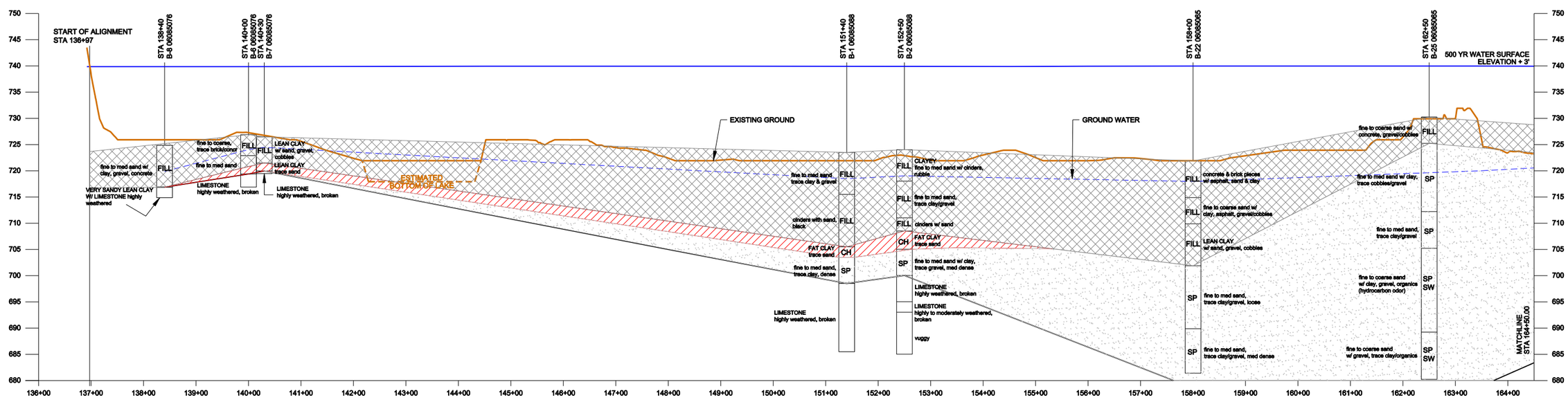

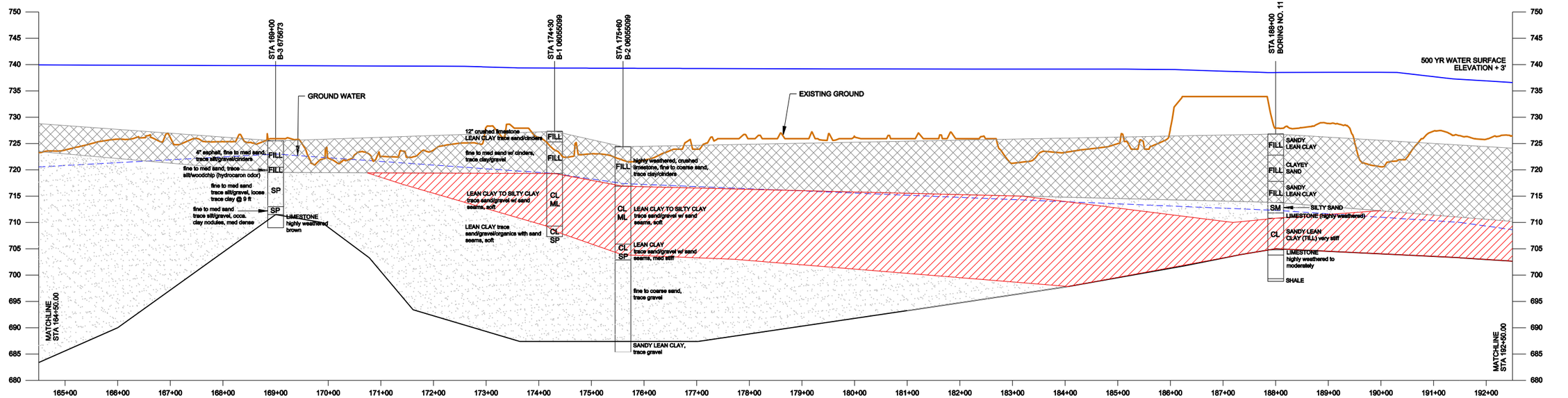

LEGEND

- FILL
- CLAY (CL, CL-ML, CH)
- SAND (SP, SW, SC)
- GROUND WATER
- 500 YR + 3'
- EXISTING GROUND

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
PROFILE-SOIL BORING
SHEET 1

EXHIBIT 5

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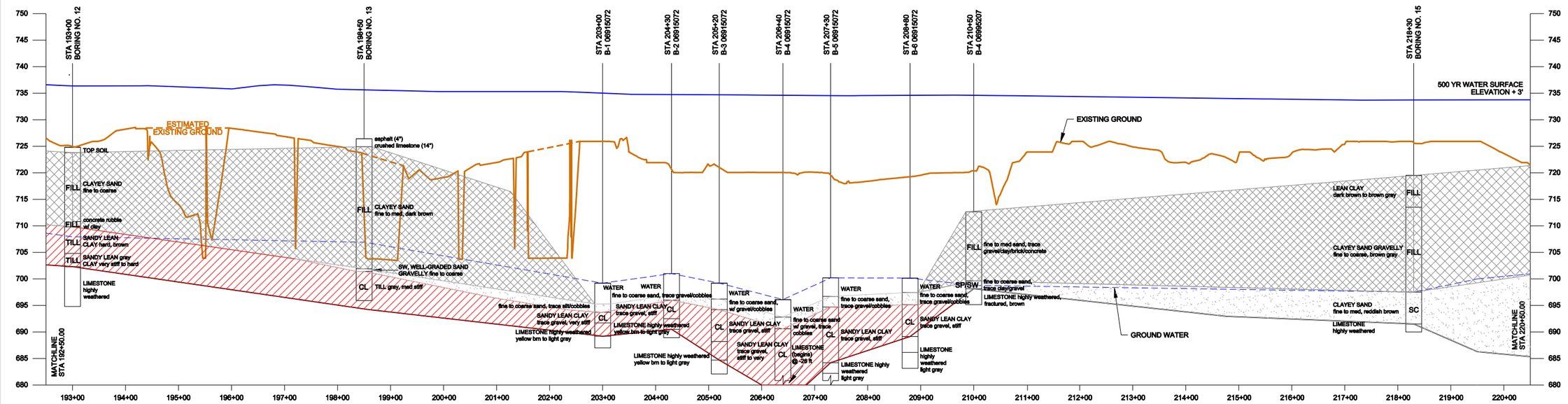

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	Revisions		

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GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
PROFILE-SOIL BORING
SHEET 2

EXHIBIT 6

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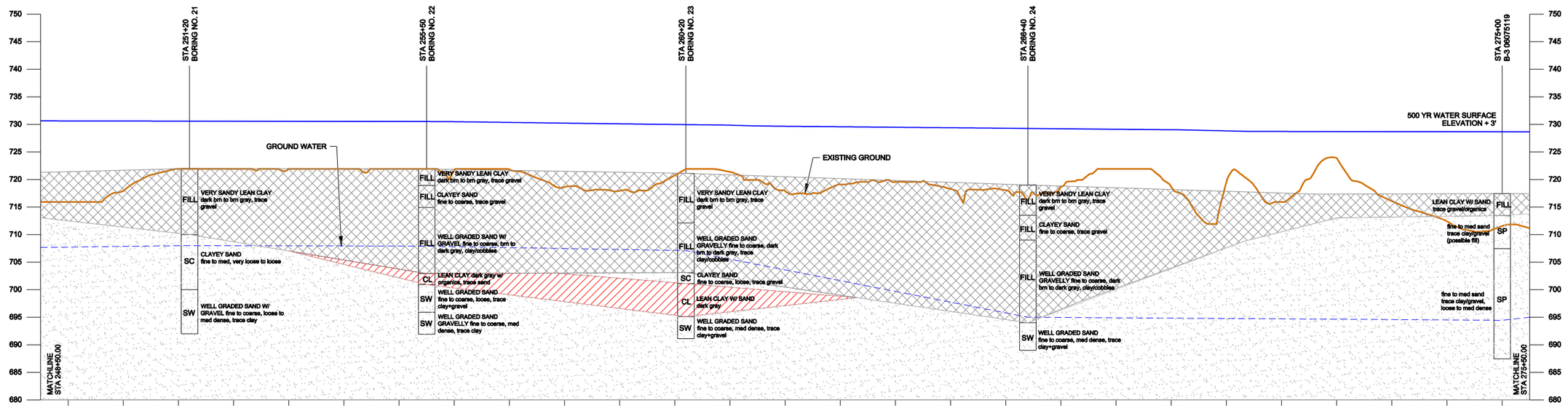

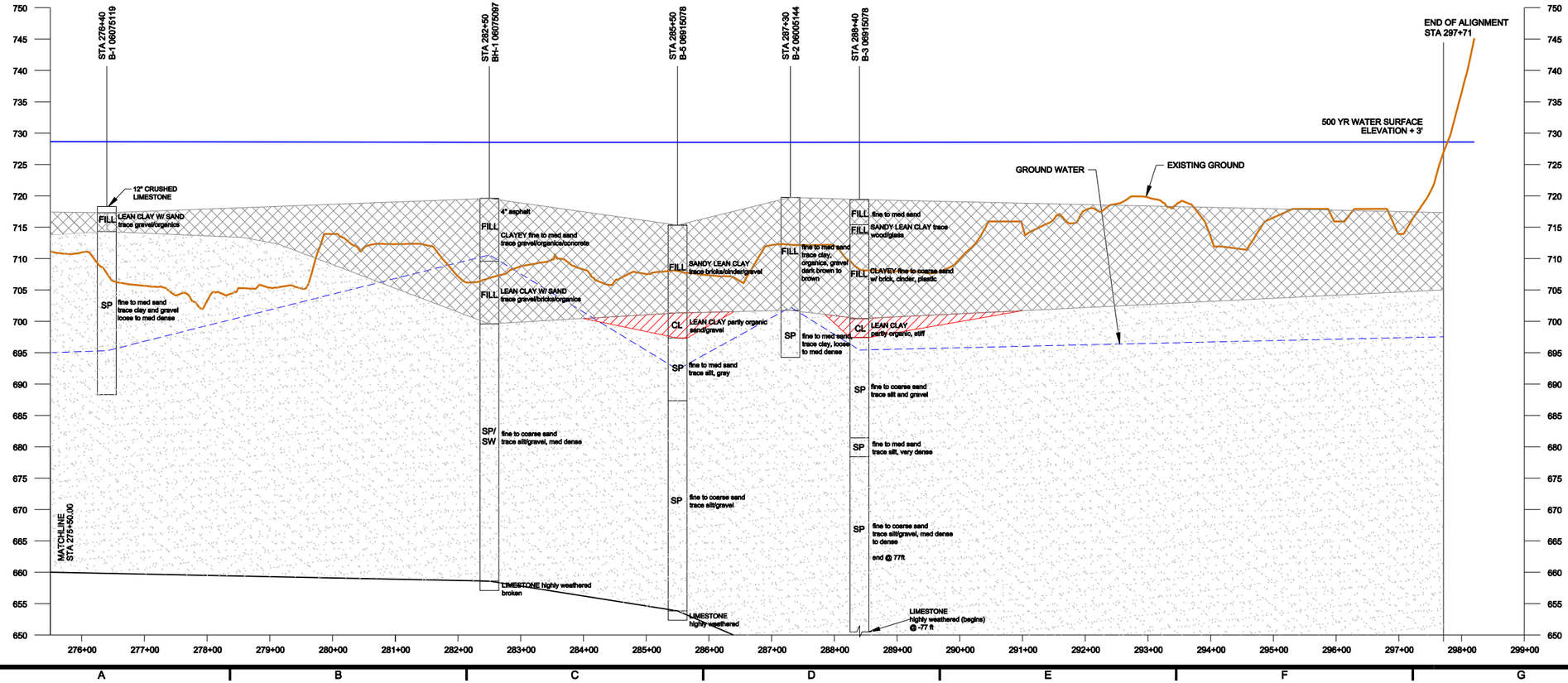

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

MEASURE 27
PROFILE-SOIL BORING
SHEET 3

EXHIBIT 7

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CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX H
STRUCTURAL

Flood Risk Management Feasibility Study

Cedar River, Linn County
Cedar Rapids, Iowa

Structural Appendix

United States Army Corps of Engineers
Rock Island District

August 2010

Stanley Consultants INC.
A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

I. INTRODUCTION

This section outlines the scope, criteria and methods of analysis used for the preliminary design of flood protection structures anticipated for all measures considered in the *Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study With Integrated Environmental Assessment* (Study*)*. This Study included the preliminary design of permanent concrete flood walls of heights ranging from 3' to 24' of stick-up above surrounding grade. Removable flood wall systems with permanent concrete substructures were also considered. Lastly, preliminary design of steel swing gates was performed to estimate the anticipated weight of structural steel per unit area of gate opening. The preliminary designs are used as the basis for developing structure dimensions and quantities needed for cost estimating purposes.

II. CODES AND STANDARDS

- EM 1110-2-2104 Strength Design for Reinforced-Concrete Hydraulic Structures (June, 1992)
- EM 1110-2-2502 Retaining and Flood Walls (September, 1989)
- EM 1110-2-2705 Structural Design of Closure Structures for Local Flood Protection Projects (March, 1994)
- ACI 318-05 Building Code Requirements for Reinforced Concrete
- AISC Manual of Steel Construction, 13th Edition.

III. APPROACH

Flood Walls. Flood walls typically consist of reinforced concrete inverted "T" type structures of varying dimensions. The base slabs for flood walls can be soil supported, or supported on deep foundation systems such as driven steel piling or auger-cast concrete piles.

No geotechnical recommendations on which to base preliminary structural designs were available at the time of this Study. Given the fact that the proposed flood protection measures will be routed through urban areas, it is assumed that the existing near-surface soils will consist primarily of fill. Typical geotechnical recommendations for dealing with existing fill usually include options ranging from over excavation and replacement with compacted engineered fill to deep foundations consisting of driven steel piles or auger-cast concrete piles.

For the purposes of this Study, it was assumed that all flood walls will be soil supported. It was further assumed that fill encountered below flood walls will be over excavated and replaced with compacted cohesive fill to help control settlements and underseepage. A 10-foot depth of over excavation below existing grade was assumed for the purposes of cost estimating. The actual depth at a given location will vary depending upon many factors. These factors include, but are not limited to, the depth of basements in nearby structures, depth of nearby utilities, and the presence of unsuitable subsurface materials under the footprint of the flood wall. For cost estimating purposes, it was assumed that a continuous steel sheet pile cutoff wall will be required under all flood walls to control underseepage. A 10' sheet pile length was chosen to ensure that cutoff wall would penetrate into the native soils below the assumed depth of overexcavation.

The Rock Island District has indicated that over excavation and backfilling under flood walls will not likely be used to control settlements and underseepage. The methodology used to determine costs at the feasibility level are acceptable. Other methods to stabilize poor foundation conditions, such as piles, will be considered and evaluated during design.

Analysis was limited to flood walls ranging from 3 feet to 24 feet of stick-up above grade. The 24' height limitation was established based on preliminary profiles developed for the various flood protection measures studied. The range in flood wall heights was divided into 3' increments, resulting in eight typical cross sections for which preliminary designs were performed.
For the purposes of this Study, the assumed controlling load case was I1 from table 4-2 of EM 1110-2-2502, with the criteria summarized in table H-1:

Table H-1. Floodwall Design Criteria

Loading Condition	Sliding Factor of Safety	Overturning (Min % of Base in Compression)	Minimum Bearing Capacity Safety Factor
Design Flood	1.5	100%	3.0

Source: Stanley Consultants

The following assumed parameters were used in the analysis:

Unit Weight of Water	62.4 pcf
Unit Weight of Concrete	150 pcf
Saturated Soil Unit Weight	125 pcf
Cohesion	75psf
Internal Friction Angle	20º
Ultimate Bearing Capacity	6,000 psf
Sheet pile Effectiveness	50%
Required Cover for Frost Protection	4 feet
Crack at Base of Heel	Yes

The dimensions of each flood wall cross section were adjusted until all stability and bearing pressure criteria was satisfied. For the purposes of this Study, it was assumed that the flood wall stem will have a constant thickness, rather than tapered. The shear strength and required reinforcing of the flood wall stem were evaluated to confirm that the proposed wall dimensions are reasonable and practical from the standpoint of strength, as well as stability.

Table H-2 summarizes results of the floodwall analysis.

Table H-2. Floodwall Analysis Results

Wall Heights	Volume of Concrete (yd^3/ft)	Base Width (ft)	Base Thickness (ft)	Stem Height (ft)	Stem Thickness (ft)
24	5.9	28	3	25	3
21	4.4	21	3	22	2.5
18	3.1	18	2.5	19.5	2
15	2.4	15	2	17	2
12	1.9	12	2	14	2
9	1.4	8	2	11	2
6	0.8	5	1.5	8.5	1.5
3	0.6	5	1.5	5.5	1.5

Source: Stanley Consultants

Removable Flood Walls. Removable wall systems typically consist of vertically-oriented structural steel members spaced at regular intervals and anchored to reinforced concrete foundations. The vertical members are typically braced against lateral water loads by steel struts bearing on concrete foundations.

Aluminum planks stacked horizontally against or between the verticals are used to complete the wall. The planks are typically fabricated with gaskets to seal the joints between them.

The details of removable wall systems vary from manufacturer to manufacturer, but most systems share similar details. Removable wall systems have been used to provide flood protection as high as 20 feet. Based on research of available literature and discussions with manufacturers, it is believed that removable wall systems can be readily obtained to provide flood protection for maximum heights ranging from 8 to 12 feet.

Due to the apparent limitations in height for which removable wall systems are suitable, these systems are not considered to be feasible for large reaches of the flood protection measures studied. Their use is considered feasible at road crossings under elevated roadways or other locations where the construction of closure gates are considered to be impractical, and the required wall heights are less than 12 feet.

Foundation details for supporting removable floodwall systems vary. For the purposes of this Study, it was assumed that removable flood walls will require soil-supported reinforced concrete foundations similar to those supporting permanent concrete flood walls. Cost estimates are based on the assumption that the quantities and costs for removable wall foundations will be the same as computed for permanent flood walls. Costs for the above ground portions of the removable walls are computed based on unit price data obtained from manufacturers.

Closure Gates. Closure structures are required where flood protection measures cross roads or railroads that must remain in service after the construction of the project. EM 1110-2-2705 contains thorough descriptions of various types of closure gates commonly used for flood protection projects. Swing gates and rolling gates are considered to be suitable for the length and height of the gates anticipated in this Study.

Rolling gates are proposed at all crossing locations unless topography, flood protection alignment, obstructions or other restrictions prohibit the construction of rolling gates and storage monoliths. Some crossings in the flood protection measures considered in this Study will require closure gate widths in excess of 100 feet. Gates of this width are beyond the normal range of typical rolling closure gates. These crossing widths may require the gate to be fabricated and rolled into place in smaller section widths. Breaking the rolling gates into segments will require the installation of removable "A" frames or other means of bracing the gates at the joints. Another purpose of the "A" frames would be to provide bulkheads against which seals could be placed to limit leaking at the joints. The use of removable "A" frames will reduce the size of structural components required for the rolling gates at large closure widths since the horizontal gate spans can be reduced to the most practical and cost effective dimension.

Swing gates are proposed for crossing locations that do not permit the construction of rolling gates. Preliminary design for swing gates of five potential sizes was performed under this Study. The proposed swing gates in this Study range from 30 feet to 40 feet in width and from 3 feet to 27 feet in height. Preliminary designs were performed in accordance with EM 1110-2-2705. The design was limited to skin plates, intercostals and girders. Loading conditions were limited to water to the top of the gate, and the analysis did not consider additional stresses resulting from dead load torsion.

The weight of steel was estimated for each gate analyzed. The weight of steel was increased by 20 percent to account for additional steel needed to reduce stresses and deflections resulting from dead load torsion and other undeveloped design details such as cross bracing and hinges. Table H-3 summarizes the weight of steel swing gates resulting from preliminary design:

Table H-3. Weight of Steel Swing Gates Based on Preliminary Design

Width (ft)	Height (ft)	Square Feet	Weight (lbs)	Weight (psf)
40	14	560	26,748	48
40	3	120	4,888	41
30	27	810	41,473	51
30	13	390	15,649	40
30	3	90	2,724	30
			Average Steel Weight	**42 psf**

Source: Stanley Consultants

Rock Island District, USACE obtained tabulation of cost, steel weight and other data for various closure structure types and sizes in several projects constructed for the Nashville District, USACE. The data provided for swing gates are presented in table H-4.

Table H-4. Various Data for Swing Gates

Width (ft)	Height (ft)	Square Feet	Weight (lbs)	Weight (psf)
29.50	8.13	239.84	15,100	63
29.50	8.13	239.84	15,100	63
35.00	9.23	323.05	23,300	72
29.50	12.30	362.85	22,600	62
30.00	12.60	378.00	20,028	53
24.00	16.17	388.08	19,500	50
20.17	19.41	391.50	26,300	67
45.00	9.70	436.50	31,700	73
35.00	12.74	445.90	25,500	57
30.00	15.45	463.50	23,400	50
45.00	10.35	465.75	31,200	67
45.00	10.80	486.00	34,100	70
45.00	11.59	521.55	36,000	69
36.50	14.99	547.14	29,078	53
35.00	15.76	551.60	28,936	52
32.00	23.60	755.20	65,300	86
35.00	22.60	791.00	65,900	83
			Average Steel Weight	**64 psf**

Source: Nashville District, USACE

The average weight of steel in the swing gates using preliminary designs in accordance with EM 1110-2-2705 is approximately 34 percent less than the weight of steel for gates previously constructed by Nashville District, USACE. The difference could be partially attributed to the limited loading conditions considered in the preliminary designs. The preliminary designs assumed structural steel having a yield stress of 50 ksi is readily available and could be used to fabricate the gates.

The gates constructed by Nashville District, USACE were most likely fabricated using ASTM A36 steel, which would generally require more steel weight to obtain comparable strength. The gates constructed by Nashville District, USACE may have been designed for impact or other loads that were not considered in the preliminary designs conducted in this Study.
Based on this analysis, it is reasonable to assume that the weight of steel in swing gates will fall between the averages computed in the tables above. The components, materials and design methods for rolling gates are similar to swing gates of comparable sizes. It is assumed that "A" frames will be used to brace rolling gates where required to reduce the horizontal span of these structures. Based on this assumption and the similarities between structural components of swing gates and rolling gates, it is reasonable to assume that the weight of steel rolling gates will be similar to that of swing gates. Therefore, the weight of steel for all gates is assumed to be 55 pounds per square foot of gate opening for cost estimating purposes.

Support structures for closure gates are typically more substantial than conventional flood walls.

This is primarily due to the fact that lateral loads from hydrostatic pressure on the gates are concentrated in piers at each end of the gate, rather than spread uniformly over the length of the structure. Rolling gates require storage monoliths similar to floodwalls, but with tracks embedded in concrete at grade to allow gates to be stored adjacent to the closures when not needed and rolled into place prior to flood events. Support structures for swing gates need to be more substantial to resist the forces required to support the weight of the gates from the hinges.

For the purposes of this Study it was assumed that the foundation and support structure costs for gate structures of a given width will be similar to the costs of permanent floodwalls having an equal width. No reduction in substructure cost was made for the amount of concrete stem removed by the gate opening. It was assumed that this additional concrete is required to stiffen the structures against concentrated loads from the gates. The costs associated with the fabricated steel gates are added to the floodwall costs. The resulting costs of gate structures per linear foot are therefore higher than the costs of conventional flood walls per linear foot.

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX I
COST ESTIMATE

Flood Risk Management Feasibility Study

Cedar River, Linn County
Cedar Rapids, Iowa

Cost Estimate

United States Army Corps of Engineers
Rock Island District

November 2010

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Engineering, Environmental and Construction Services - Worldwide

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CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

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Cost Estimate Report

I. PROJECT DESCRIPTION

A. General. The Cedar River, Linn County, Cedar Rapids, Iowa - Flood Risk Management Feasibility Study covered the significant areas within the corporate limits of the City of Cedar Rapids, Iowa that were impacted by the 2008 Cedar River flood. This cost estimate is for a flood protection measure that controls flooding of the commercial and industrial areas east of the Cedar River against the 500 year flood

B. Purpose. The purpose of this work is to develop a cost estimate based on conceptual design of Alternative 4C. This cost estimate was prepared using MII (MCACES 2nd Generation) Micro-Computer Aided Cost Estimating System.

C. Design Features. Feature of the flood protection system include earthen levees; concrete "T" flood walls; gates at roadways; demountable flood walls at railroads and selected roadways; sanitary and stormwater sewer pump stations; and relocation of existing utilities.

II. BASIS OF ESTIMATE

A. Basis of Conceptual Design. The project's conceptual design is based on the recommended flood protection system, Alternative 4C, as presented in the "Design analysis for Flood Risk Management Feasibility Study, Cedar River, Linn County, Cedar Rapids, Iowa," for the Rock Island District, US Army Corps of Engineers dated November 2009.

B. Basis of Quantities. This cost estimate is based on quantity take-offs that have been estimated by the designer from the document listed above. A quantity summary along with estimated quantity take-offs are presented in table I-1.

III. CONSTRUCTION SCHEDULE

A preliminary construction schedule has been prepared using the following assumptions:

- Planning, Engineering and Design – 18 months starting January 2011
- Cost Share Agreement and Real Estate Acquisition would occur during the design phase
- BCOE Review, Approvals, Solicitation, Bid Evaluation and Contract Award – 6 months
- Construction of closure structures (gates and demountable walls) at roadways and railroads need to be sequenced to allow construction to occur at only two locations at a time to minimize disruption of the traveling public. Estimated construction time at each closure – 6 to 8 months. Total construction time – 3 years
- Construction of concrete "T" walls, earthen levees, and sanitary and stormwater pump stations will occur at the same time the closure structures are being constructed.

IV. ACQUISITION PLAN

The cost estimate is based on a single construction contract being awarded to a prime contractor with subcontractors for the various specialty work such as demountable flood walls, closure gates, and pump stations. The contract would be advertised as an unrestricted Request for Proposals. The lowest price, technically acceptable, source selection process will be used to evaluate the Request for Proposals. The prime contractor would be responsible for project management and scheduling, major construction activities such as demolition, levees, "T' wall construction, etc, and all associated site work as well as overseeing the subcontractors' work.

V. PROJECT CONSTRUCTION

A. Mobilization/Demobilization. It is assumed that the prime contractor, construction equipment, and skilled labor will be mobilized from Cedar Rapids, Linn County, and surrounding areas. Mobilization includes transporting, and setting-up construction equipment and temporary construction facilities.

B. Staging and Site Access. Staging areas for the project would be in available locations as selected by the prime contractor as agreed with the contracting parties.

Construction access points will be the responsibility of the prime contractor as agreed with property owners and the contracting parties.

C. Borrow/Disposal Areas and Materials. The location of borrow and disposal area will be a government furnished area near the airport for all borrow and waste disposal, except structural demolition waste, which must go to a landfill.

D. Construction Methodology. Construction methodology will be the responsibility of the prime contractor based on the final contract documents.

E. Unusual Conditions (Soil, Water, Weather, Traffic, Utilities). Unanticipated bedrock, high-river levels, flooding, traffic traveling on streets and roadways, winter weather, and the location of existing underground utilities.

F. Unique Construction Techniques. Demountable flood walls, concrete "T" walls and roadway crossing flood gates. No specialized construction equipment is anticipated for the project based on the conceptual design.

G. Equipment/Labor Availability and Distance Traveled. All equipment and labor is assumed to be available from Cedar Rapids, Linn County, and surrounding communities.

VI. ENVIRONMENTAL CONCERNS

There is a potential for construction equipment to leak or spill contaminates into the Cedar River. Costs associated with these potential environmental concerns were not included in this estimate. Environmental regulations regarding stormwater runoff (SWPPP), disposal of demolition and construction debris, etc, will be the responsibility of the prime contractor and will be accordance with all local, state and federal regulations.

VII. EFFECTIVE DATES FOR LABOR, EQUIPMENT AND MATERIAL PRICING

Where applicable, local material quotes where obtained, otherwise the material costs are based on the 2008 English Cost Book (comprised of RS Means and USACE historical data).

The labor was adjusted to match the current Davis Bacon wage rates for Linn County, General Decision numbers IA20100001 03/12/2010 IA1, IA20100037 04/16/2010 IA37, and IA20100104 03/12/2010 IA104. The provided fringe amount was broken into 80 percent Non taxable fringe & 20 percent Taxable fringe.

The equipment is based on the MII Equipment Region 5r 2007 database, which is developed for the Midwest. Current gasoline prices are set as follows; gasoline at $2.70/gal, diesel (off-road) at $2.68/gal, and diesel (on-road) at $2.90/gal.

VIII. PROJECT MARKUPS

A. Escalation. Escalation is not included in this MII model.

B. Contingency. This cost estimate does not include contingency. The contingency show in the TPCS is 21.59%. This percentage was developed in the CSRA.

IX. MII CONSTRUCTION COST ESTIMATE

The construction cost estimate was developed using MII (MCACES 2nd Generation) cost estimating software in accordance with guidance contained in ER 1110-2-1302, Civil Works Cost Engineering. The MII cost estimate does not include Contingencies as mentioned above, it is a Total Project Cost estimate as it includes: Lands and Damages, Cultural Resources, Planning Engineering and Design and Construction Management. See Appendix I, *Cost Estimate Narrative*, for the MII construction cost estimate output reports.

APPENDIX I-A

PROJECT COST AND SCHEDULE RISK ANALYSIS REPORT

Downtown Cedar Rapids East Side – River Edge Alignment Measure 27, Alternative 4C

October 20, 2010

Prepared for:
U.S. Army Corps of Engineers,
Rock Island District

Prepared by:
U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

US Army Corps
of Engineers®

Cedar Rapids General Investigation Feasibility Study

Downtown Cedar Rapids East Side – River Edge Alignment Measure 27, Alternative 4C

Project Cost and Schedule Risk Analysis Report

Prepared for:

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Rock Island District

Prepared by:

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October 20, 2010

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EXECUTIVE SUMMARY

Under the auspices of the US Army Corps of Engineers (USACE), Rock Island District, this report presents a recommendation for the total project cost and schedule contingencies for the Cedar Rapids General Investigation Feasibility Study Downtown Cedar Rapids East Side – River Edge Alignment Measure 27, Alternative 4C (Cedar Rapids Recommended Plan). In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost.

Specific to the Cedar Rapids Project, the most likely total project cost (at price level) is estimated at approximately $81 Million. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $18 Million, or 23%. This contingency combines and averages the contingency resulting from the analysis (21.11%) and the contingency applied to the Lands and Damages feature account (35%), which was prepared by the Rock Island District Real Estate Branch. This contingency includes $16 Million (21%) for cost growth potential due to risk analyzed in the base cost estimate and $2 Million (2%) for cost growth potential due to risk analyzed in the baseline schedule.

Walla Walla Cost Dx performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portrays the development of contingencies . The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Most Likely Cost Estimate	**$80,765,309**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$85,127,789	5.40%
50%	$94,223,255	16.66%
80%	**$99,017,210**	**22.60%**
95%	$103,234,523	27.82%

The following table ES-2 portrays the full costs of the recommended alternative based on the anticipated contracts. The costs are intended to address the congressional

request of estimates to implement the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-2. Cost Summary

CEDAR RAPIDS Rehab		COST ($1,000)	CNTG ($1,000)	TOTAL ($1,000)
01	LANDS AND DAMAGES	8,667	3,033	11,700
02	RELOCATIONS	9,976	2,106	12,082
11	LEVEES AND FLOODWALLS	44,545	9,403	53,948
30	PLANNING, ENGINEERING AND DESIGN	10,220	2,157	12,377
31	CONSTRUCTION MANAGEMENT	4,542	959	5,501
	TOTAL PROJECT COSTS	**80,765**	**18,253**	**99,018**
	Schedule Completion with Contingency	**17 Mar 2016**	**28 months**	**11 Jul 2018**

Notes:
1) All costs except Lands and Damages include the recommended contingency of 21%. Lands and Damages contingencies herein reflect 35% (prepared by others).
2) Costs exclude O&M and Life Cycle Cost estimates.

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis were Risks TL-2 (Confidence in Investigations) and EXT-4 (Market Conditions/Bidding Climate), which together contribute over 44 percent of the statistical cost variance.

The key schedule risk driver identified through sensitivity analysis is Risk RE-1 (Investigations and Surveys Not Complete), which contributes over 33 percent of the statistical schedule variance.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

Under the auspices of the US Army Corps of Engineers (USACE), Rock Island District, this report presents a recommendation for the total project cost and schedule contingencies for the Downtown Cedar Rapids East Side – River Edge Alignment Measure 27, Alternative 4C (Recommended Plan) Project, Cedar Rapids, Iowa.

2.0 BACKGROUND

The Cedar Rapids Feasibility Study resulted in Alternative 4C as being the Government's Recommended Plan. Alternative 4C provides a level of flood protection close to the epic flood of 2008 height for the east side downtown area of Cedar Rapids, Iowa. Cedar Rapids is located along a historical rapids site along the Cedar River. Alternative 4C main features consist of concrete floodwalls, closure structures and earthen levees. The order of magnitude of Alternative 4C is $100 Million in total project cost. Design and construction is planned to occur over a 5 year period.

As a part of this effort, Rock Island District requested that the USACE Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx) provide an agency technical review (ATR) of the cost estimate and schedule for Recommended Project Plan. That tasking also included providing a risk analysis study to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the most likely Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule,

and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Rock Island District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Dx. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering Dx.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Cost Engineering Dx assembled a team, also relying on local Rock Island District staff to further augment labor, expertise and information gathering. The Cost Engineering Dx team consisted of one senior civil cost engineer.

The Cost Engineering Dx cost engineer facilitated a risk identification and qualitative analysis meeting onsite with the Rock Island on November 17, 2010. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the framework for the risk analysis. Subsequent revisions to the risk register occurred (specific to the Recommended Plan) until a meeting via teleconference on May 6, 2010 due to changing project assumptions and conditions. The initial cost and schedule risk models were completed and results reported on June 14, 2010. Several revisions and iterations of the cost and schedule risk model took place between June 14, 2010 and October 20, 2010 due to revisions to the estimate and schedule, especially those resulting from Agency Technical Review of the cost estimate, schedule, and risk analysis documents. The final results were completed and reported on October 20, 2010.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Dx guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to

Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT was obtained using creative processes such as brainstorming or other facilitated risk assessment meetings.

Formal PDT meetings were held for the purposes of identifying and assessing risk factors. The formal meeting conducted on November 17, 2009 included the following:

- Program and Project Manger
- Project Engineer (Engineering Technical Lead)
- Real Estate
- District Environmental Coordinator/Specialist
- Civil Design (both AE and District)
- Cost engineers (both AE and District)
- Planning Study Leads
- Districts Economists
- City of Cedar Rapids

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk

factor identification, market analysis, and risk assessment. Specifically, as a result of the Agency Technical Review comments, six additional risks were identified and added to the quantitative study:

Risk Number	Description
CON-MOD	Consideration for Post Award Cost Modifications
INT-1	Consideration for Low and Unknown Internal Risk
EXT-1	Consideration for Low and Unknown External Risk
EXT-2	Differing/Changed Site Conditions
EXT-3	Consideration for Seasonal Weather Impacts
EXT-4	Market Conditions/Bidding Climate

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the with- and without-project conditions at Cedar Rapids.

a. The MII MCACES (Micro-Computer Aided Cost Estimating Software) file "Flood_Study_Measure_27-500_Level_19OCT10.mlp" was the basis for the cost and schedule risk analyses.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. The schedule was analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and monthly recurring costs (unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay).

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for Iowa is 0.95, meaning that this project is not susceptible to differential between the local market and OMB inflation factors for future construction.

e. Per the data in the estimate, the Job Office Overhead (JOOH) amount for the Contract Cost comprises approximately 5.3% of the Project Cost at Baseline. Thus, the assumed monthly recurring rate for this project is 5.3%. For the P80 schedule, this comprises approximately 2.36% of the total contingency due to the accrual of residual fixed costs associated with delay.

f. The Cost Dx guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk "watch list" for further monitoring and evaluation.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the

identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Contingency and Sensitivity Analysis

Table 1 provides the raw construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $18 Million at the P80 confidence level (23% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 16% and 40% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Project Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$80,765,309	$13,457,946	15.84%
80% Confidence Level			
Project Cost	$80,765,309	$18,251,901	22.60%
100% Confidence Level			
Project Cost	$80,765,309	$32,348,032	40.05%

Notes:
1) All costs except Lands and Damages include the recommended contingency of 21%. Lands and Damages contingencies herein reflect 35% (prepared by others).
2) These figures combine uncertainty in the baseline cost estimates and schedule.
3) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of “unknown unknowns”) makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register,

sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost and are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to total project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 28 months based on the P80 level of confidence. These contingencies were used to calculate the projected monthly recurring cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected monthly recurring costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)	Contingency (%)
50% Confidence Level			
Total Project Duration	63	24	38%
80% Confidence Level			
Total Project Duration	63	28	45%
100% Confidence Level			
Total Project Duration	63	41	66%

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

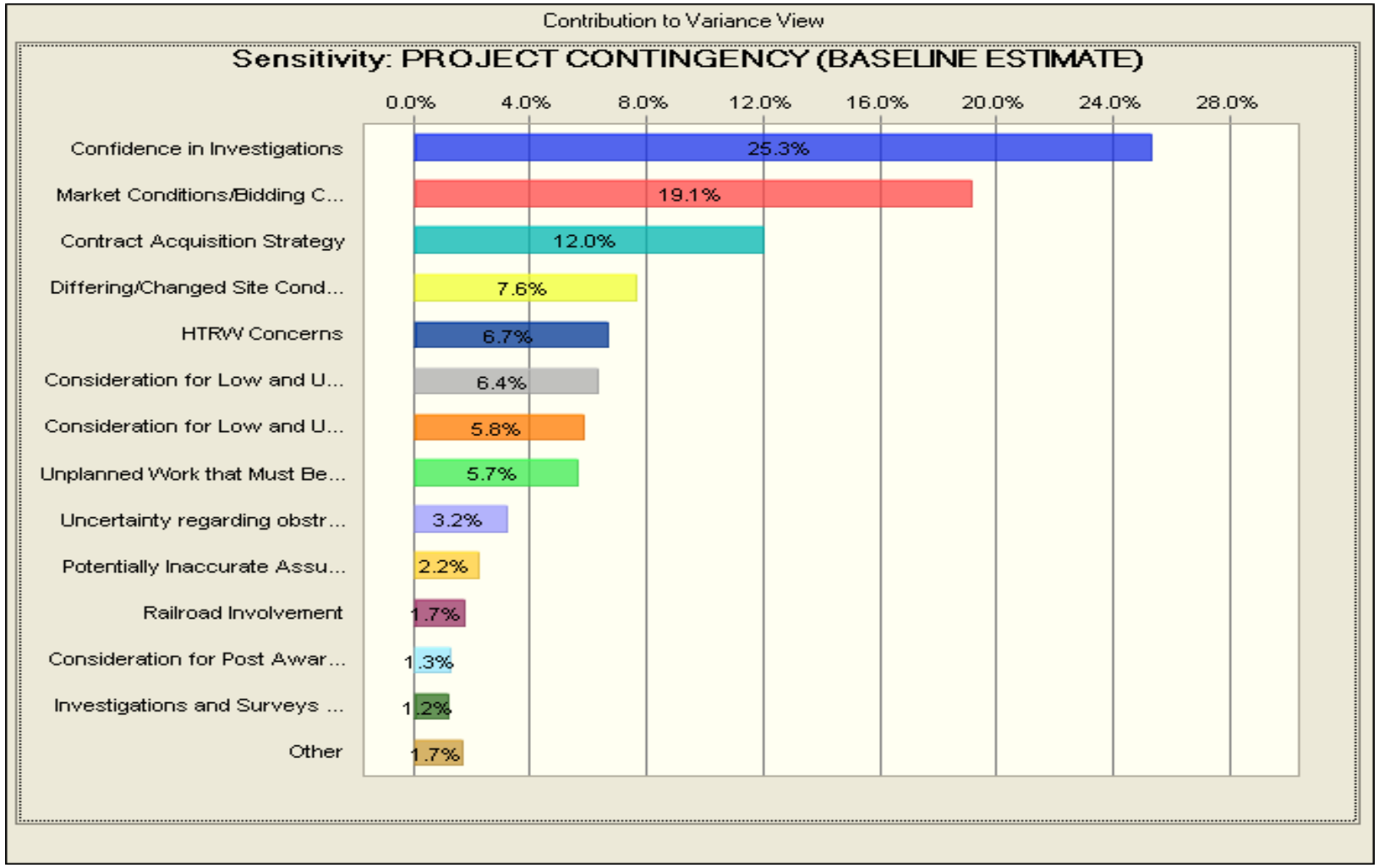
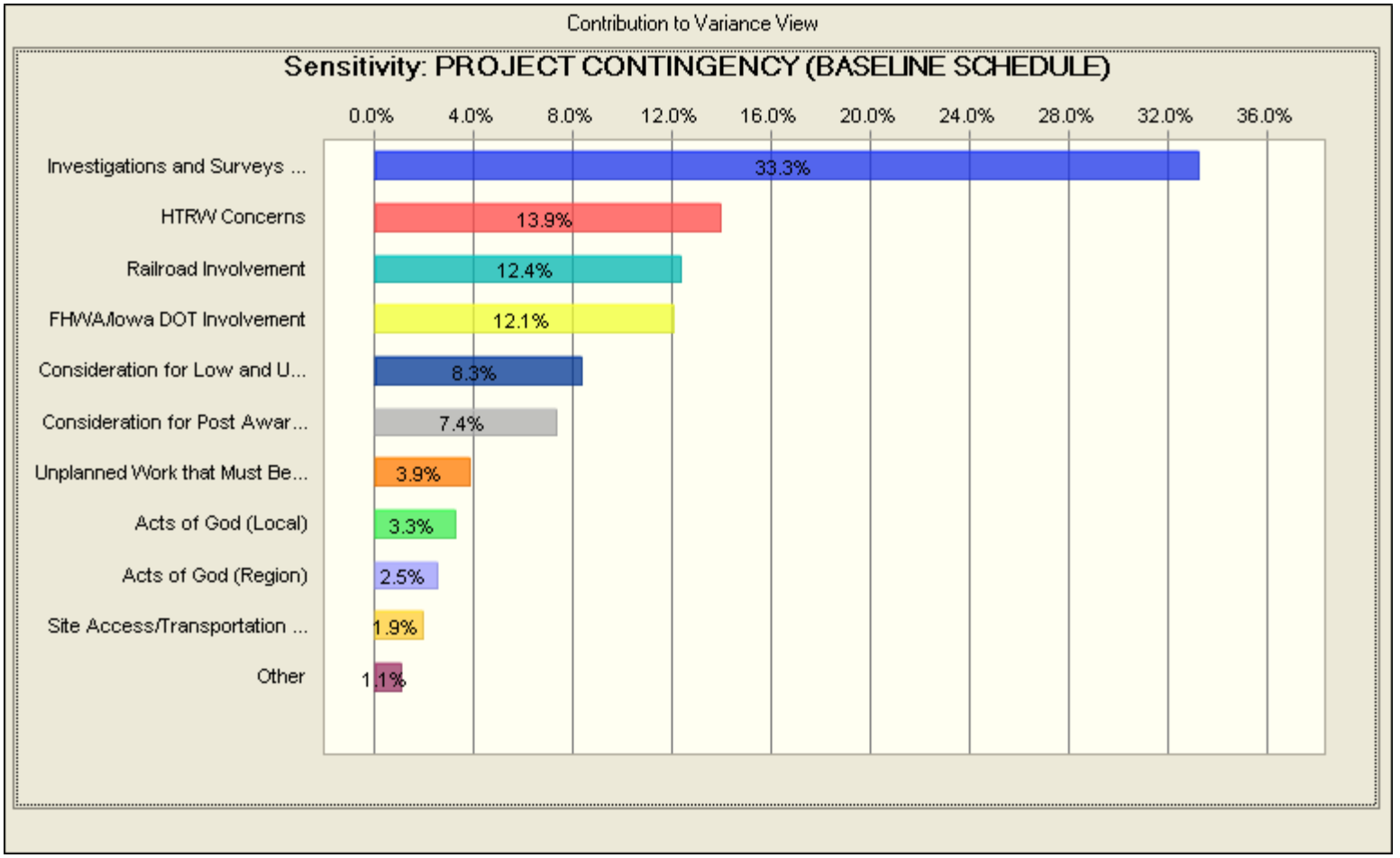


Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Total project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis were Risks TL-2 (Confidence in Investigations) and EXT-4 (Market Conditions/Bidding Climate), which together contribute over 44 percent of the statistical cost variance.

2. The key schedule risk driver identified through sensitivity analysis is Risk RE-1 (Investigations and Surveys Not Complete), which contributes over 33 percent of the statistical schedule variance.

3. The schedule was not resource loaded and contains open-ended tasks, and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected monthly recurring costs. Resource impacts related to potential schedule delays could not be evaluated.

4. Operation and maintenance activities were not included in the cost estimate or schedules. Therefore, a full lifecycle risk analysis could not be performed. Risk analysis results or conclusions could be significantly different if the necessary operation and maintenance activities were included.

Table 3. Project Cost Comparison Summary

Confidence Level	Project Cost ($)	Contingency (%)
P0	**$70,998,476**	**-12.09%**
P5	**$85,127,789**	**5.40%**
P10	**$86,946,351**	**7.65%**
P15	**$88,439,167**	**9.50%**
P20	**$89,547,028**	**10.87%**
P25	**$90,457,786**	**12.00%**
P30	**$91,314,496**	**13.06%**
P35	**$92,086,160**	**14.02%**
P40	**$92,864,539**	**14.98%**
P45	**$93,556,058**	**15.84%**
P50	**$94,223,255**	**16.66%**
P55	**$94,923,218**	**17.53%**
P60	**$95,652,347**	**18.43%**
P65	**$96,423,918**	**19.39%**
P70	**$97,206,994**	**20.36%**
P75	**$98,086,562**	**21.45%**
P80	**$99,017,210**	**22.60%**
P85	**$100,058,947**	**23.89%**
P90	**$101,344,561**	**25.48%**
P95	**$103,234,523**	**27.82%**
P100	**$113,113,341**	**40.05%**

Note: All costs except Lands and Damages include the recommended contingency of 21%. Lands and Damages contingencies herein reflect 35% (prepared by others).

Figure 3. Project Cost Summary

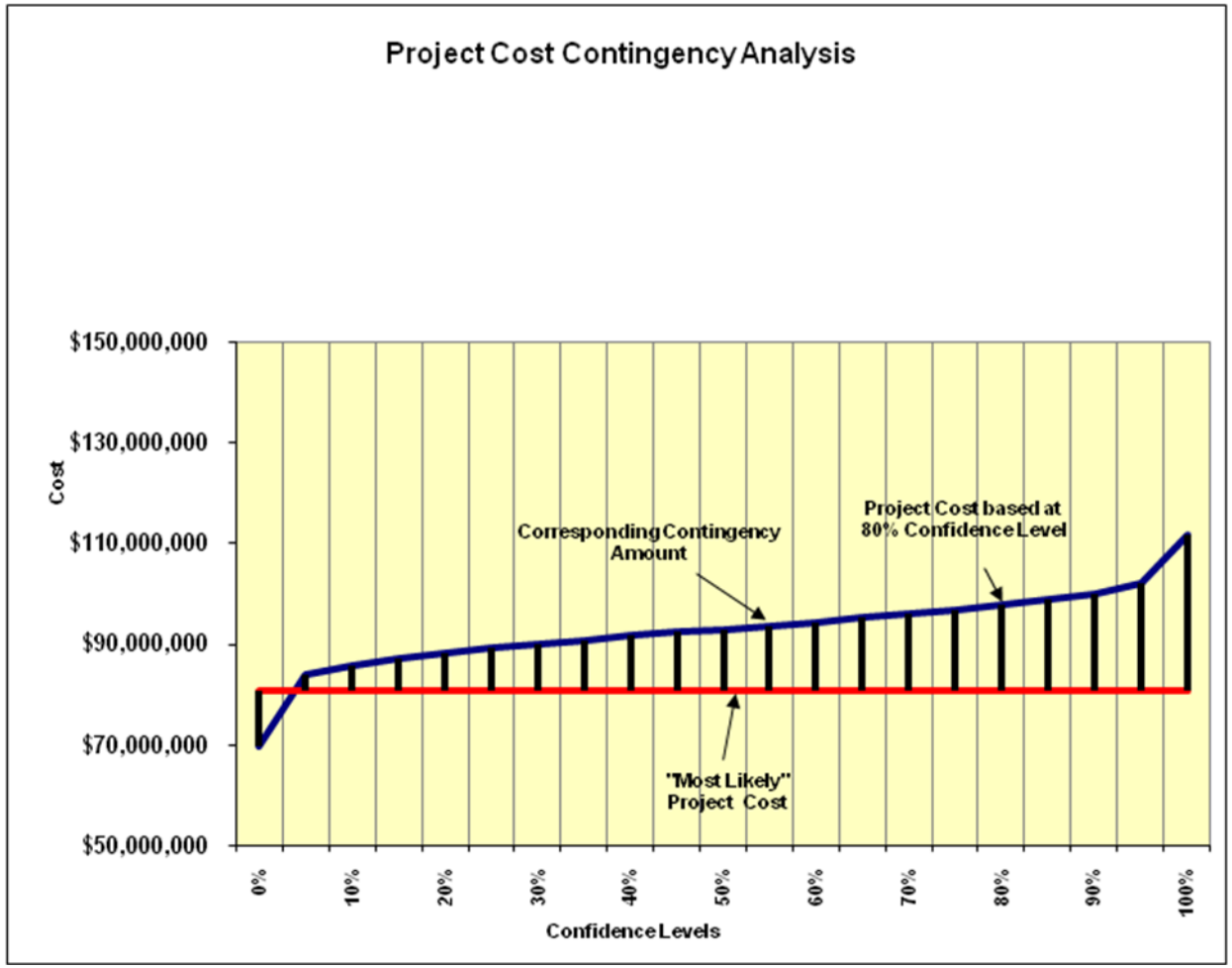
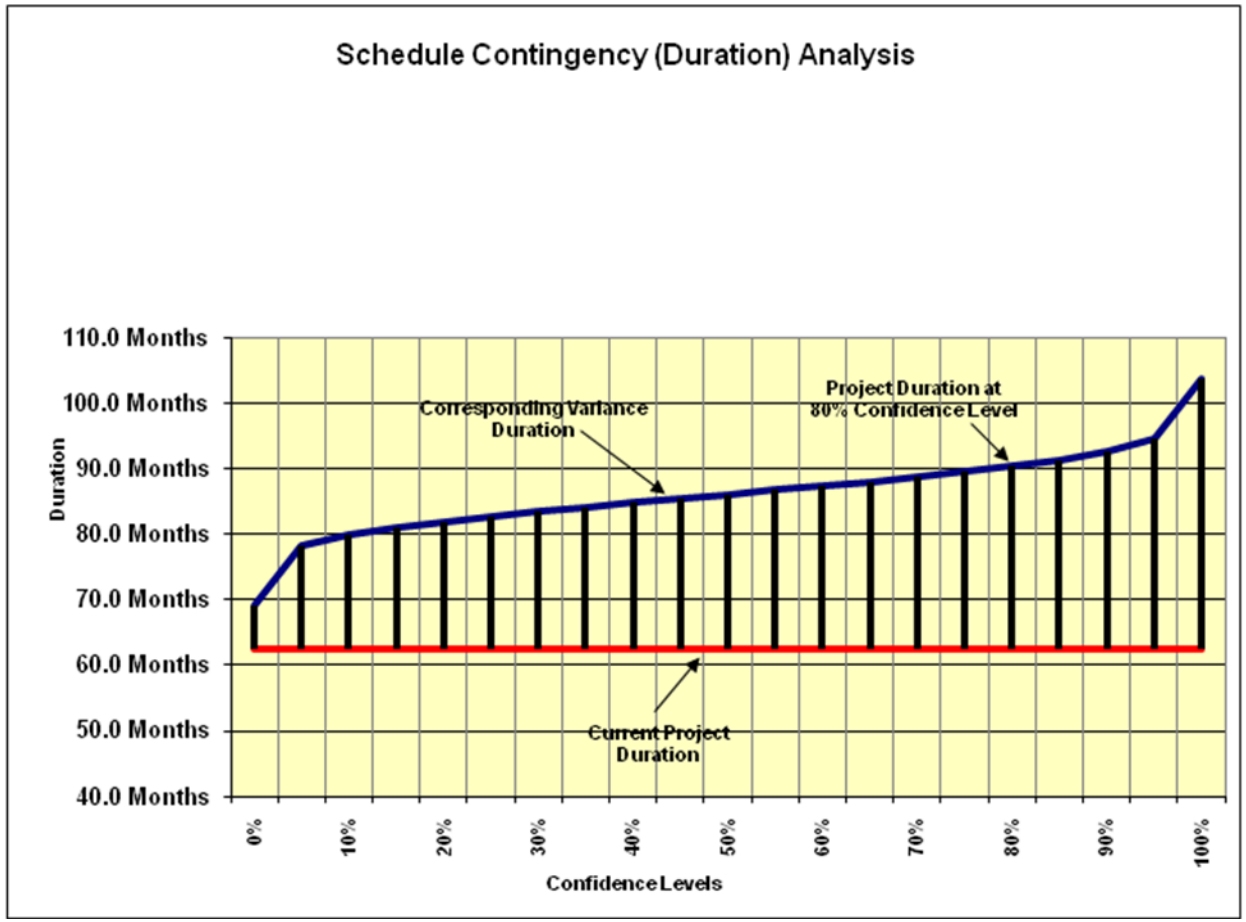


Figure 4. Project Duration Summary



7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that proactive management of risks does not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis were Risks TL-2 (Confidence in Investigations) and EXT-4 (Market Conditions/Bidding Climate), which together contribute over 44 percent of the statistical cost variance.

    a) Confidence in Investigations: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies prior to project authorization, continuing to refine scoping details during the Pre-Construction Engineering and Design (PED Phase).

    b) Market Conditions/Bidding Climate: Project leadership should take proactive measures to obtain decisions regarding acquisition strategy, as well as communication to management regarding the impact of those decisions on cost performance. Project leadership should develop the acquisition strategy to maximize competition and cost control, so that current working estimates can capture the probable costs and schedule durations. The number and type of contracts is related to acquisition strategy and also the ultimate funding situation. Ultimately, this is an external risk, and its impacts must be communicated to management, and funds should be maintained in project reserve for treatment of this risk.

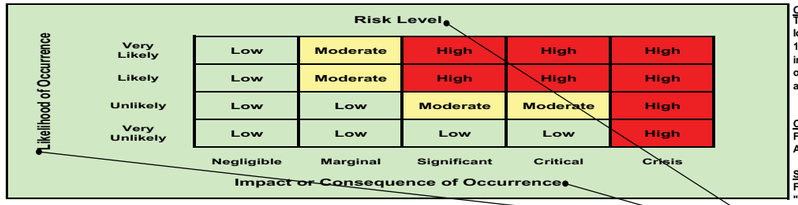
2. Key Schedule Risk Drivers: The key schedule risk driver identified through sensitivity analysis is Risk RE-1 (Investigations and Surveys Not Complete), which contributes over 33 percent of the statistical schedule variance.

a) Investigations and Surveys Not Complete: Project leadership should attempt to capture and finalize the scope of the project to the maximum extent possible. It is imperative to identify all features of work and probable methodologies prior to project authorization, continuing to refine scoping details during the Pre-Construction Engineering and Design (PED Phase). Ultimately, an accurate schedule with a reasonable level of detail (i.e. consideration for critical path and near critical path activities, reasonable activity duration estimates, resource lags, etc.) will reduce uncertainty and provide a better platform for managing risk of schedule delay.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

Cedar Rapids Feasibility Study - PDT Risk Register



Overall Project Scope
The Cedar Rapids Project is a flood risk management project throughout the vicinity of the City of Cedar Rapids, Iowa. Cedar Rapids is located along a historical rapids site along the Cedar River. Currently, there are as many as 13 alternatives being considered, each consisting of variations of a network of levee construction and improvements along the river banks throughout the region of Cedar Rapids. The approximate order of magnitude of the project is $150 Million in total project cost, and will include phased design and construction lasting approximately 10 years.

Cost Impacts
For the Cedar Rapids Project, any cost impact of $1.5 Million or higher should be considered at least "Significant." Anything over $750,000 should be considered at least "Marginal."

Schedule Impacts
For the Cedar Rapids Project, any schedule impact of 12 months or greater should be considered at least "Significant." Anything over 6 months should be considered at least "Marginal."

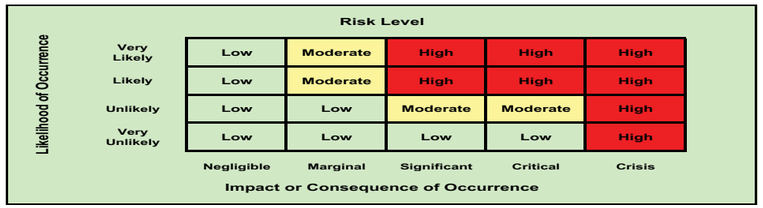
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost			Project Schedule			Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*				
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)												
	PROJECT & PROGRAM MGMT												
PPM-1	Competing With Other Projects for Funding	There are other projects around the country competing for the same funding.	Could cause schedule delays.	Likely	Significant	High	Likely	Critical	High	Triangular		District Management	Project Cost & Schedule
PPM-2	Compressed Schedule to meet Chief's Report Schedule	The PDT does not have the time to prepare the final report, causing quality issues with the report.	Small potential for cost implications associated with lesser quality. Overriding issues is related to schedule delay caused by report needing reformulation and rework.	Very Unlikely	Significant	Low	Very Unlikely	Critical	Low	Triangular		District Management	Project Cost & Schedule
PPM-3	Internal Red Tape Causes Delays in Obtaining Approvals	There is a great deal of process, review, and approval to get the final authorization.	Could cause schedule delays.	Likely	Marginal	Moderate	Likely	Significant	High	Triangular		District Management	Project Schedule
PPM-4	Regulator Agency Issues	There are concerns about coordinating and obtaining the efforts from required external agencies, such as FWS and SHPO.	Could cause schedule delays.	Likely	Significant	High	Likely	Significant	High	Uniform		Project Manager	Project Cost & Schedule
PPM-5	Seasonal Window for Completing Investigations	Some investigations can only occur in certain seasons.	Could cause schedule delays.	Very Unlikely	Marginal	Low	Very Unlikely	Significant	Low	Triangular		Technical Lead	Project Cost & Schedule
PPM-6	Unplanned Work that Must Be Accommodated	Stakeholders may request or require additional work based on future investigations and studies.	Could impact cost and schedule.	Unlikely	Significant	Moderate	Unlikely	Significant	Moderate	Uniform		Project Sponsor(s)	Project Cost & Schedule
	OPPORTUNITY												
PPM-7	Pressure to Deliver on an Accelerated Schedule	There is already pressure to deliver the Chief's Report on an accelerated timeline, and indications that this same pressure could prevail throughout the remainder of the project.	Could impact cost and schedule. This actually has positive implications for cost and schedule.	Very Likely	Significant	High	Very Likely	Significant	High	Custom		District Management	Project Cost & Schedule
PPM-8	Insufficient Time to Plan	The PDT is on an accelerated timeline, and may not have adequate time to plan or perform all necessary activities normally associated with a project of this type. This could lead to issues of lesser quality (this potential is introduced by lacking time to collect all data that would normally be studied).	Could impact cost and schedule.	Very Likely	Significant	High	Very Likely	Significant	High	Uniform		District Management	Project Cost & Schedule
	CONTRACT ACQUISITION RISKS												
CA-1	Contract Acquisition Strategy Undefined	There is no defined acquisition strategy, as it has received no decision from the TASB or the Contracting Officer on the ultimate contracting and contract phasing plan.	Could affect contract costs and project schedule.	Very Likely	Significant	High	Very Likely	Marginal	Moderate	Triangular		TASB	Contract Cost
	OPPORTUNITY												
CA-2	Contract Phasing	Depending on the contract phasing scheme, there could be some significant project performance improvement.	Could positively affect cost and schedule.	Likely	Significant	High	Likely	Significant	High	Triangular		TASB	Contract Cost & Project Schedule
	TECHNICAL RISKS												

TL-1	Design Development Incomplete	Design templates have been applied due to the accelerated schedule. Some details and templates are being used throughout. PDT feels that some of these design assumptions are conservative.	Although the team has accounted for the features on the conservative side, this could impact costs and schedule both positively or negatively.	Very Likely	Significant	High	Very Likely	Negligible	Low	Triangular		Technical Lead	Project Cost
TL-2	Confidence in Investigations	Surveying and geotechnical investigations are incomplete. There is a gap in the survey data that runs through the alignment. There is some information available from the City.	Although the team has accounted for the features on the conservative side, this could impact costs and schedule both positively or negatively.	Very Likely	Significant	High	Very Likely	Negligible	Low	Triangular		Technical Lead	Project Cost
TL-3	Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issues	PDT has expressed that the exact alignment is not known, and there is not detailed information available regarding utility location/configuration. Assumptions made that may impact the eventual alignment/relocation scheme.	Could impact contract cost and project schedule.	Very Likely	Significant	High	Very Likely	Marginal	Moderate	Triangular		Technical Lead	Project Cost
TL-4	Innovative Design/First of a Kind Issues	Several closure gates included in the design at various locations with heights that exceed the industry norm. Difficult to locate suppliers capable of manufacturing.	Could impact contract cost and project schedule.	Likely	Significant	High	Very Likely	Significant	High	Custom		Technical Lead	Project Cost & Schedule
TL-5	Uncertainty regarding obstructions/construction constraints (structural)	There are a number of known obstructions and structures to work around. The exact configuration and impact is unknown.	Could impact contract cost and project schedule.	Very Likely	Significant	High	Very Likely	Significant	High	Triangular		Technical Lead	Project Cost & Schedule
TL-6	Borrow Site Plan in Question	There is consensus that there will be suitable and sufficient material locally. However, it may be found through investigation to be at site further than anticipated in the baseline estimate. The other potential issue is that borrow sites could be ruled out due to environmental issues.	Could impact contract cost.	Very Unlikely	Marginal	Low	Very Likely		Low	Triangular		Geotechnical/Civil Design	Project Cost & Schedule
	LANDS AND DAMAGES RISKS												
LD-1	Real Estate Plan Undefined (Corps)	The alignment has not been determined, so this could significantly impact the footprint required for Federal land acquisition.	Could affect costs and project schedule.	Very Likely	Marginal	Moderate	Very Likely	Significant	High	Triangular		Real Estate	Project Schedule
LD-2	Real Estate Plan for Mitigation and Borrow Needs Identified	There will be mitigation required, but the exact footprint is not necessarily captured by the current real estate plan.	Could affect costs and project schedule.	Likely	Negligible	Low	Likely	Negligible	Low	Uniform		Real Estate	Project Cost & Schedule
LD-3	Potential Property Condemnations	There are so many property owners involved in the current footprint, that there is potential to have objections from landowners, necessitating possible condemnations.	Could affect costs and project schedule.	Very Likely	Significant	High	Very Likely	Significant	High	Uniform		Real Estate	Project Cost & Schedule
LD-4	Railroad Involvement	Two to four railroads in project area. One is owned by a utility company (CRANDIC), and one by Union Pacific (may be also Canadian National and Iowa Northern).	PDT has dealt railroad before and had positive results. However, there is still risk of cost impact or delays due to railroad involvement.	Very Likely	Marginal	Moderate	Very Likely	Critical	High	Uniform		Project Sponsor(s)	Project Schedule
LD-5	FHWA/Iowa DOT Involvement	Federal Highways and Iowa DOT has jurisdiction over roadways that run through the project alignment.	Could cause schedule delays.	Very Likely		Low	Very Likely	Marginal	Moderate	Uniform		Project Sponsor(s)	Project Schedule
LD-6	Relocation Assumptions	Plan assumed that relocations would extend 30-feet from the landward toe of the levees. This may change, as the alignment is not final.	Could affect project costs.	Likely	Significant	High	Likely	Negligible	Low	Uniform		Real Estate	Project Cost
LD-7	Potentially Inaccurate Assumptions Made Specific to Number of Properties to be Purchased	It is not known how many buyouts will occur and by which entity. This could dramatically change the real estate appraisal values and plan.	Could impact cost and schedule (either positively or negatively). Could impact the eventual benefits calculations (decrease).	Very Likely	Significant	High	Very Likely	Significant	High	Triangular		Real Estate	Project Cost & Schedule
LD-8	Uncertainty regarding availability of relocation housing	There may not be suitable and available housing for all of the property tenants that are to be relocated.	Could impact cost and schedule (either positively or negatively).	Very Likely	Significant	High	Very Likely	Significant	High	Uniform		Real Estate	Project Cost & Schedule
	REGULATORY AND ENVIRONMENTAL RISKS												
RE-1	Investigations and Surveys not complete	The cultural resource surveys have not been conducted or completed yet. There are indications of archaeological concerns.	Could impact cost and schedule.	Very Likely	Significant	High	Very Likely	Significant	High	Triangular		Environmental Compliance	Project Cost & Schedule
RE-2	HTRW Concerns	The HTRW surveys and investigations are not complete. Currently in Phase I. May know soon regarding the potential issues that exist.	Could impact cost and schedule.	Very Likely	Significant	High	Very Likely	Significant	High	Uniform		Environmental Compliance	Project Cost & Schedule
RE-3	Adaptive Management	The authorization included an ecosystem restoration component for the project.	Could impact cost and schedule.	Unlikely	Significant	Moderate	Unlikely	Significant	Moderate	Uniform		Environmental Compliance	Project Cost & Schedule

	OPPORTUNITY												
RE-4	Opportunity if the Czech Museum Relocates	Currently, the estimate assumes the Czech Museum will stay within the project footprint, which costs considerably more.	If the Museum relocates (willingly), it could create substantial savings.	Likely	Marginal	Moderate	Likely	Negligible	Low	Uniform		Project Manager	Project Cost
RE-5	Potential Impact to the African American Museum of Iowa	The current plan assumed that there will be no impact to the Museum. However, if a 500 year plan is implemented, then they would be impacted, and purchase of the property and relocation would become project costs.	Could impact cost.	Likely	Marginal	Moderate	Likely	Negligible	Low	Uniform		Project Manager	Project Cost
RE-6	Potential Archaeological Sites	Historically occupied site for 100s of years. Indications (geomorphologic investigations) are that there will be archaeological sites and finds discovered.	Could impact cost and schedule.	Likely	Marginal	Moderate	Likely	Significant	High	Uniform		Project Manager	Project Schedule
	CONSTRUCTION RISKS												
	OPPORTUNITY												
CON-1	Uncertainty with Construction Schedule/Contract Sequencing	The exact scheme of contract sequencing is unknown. Could improve the overall project delivery schedule.	Could improve the project schedule.	Likely	Significant	High	Likely	Significant	High	Triangular		Technical Lead	Contract Cost & Project Schedule
CON-2	Equipment Availability	This is a large job that will require a great deal of equipment and specialized trucks that may be more than the region has to offer.	Could impact contract costs.	Likely	Significant	High	Likely	Negligible	Low	Triangular		Cost Engineering	Contract Cost
CON-3	Inadequate Housing/Utilities to Support Workforce	This job will require a large workforce, many of whom may have to travel in from outside the area. There may not be adequate housing and/or temporary facilities to accommodate them.	Could impact contract costs.	Likely	Marginal	Moderate	Likely	Negligible	Low	Triangular		Cost Engineering	Contract Cost
CON-4	Labor Force Availability	This job will require a large workforce, many of whom may have to travel in from outside the area. There may be a shortage of workforce, causing potential challenges for the project to be prosecuted.	Could impact contract costs.	Likely	Marginal	Moderate	Likely	Negligible	Low	Triangular		Cost Engineering	Contract Cost
CON-5	Critical Fabrication Delivery	There will be potential issues in the fabrication of the closure structures, since they are taller that typical.	Could impact cost and schedule.	Likely	Marginal	Moderate	Likely	Significant	High	Triangular		Technical Lead	Contract Cost & Project Schedule
CON-6	Site Access/Transportation Issues	There are some narrow thoroughfares and tight access points for a 3-block run in downtown. Also, this would significantly increase traffic through downtown Cedar Rapids. There are site access issues in several areas of the project alignment.	Could impact cost and schedule.	Very Likely	Marginal	Moderate	Very Likely	Marginal	Moderate	Triangular		Technical Lead	Contract Cost & Project Schedule
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)												
PR-1	Adequacy of Project Funding	Iowa has very influential Senators. If they were not re-elected, this could significantly impact the funding of the project.	Could impact cost and schedule.	Very Unlikely	Significant	Low	Very Unlikely	Significant	Low	Uniform		Project Manager	Project Cost & Schedule
	OPPORTUNITY												
PR-2	Acts of God (Local)	Another flood event in the area could cause increased awareness and urgency, which could be a net positive for the success of this project.	Could positively impact cost and schedule.	Likely	Significant	High	Likely	Significant	High	Uniform		N/A	Project Cost & Schedule
PR-3	Acts of God (Region)	A catastrophic event elsewhere could draw away resources from this project.	Could impact cost and schedule.	Likely	Significant	High	Likely	Significant	High	Uniform		N/A	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).
1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Cedar Rapids Feasibility Study - PDT Risk Register for Alternative 4C - Conducted on 2010-03-30



Overall Project Scope

The Cedar Rapids Feasibility Study resulted in Alternative 4C as being the Governments recommended plan. Alternative 4C provides a level of flood protection close to the epic flood of 2008 height for the east side downtown area of Cedar Rapids, Iowa. Cedar Rapids is located along a historical rapids site along the Cedar River. Alternative 4C main features consist of concrete floodwalls, closure structures and earthen levees. The order of magnitude of Alternative 4C is $100 Million in total project cost. Design and construction is planned to occur over a 5 year period.

Cost Impacts
For the Cedar Rapids Project, any cost impact of $1.0 Million or higher should be considered at least "Significant."
Anything over $500,000 should be considered at least "Marginal."

Schedule Impacts
For the Cedar Rapids Project, any schedule impact of 12 months or greater should be considered at least "Significant."
Anything over 6 months should be considered at least "Marginal."

				Project Cost				Project Schedule							
Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
PROJECT & PROGRAM MGMT															
PPM-1	Competing With Other Projects for Funding	There are other projects around the country competing for the same funding.	Project is of such a size that specific congressional funding will be needed. Funding is not expected within the normal USACE budget. PDT believes if congressional funding does not occur within the first year or two after authorization that funding will likely never occur.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular		District Management	Project Cost & Schedule
PPM-2	Compressed Schedule to meet Chief's Report Schedule	The PDT does not have the time to prepare the final report, causing quality issues with the report.	This has very little to do with the PED and construction schedule. The reality is that the compressed schedule is allowing the PDT to focus on the feasibility deadline of December 2010. Feasibility phase continues to be on schedule.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Unlikely	Negligible	Low	Low - Not Studied	Triangular	PPM-3 & PPM-7	District Management	Project Cost & Schedule
PPM-3	Internal Red Tape Causes Delays in Obtaining Approvals	There is a great deal of process, review, and approval to get the final authorization.	This relates to the feasibility study. Our District has held multiple In Progress Review meetings with Division and HQ to make sure everyone is on board with the schedule and coordination of review approvals. The project has developed a very reasonable 5-year schedule for the PED and construction.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular	PPM-2 & PPM-7	District Management	Project Schedule
PPM-4	Regulator Agency Issues	There are concerns about coordinating and obtaining the efforts from required external agencies, such as FWS and SHPO.	Coordination with regulator agencies is ongoing during the feasibility phase. No environmental impacts have been identified. Very few existing structures are impacted by the footprint of Alignment 4C.	Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Uniform		Project Manager	Project Cost & Schedule
PPM-5	Seasonal Window for Completing Investigations	Some investigations can only occur in certain seasons.	Low risk since seasonal investigations have been completed or are currently occurring. Investigations that may occur during PED can be obtained any time of the year.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Project Cost & Schedule
PPM-6	Unplanned Work that Must Be Accommodated	Stakeholders may request or require additional work based on future investigations and studies.	Project can only proceed in what has been authorized as a result of the feasibility report. Betterments after authorization would come at 100% of the local cost share.	Unlikely	Significant	Moderate	$3.7 Million	Unlikely	Significant	Moderate	2.4 months	Uniform		Project Sponsor(s)	Project Cost & Schedule
PPM-7	Pressure to Deliver on an Accelerated Schedule	There is already pressure to deliver the Chief's Report on an accelerated timeline, and indications that this same pressure could prevail throughout the remainder of the project.	This correlates to PPM-2. A reasonable 5-year schedule has been developed for PED and Construction phases. This is viewed as a positive for the study in the way of saved costs.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Unlikely	Negligible	Low	Low - Not Studied	Custom	PPM-2 & PPM-3	District Management	Project Cost & Schedule
PPM-8	Insufficient Time to Plan	The PDT is on an accelerated timeline, and may not have adequate time to plan or perform all necessary activities normally associated with a project of this type. This could lead to issues of lesser quality (this potential is introduced by lacking time to collect all data that would normally be studied).	Developed a project schedule that reflects a reasonable 2-years to complete PED and Real Estate before construction begins. PDT has addressed all necessary feasibility study elements.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Uniform		District Management	Project Cost & Schedule
CONTRACT ACQUISITION RISKS															
CA-1	Contract Acquisition Strategy	There is no defined acquisition strategy, as it has received no decision from the TASB or the Contracting Officer on the ultimate contracting and contract phasing plan.	A contract acquisition plan was developed for this project. Unrestricted invitation for bids would take place on a single construction contract. Authority to do so is being coordinated through Division and HQ. The future may hold some acquisition rule c	Likely	Marginal	Moderate	$2.6 Million	Unlikely	Marginal	Low	Low - Not Studied	Triangular	CA-2	TASB	Contract Cost
CA-2	Contract Phasing	Depending on the contract phasing scheme, there could be some significant project performance improvement.	PDT recommended that this be lumped into CA-1. A detailed 5-year project schedule was developed for Alternative 4C. The schedule plans for a single construction contract.			Low	Low - Not Studied			Low	Low - Not Studied	Triangular	CA-1	TASB	Contract Cost & Project Schedule

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
TECHNICAL RISKS															
TL-1	Design Development Incomplete	Design templates have been applied due to the accelerated schedule. Some details and templates are being used throughout. PDT feels that some of these design assumptions are conservative.	Design development for Alternative 4C is believed to be very conservative. Levee embankment was modeled in Inroads so one would expect a contingency 10% or less on this line item. Estimated floodwall heights were all rounded upward in increments of 3-feet. For example, if a design floodwall height was 6.5 feet, the cost estimate figured the unit price for a floodwall 9-feet high. A VE analysis will be happening in the next couple of months that may find additional cost savings.	Unlikely	Significant	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Project Cost
TL-2	Confidence in Investigations	Surveying and geotechnical investigations are incomplete. There is a gap in the survey data that runs through the alignment. There is some information available from the City.	This is seen as a cost savings opportunity. 6-feet of over excavation and backfill was figured for all floodwalls taking a very conservative assumption of bad foundations throughout. Good borrow material has been identified on City owned property at the Cedar Rapids Regional Airport. Existing estimates are based on this borrow location.	Likely	Significant	High	$656,000	Likely	Negligible	Low	Low - Not Studied	Triangular	TL-6	Technical Lead	Project Cost
TL-3	Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issues	PDT has expressed that the exact alignment is not known, and there is not detailed information available regarding utility location/configuration. Assumptions made that may impact the eventual alignment/relocation scheme.	Alternative 4C is now defined along with all utilities impacted within the footprint of this alignment. All known utilities, based on as-builts, are accounted for in the cost estimate and looked at in detail by our A/E since cost on this are a large cost of the project.	Likely	Marginal	Moderate	$948,000	Likely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Project Cost
TL-4	Innovative Design/First of a Kind Issues	Several closure gates included in the design at various locations with heights that exceed the industry norm. Difficult to locate suppliers capable of manufacturing.	Alternative 4C does not involve closure structures much above 20 feet. Originally, there were alternatives on the table that had closure structures in the 25 to 30 foot range. This original concern is not see as an issue.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Custom		Technical Lead	Project Cost & Schedule
TL-5	Uncertainty regarding obstructions/construction constraints (structural)	There are a number of known obstructions and structures to work around. The exact configuration and impact is unknown.	Alternative 4C is located entirely on the east side that has significantly fewer obstructions than the west side. Obstructions are in close proximity to the alignment such as downtown buildings and I-380 Bridge but alignment consists of floodwalls through	Likely	Marginal	Moderate	$1.5 Million	Unlikely	Marginal	Low	Low - Not Studied	Triangular		Technical Lead	Project Cost & Schedule
TL-6	Borrow Site Plan in Question	There is consensus that there will be suitable and sufficient material locally. However, it may be found through investigation to be at site further than anticipated in the baseline estimate. The other potential issue is that borrow sites could be ruled out due to environmental issues.	A plentiful amount of land with lean clay has been confirmed with borings at the Cedar Rapids Regional Airport. The City owns the property that the airport resides on. Construction estimates are based on obtaining borrow from this location.	Very Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Triangular	TL-2	Geotechnical/Civil Design	Project Cost & Schedule
LANDS AND DAMAGES RISKS															
LD-1	Real Estate Plan Undefined (Corps) - Non RR	The alignment has not been determined, so this could significantly impact the footprint required for Federal land acquisition.	Alternative 4C has now been identified as the recommended alignment. RE Plan will be completed by the end of April 2010.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Significant	Moderate	1.1 months	Triangular		Real Estate	Project Schedule
LD-2	Real Estate Plan for Mitigation and Borrow Needs Identified	There will be mitigation required, but the exact footprint is not necessarily captured by the current real estate plan.	PDT sees this risk as being the same as LD-1 and should be lumped into it.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Significant	Moderate	1 month	Uniform	LD-1	Real Estate	Project Cost & Schedule
LD-3	Potential Property Condemnations	There are so many property owners involved in the current footprint, that there is potential to have objections from landowners, necessitating possible condemnations.	Alternative 4C is located entirely on the east side. Very few private residences are impacted under the footprint of the east side alignment vs. hundreds that were in play on any west side alignment. The City owns a majority of the ROW for Alignment 4C along with two large industries that are favorable of the project.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Uniform		Real Estate	Project Cost & Schedule
LD-4	Railroad Involvement	Two to four railroads in project area. One is owned by a utility company (CRANDIC), and one by Union Pacific (may be also Canadian National and Iowa Northern).	Cost estimates for closure structures are based on previous contracts with RR.	Likely	Marginal	Moderate	$1.9 million	Likely	Significant	High	4.8 months	Uniform		Project Sponsor(s)	Project Schedule
LD-5	FHWA/Iowa DOT Involvement	Federal Highways and Iowa DOT has jurisdiction over roadways that run through the project alignment.	Historically the Iowa DOT has been very responsive.	Unlikely	Negligible	Low	Low - Not Studied	Likely	Marginal	Moderate	4.8 months	Uniform		Project Sponsor(s)	Project Schedule
LD-6	Relocation Assumptions	Plan assumed that relocations would extend 30-feet from the landward toe of the levees. This may change, as the alignment is not final.	Footprints of Alternative 4C were developed in Inroads. The footprints developed were based on an design elevation related to the 2008 flood level so are conservative given that Alternative 4C is at a lower design elevation.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Uniform		Real Estate	Project Cost
LD-7	Potentially Inaccurate Assumptions Made Specific to Number of Properties to be Purchased	It is not known how many buyouts will occur and by which entity. This could dramatically change the real estate appraisal values and plan.	PDT thought this should be lumped into LD-1. All buy outs by the City are occurring on the west side so risk does not apply to Alternative 4C.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular	LD-1	Real Estate	Project Cost & Schedule
LD-8	Uncertainty regarding availability of relocation housing	There may not be suitable and available housing for all of the property tenants that are to be relocated.	Almost all residential houses are on the west side. Alternative 4C that lies on the east side only a few residential properties that will be impacted.	Very Unlikely	Negligible	Low	Low - Not Studied	Very Unlikely	Negligible	Low	Low - Not Studied	Uniform		Real Estate	Project Cost & Schedule

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)				
REGULATORY AND ENVIRONMENTAL RISKS															
RE-1	Investigations and Surveys not complete	The cultural resource surveys have not been conducted or completed yet. There are indications of archaeological concerns.	Programmatic agreement is in place with SHPO. A 1% of the total construction costs has been estimated for cultural mitigation. Very few structures are being impacted on Alternative 4C.	Likely	Marginal	Moderate	$1.4 million	Likely	Significant	High	6.7 months	Triangular		Environmental Compliance	Project Cost & Schedule
RE-2	HTRW Concerns	The HTRW surveys and investigations are not complete. Currently in Phase I. May know soon regarding the potential issues that exist.	Could impact cost and schedule.	Likely	Marginal	Moderate	$4 million	Likely	Significant	High	4.8 months	Uniform		Environmental Compliance	Project Cost & Schedule
RE-3	Adaptive Management	The authorization included an ecosystem restoration component for the project.	No identified ecosystem impacts on Alternative 4C.			Low	Low - Not Studied			Low	Low - Not Studied	Uniform		Environmental Compliance	Project Cost & Schedule
RE-4	Opportunity if the Czech Museum Relocates	Currently, the estimate assumes the Czech Museum will stay within the project footprint, which costs considerably more.	Czech Museum is located on the west side. Alternative 4C protects only the east side. Remove from risk matrix.											Project Manager	Project Cost
RE-5	Potential Impact to the African American Museum of Iowa	The current plan assumed that there will be no impact to the Museum. However, if a 500 year plan is implemented, then they would be impacted, and purchase of the property and relocation would become project costs.	Museum will not be impacted by the footprint of the project. However, it will remain on the wet side of the line of protection with no relocation planned.	Unlikely	Negligible	Low	Low - Not Studied	Very Unlikely	Negligible	Low	Low - Not Studied	Uniform		Project Manager	Project Cost
RE-6	Potential Archaeological Sites	Historically occupied site for 100s of years. Indications (geomorphologic investigations) are that there will be archaeological sites and finds discovered.	This is the same risk as associated in RE-1.	Likely	Marginal	Moderate	Captured by Risk RE-1	Likely	Significant	High	Captured by Risk RE-1	Uniform	RE-1	Project Manager	Project Schedule
CONSTRUCTION RISKS															
CON-1	Uncertainty with Construction Schedule/Contract Sequencing	The exact scheme of contract sequencing is unknown. Could improve the overall project delivery schedule.	A construction schedule and contract sequencing was developed by the PDT. Construction schedule involves one large contract completed over a 3-year construction schedule. The schedule and cost estimate was laid out to correspond to normal working hours and days for the contractor.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Marginal	Low	Low - Not Studied	Triangular		Technical Lead	Contract Cost & Project Schedule
CON-2	Equipment Availability	This is a large job that will require a great deal of equipment and specialized trucks that may be more than the region has to offer.	Alternative 4C has an overall construction estimate of $70.9 million. Given a 3-year construction schedule with one large contract, equipment availability should not be an issue.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
CON-3	Inadequate Housing/Utilities to Support Workforce	This job will require a large workforce, many of whom may have to travel in from outside the area. There may not be adequate housing and/or temporary facilities to accommodate them.	Alternative 4C has an overall construction estimate of $70.9 million. Given a 3-year construction schedule with one large contract, housing and facilities will not be an issue.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
CON-4	Labor Force Availability	This job will require a large workforce, many of whom may have to travel in from outside the area. There may be a shortage of workforce, causing potential challenges for the project to be prosecuted.	Alternative 4C has an overall construction estimate of $70.9 million. Given a 3-year construction schedule with one large contract, workforce availability will not be an issue.	Unlikely	Marginal	Low	Low - Not Studied	Unlikely	Negligible	Low	Low - Not Studied	Triangular		Cost Engineering	Contract Cost
CON-5	Critical Fabrication Delivery	There will be potential issues in the fabrication of the closure structures, since they are taller that typical.	Largest closure structures are less than 20-feet in height. Construction of similar sized gates in the past have been completed. Project schedule has been worked out to have construction of gates during the course of 3-years.	Likely	Marginal	Moderate	$664,000	Likely	Negligible	Low	Low - Not Studied	Triangular		Technical Lead	Contract Cost & Project Schedule
CON-6	Site Access/Transportation Issues	There are some narrow thoroughfares and tight access points for a 3-block run in downtown. Also, this would significantly increase traffic through downtown Cedar Rapids. There are site access issues in several areas of the project alignment.	The haul route from the borrow site will follow Interstate 380 from the airport to the downtown area. The project schedule has only two bridge closures being worked on at any given time. Cedar Rapids has seven bridges across the Cedar River along the project area through the downtown area. Closure of a couple of bridges at a time will not be a significant interruption to traffic. A total of 30-feet of permanent easement and 15-feet of temporary easement exist on the landside of the system throughout the entire alignment to account for relocations of utilities and roadways and to account for staging areas.	Very Likely	Marginal	Moderate	$1.7 million	Very Likely	Marginal	Moderate	1.7 months	Triangular		Technical Lead	Contract Cost & Project Schedule
PROGRAMMATIC RISKS (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
PR-1	Adequacy of Project Funding	Iowa has very influential Senators. If they were not re-elected, this could significantly impact the funding of the project.	Could impact cost and schedule.	Very Unlikely	Significant	Low	Low - Not Studied	Very Unlikely	Significant	Low	Low - Not Studied	Uniform		Project Manager	Project Cost & Schedule
PR-2	Acts of God (Local)	Another flood event in the area could cause increased awareness and urgency, which could be a net positive for the success of this project.	Correlates to PR-3.	Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	2.4 months	Uniform	PR-3	N/A	Project Cost & Schedule
PR-3	Acts of God (Region)	A catastrophic event elsewhere could draw away resources from this project.	The possibility for an Act of God event to coincide when construction is underway is seen as very remote.	Unlikely	Negligible	Low	Low - Not Studied	Unlikely	Significant	Moderate	2.4 months	Uniform	PR-2	N/A	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
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11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$80,765,309**
Baseline Estimate Cost Contingency Amount ->	$15,139,554
Baseline Estimate Construction Cost (80% Confidence) ->	**$95,904,863**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**62.5 Months**
Schedule Contingency Duration ->	27.8 Months
Project Schedule Duration (80% Confidence) ->	**90.3 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$1,908,547**

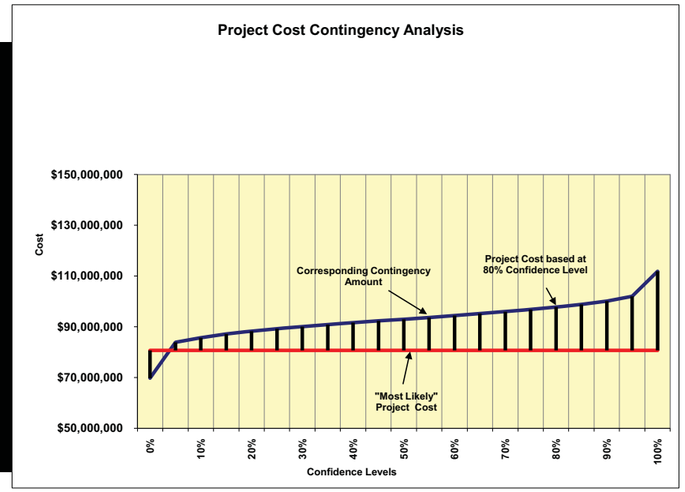
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$17,048,101**
Project Contingency Percentage (80% Confidence) ->	**21%**

Project Cost (80% Confidence) ->	**$97,813,410**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

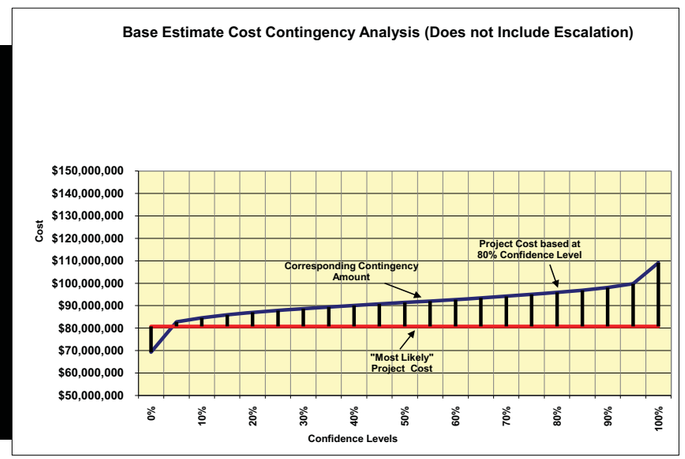
Most Likely Cost Estimate	$80,765,309		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	$69,794,677	($10,970,633)	-13.58%
5%	$83,923,989	$3,158,679	3.91%
10%	$85,742,551	$4,977,241	6.16%
15%	$87,235,368	$6,470,058	8.01%
20%	$88,343,228	$7,577,919	9.38%
25%	$89,253,986	$8,488,677	10.51%
30%	$90,110,696	$9,345,386	11.57%
35%	$90,882,360	$10,117,051	12.53%
40%	$91,660,739	$10,895,430	13.49%
45%	$92,352,258	$11,586,949	14.35%
50%	$93,019,455	$12,254,146	15.17%
55%	$93,719,418	$12,954,109	16.04%
60%	$94,448,548	$13,683,238	16.94%
65%	$95,220,119	$14,454,809	17.90%
70%	$96,003,194	$15,237,885	18.87%
75%	$96,882,762	$16,117,453	19.96%
80%	**$97,813,410**	**$17,048,101**	**21.11%**
85%	$98,855,147	$18,089,838	22.40%
90%	$100,140,761	$19,375,451	23.99%
95%	$102,030,723	$21,265,414	26.33%
100%	$111,909,541	$31,144,232	38.56%



- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

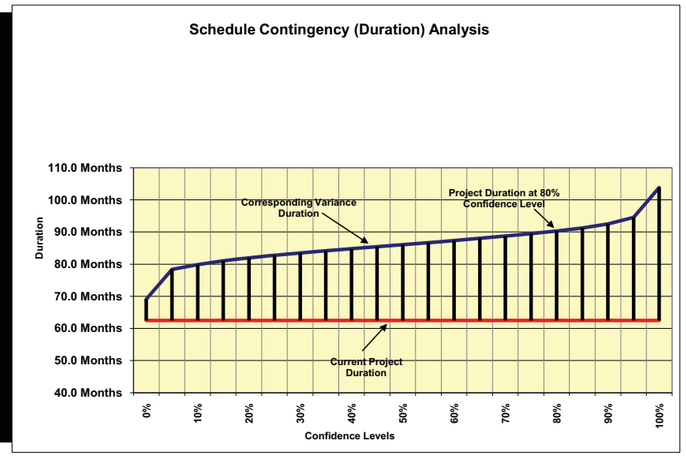
Most Likely Cost Estimate	$80,765,309		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	$69,337,747	($11,427,562.20)	-14.15%
5%	$82,833,825	$2,068,515.94	2.56%
10%	$84,549,540	$3,784,230.62	4.69%
15%	$85,962,381	$5,197,072.16	6.43%
20%	$87,006,651	$6,241,341.71	7.73%
25%	$87,863,927	$7,098,617.78	8.79%
30%	$88,668,523	$7,903,214.01	9.79%
35%	$89,394,874	$8,629,564.89	10.68%
40%	$90,128,684	$9,363,374.53	11.59%
45%	$90,775,847	$10,010,537.98	12.39%
50%	$91,398,546	$10,633,236.84	13.17%
55%	$92,057,777	$11,292,467.88	13.98%
60%	$92,742,438	$11,977,128.70	14.83%
65%	$93,467,084	$12,701,774.47	15.73%
70%	$94,201,979	$13,436,669.43	16.64%
75%	$95,025,629	$14,260,320.12	17.66%
80%	**$95,904,863**	**$15,139,554.02**	**18.75%**
85%	$96,879,329	$16,114,019.96	19.95%
90%	$98,078,206	$17,312,896.48	21.44%
95%	$99,829,393	$19,064,083.43	23.60%
100%	$109,075,190	$28,309,880.93	35.05%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

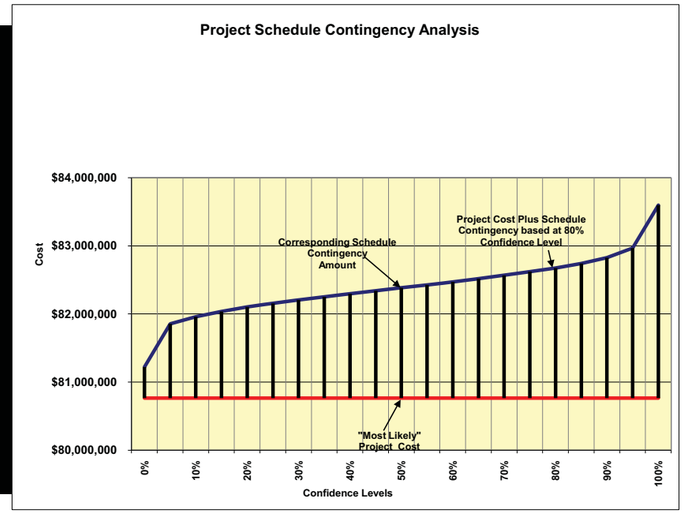
Most Likely Schedule Duration	62.5 Months		
Confidence Level	**Project Duration**	**Contingency**	**Contingency %**
0%	69.1 Months	6.7 Months	10.67%
5%	78.4 Months	15.9 Months	25.46%
10%	79.9 Months	17.4 Months	27.86%
15%	81.0 Months	18.6 Months	29.73%
20%	82.0 Months	19.5 Months	31.22%
25%	82.7 Months	20.3 Months	32.47%
30%	83.5 Months	21.0 Months	33.68%
35%	84.2 Months	21.7 Months	34.74%
40%	84.8 Months	22.3 Months	35.78%
45%	85.5 Months	23.0 Months	36.82%
50%	86.1 Months	23.6 Months	37.86%
55%	86.7 Months	24.2 Months	38.81%
60%	87.3 Months	24.9 Months	39.85%
65%	88.0 Months	25.6 Months	40.94%
70%	88.7 Months	26.3 Months	42.07%
75%	89.6 Months	27.1 Months	43.38%
80%	**90.3 Months**	**27.8 Months**	**44.58%**
85%	91.3 Months	28.8 Months	46.15%
90%	92.5 Months	30.1 Months	48.17%
95%	94.6 Months	32.1 Months	51.41%
100%	103.8 Months	41.3 Months	66.20%

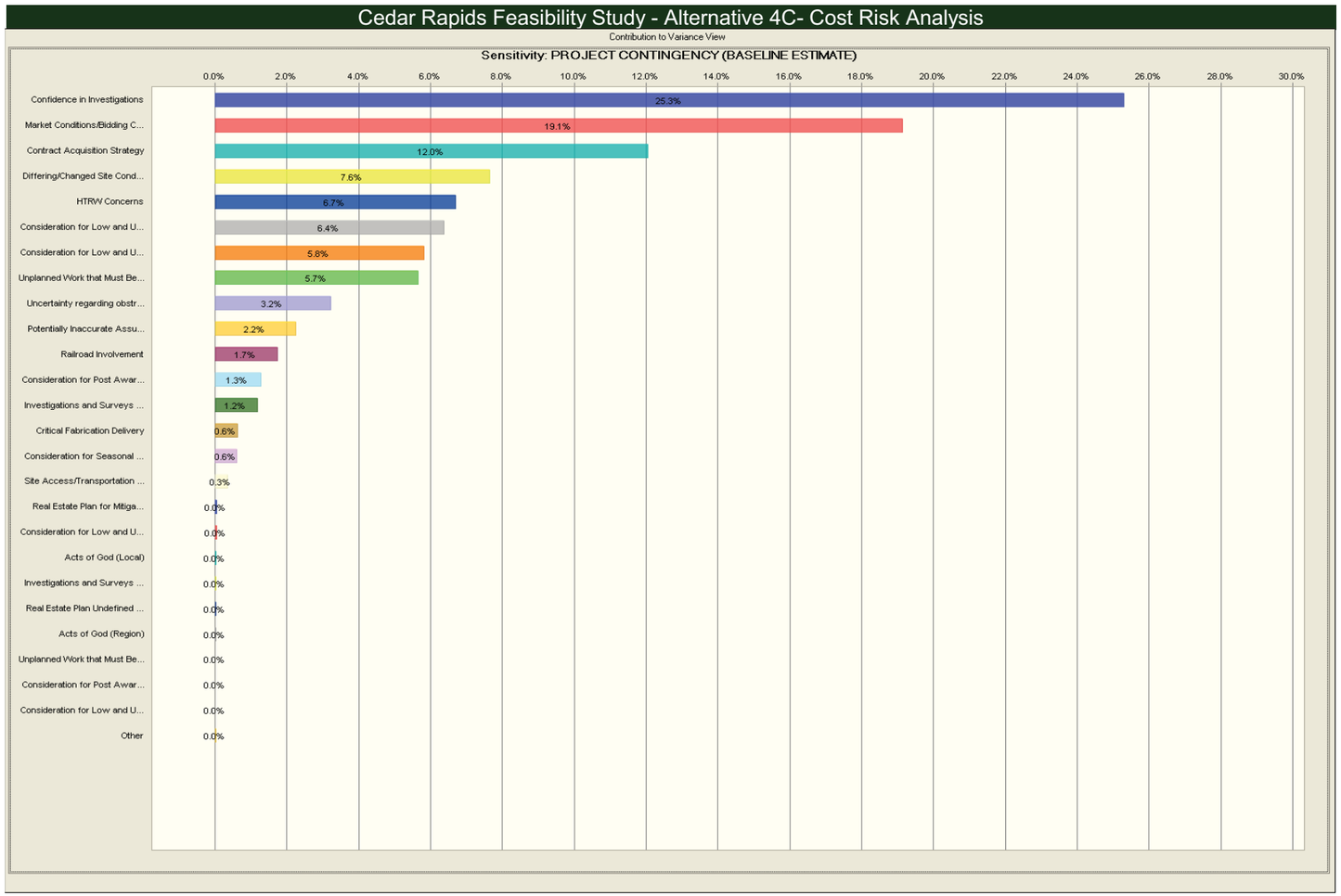


- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$80,765,309		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$81,222,239	$456,929	0.57%
5%	$81,855,473	$1,090,163	1.35%
10%	$81,958,320	$1,193,011	1.48%
15%	$82,038,295	$1,272,986	1.58%
20%	$82,101,887	$1,336,577	1.65%
25%	$82,155,368	$1,390,059	1.72%
30%	$82,207,482	$1,442,172	1.79%
35%	$82,252,795	$1,487,486	1.84%
40%	$82,297,364	$1,532,055	1.90%
45%	$82,341,720	$1,576,411	1.95%
50%	$82,386,218	$1,620,909	2.01%
55%	$82,426,950	$1,661,641	2.06%
60%	$82,471,419	$1,706,110	2.11%
65%	$82,518,344	$1,753,035	2.17%
70%	$82,566,525	$1,801,215	2.23%
75%	$82,622,442	$1,857,133	2.30%
80%	**$82,673,856**	**$1,908,547**	**2.36%**
85%	$82,741,127	$1,975,818	2.45%
90%	$82,827,864	$2,062,555	2.55%
95%	$82,966,640	$2,201,331	2.73%
100%	$83,599,660	$2,834,351	3.51%




Cedar Rapids Feasibility Study - Alternative 4C- Cost Risk Analysis
Contribution to Variance View
Sensitivity: PROJECT CONTINGENCY (BASELINE ESTIMATE)
0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% 14.0% 16.0% 18.0% 20.0% 22.0% 24.0% 26.0% 28.0% 30.0%
Confidence in Investigations 25.3%
Market Conditions/Bidding C... 19.1%
Contract Acquisition Strategy 12.0%
Differing/Changed Site Cond... 7.6%
HTRW Concerns 6.7%
Consideration for Low and U... 6.4%
Consideration for Low and U... 5.8%
Unplanned Work that Must Be... 5.7%
Uncertainty regarding obstr... 3.2%
Potentially Inaccurate Assu... 2.2%
Railroad Involvement 1.7%
Consideration for Post Awar... 1.3%
Investigations and Surveys ... 1.2%
Critical Fabrication Delivery 0.6%
Consideration for Seasonal ... 0.6%
Site Access/Transportation ... 0.3%
Real Estate Plan for Mitiga... 0.0%
Consideration for Low and U... 0.0%
Acts of God (Local) 0.0%
Investigations and Surveys ... 0.0%
Real Estate Plan Undefined ... 0.0%
Acts of God (Region) 0.0%
Unplanned Work that Must Be... 0.0%
Consideration for Post Awar... 0.0%
Consideration for Low and U... 0.0%
Other 0.0%

Cedar Rapids Feasibility Study - Alternative 4C - Cost Risk Analysis Model

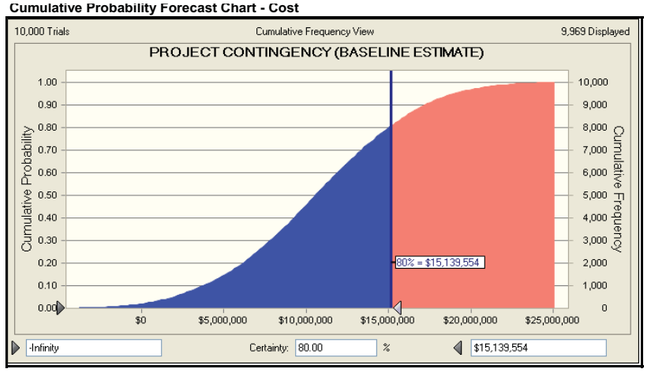
Risk No.	Risk/Opportunity Event	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Variance Distribution	Correlation to Other(s)	Probability of Occurrence	Crystal Ball Simulation: Expected Values ($$$): Low	Most Likely	High	Contingency Model	Notes	Expected Values (%s): Low	Most Likely	High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
PROJECT & PROGRAM MGMT															
PPM-6	Unplanned Work that Must Be Accommodated	Unlikely	Significant	Moderate	Uniform		100%	$0	$0	$4,331,210	$0		0.00%	0.00%	5.36%
CONTRACT ACQUISITION RISKS															
CA-1	Contract Acquisition Strategy	Likely	Marginal	Moderate	Triangular		100%	($2,838,432)	$0	$5,676,864	$0		-3.51%	0.00%	7.03%
TECHNICAL RISKS															
TL-2	Confidence in Investigations	Likely	Significant	High	Triangular		100%	($8,587,580)	$0	$3,872,625	$0		-10.63%	0.00%	4.79%
TL-3	Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issues	Likely	Marginal	Moderate	Triangular		100%	($1,318,958)	$0	$2,637,917	$0		-1.63%	0.00%	3.27%
TL-5	Uncertainty regarding obstructions/construction constraints (structural)	Likely	Marginal	Moderate	Triangular		100%	($1,229,987)	$0	$2,869,970	$0		-1.52%	0.00%	3.55%
LANDS AND DAMAGES RISKS															
LD-4	Railroad Involvement	Likely	Marginal	Moderate	Uniform		100%	$0	$0	$2,323,356	$0		0.00%	0.00%	2.88%
REGULATORY AND ENVIRONMENTAL RISKS															
RE-1	Investigations and Surveys not complete	Likely	Marginal	Moderate	Triangular		100%	$0	$0	$2,227,231	$0		0.00%	0.00%	2.76%
RE-2	HTRW Concerns	Likely	Marginal	Moderate	Uniform		100%	$0	$0	$4,558,187	$0		0.00%	0.00%	5.64%
RE-6	Potential Archaeological Sites	Likely	Marginal	Moderate	NA	NA	NA	NA	NA	NA	NA	***This risk is already captured by Risk RE-1***	NA	NA	NA

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

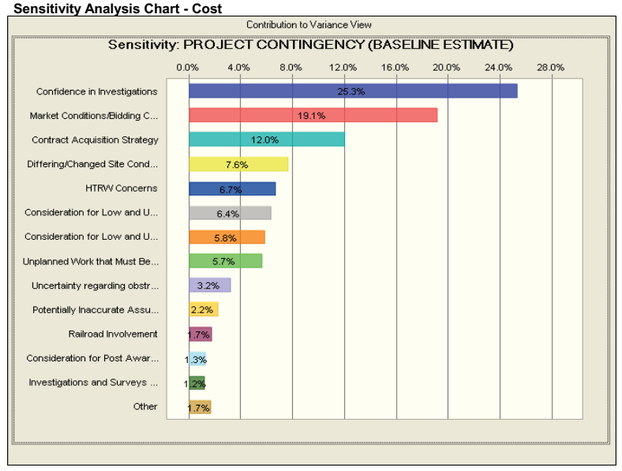
CONSTRUCTION RISKS															
CON-5	Critical Fabrication Delivery	Likely	Marginal	Moderate	Triangular		100%	$0	$0	$1,448,430	$0		0.00%	0.00%	1.79%
CON-6	Site Access/Transportation Issues	Very Likely	Marginal	Moderate	Triangular		100%	$0	$0	$1,359,459	$0		0.00%	0.00%	1.68%
CON-MOD	Consideration for Post Award Cost Modifications	Likely	Marginal	Moderate	Triangular		100%	$0	$0	$2,793,825	$0	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***			
CONSIDERATION FOR INTERNAL RISKS IDENTIFIED AS LOW OR NOT STUDIED ("UNKNOWN, UNKNOWNs")															
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	Moderate	Triangular		100%	($2,422,959)	$0	$4,038,265	$0	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***			
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	Moderate	Triangular		100%	($2,422,959)	$0	$4,038,265	$0	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***			
EXT-2	Differing/Changed Site Conditions	Unlikely	Significant	Moderate	Triangular		100%	($2,422,959)	$0	$4,038,265	$0	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***			
EXT-3	Consideration for Seasonal Weather Impacts	Likely	Marginal	Moderate	Triangular		100%	$0	$0	$1,359,459	$0	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***			
EXT-4	Market Conditions/Bidding Climate	Unlikely	Significant	Moderate	Triangular		100%	($5,676,864)	$0	$5,676,864	$0	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***			
											$0				

PROJECT CONTINGENCY (BASELINE ESTIMATE)	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
	0%	$80,765,309	($11,427,562)	**$69,337,747**	**-14.15%**
	5%	$80,765,309	$2,068,516	**$82,833,825**	**2.56%**
	10%	$80,765,309	$3,784,231	**$84,549,540**	**4.69%**
	15%	$80,765,309	$5,197,072	**$85,962,381**	**6.43%**
	20%	$80,765,309	$6,241,342	**$87,006,651**	**7.73%**
	25%	$80,765,309	$7,098,618	**$87,863,927**	**8.79%**
	30%	$80,765,309	$7,903,214	**$88,668,523**	**9.79%**
	35%	$80,765,309	$8,629,565	**$89,394,874**	**10.68%**
	40%	$80,765,309	$9,363,375	**$90,128,684**	**11.59%**
	45%	$80,765,309	$10,010,538	**$90,775,847**	**12.39%**
	50%	$80,765,309	$10,633,237	**$91,398,546**	**13.17%**
	55%	$80,765,309	$11,292,468	**$92,057,777**	**13.98%**
	60%	$80,765,309	$11,977,129	**$92,742,438**	**14.83%**
	65%	$80,765,309	$12,701,774	**$93,467,084**	**15.73%**
	70%	$80,765,309	$13,436,669	**$94,201,979**	**16.64%**
	75%	$80,765,309	$14,260,320	**$95,025,629**	**17.66%**
	80%	$80,765,309	$15,139,554	**$95,904,863**	**18.75%**
	85%	$80,765,309	$16,114,020	**$96,879,329**	**19.95%**
	90%	$80,765,309	$17,312,896	**$98,078,206**	**21.44%**
	95%	$80,765,309	$19,064,083	**$99,829,393**	**23.60%**
	100%	$80,765,309	$28,309,881	**$109,075,190**	**35.05%**

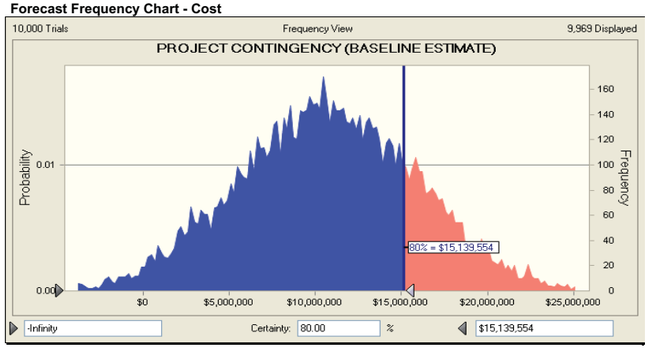
Cumulative Probability Forecast Chart - Cost

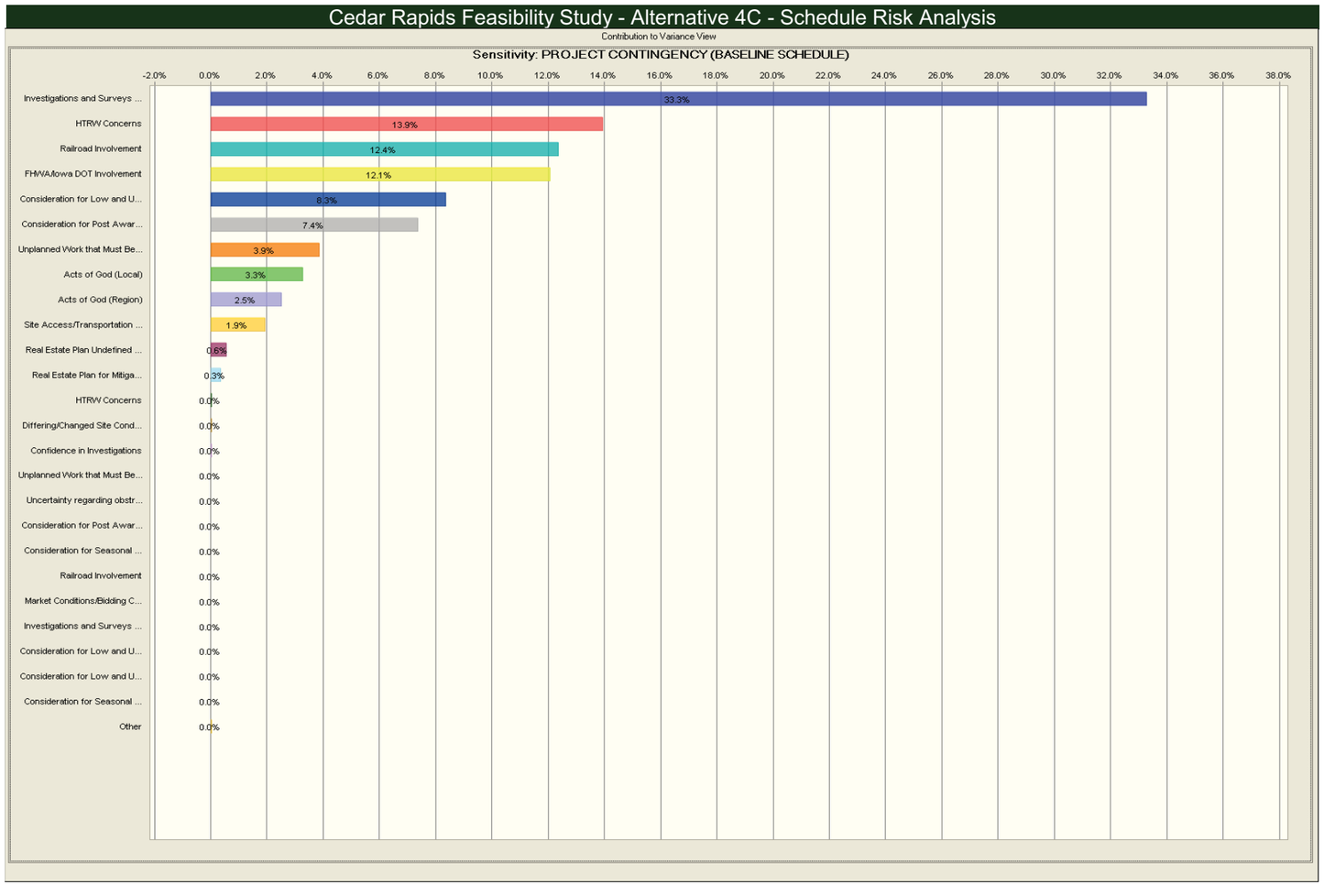


Sensitivity Analysis Chart - Cost



Forecast Frequency Chart - Cost




Cedar Rapids Feasibility Study - Alternative 4C - Schedule Risk Analysis
Contribution to Variance View
Sensitivity: PROJECT CONTINGENCY (BASELINE SCHEDULE)
-2.0% 0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% 14.0% 16.0% 18.0% 20.0% 22.0% 24.0% 26.0% 28.0% 30.0% 32.0% 34.0% 36.0% 38.0%
Investigations and Surveys ... 33.3%
HTRW Concerns 13.9%
Railroad Involvement 12.4%
FHWA/Iowa DOT Involvement 12.1%
Consideration for Low and U... 8.3%
Consideration for Post Awar... 7.4%
Unplanned Work that Must Be... 3.9%
Acts of God (Local) 3.3%
Acts of God (Region) 2.5%
Site Access/Transportation ... 1.9%
Real Estate Plan Undefined ... 0.6%
Real Estate Plan for Mitiga... 0.3%
HTRW Concerns 0.0%
Differing/Changed Site Cond... 0.0%
Confidence in Investigations 0.0%
Unplanned Work that Must Be... 0.0%
Uncertainty regarding obstr... 0.0%
Consideration for Post Awar... 0.0%
Consideration for Seasonal ... 0.0%
Railroad Involvement 0.0%
Market Conditions/Bidding C... 0.0%
Investigations and Surveys ... 0.0%
Consideration for Low and U... 0.0%
Consideration for Low and U... 0.0%
Consideration for Seasonal ... 0.0%
Other 0.0%

Cedar Rapids Feasibility Study - Alternative 4C - Schedule Risk Analysis Model

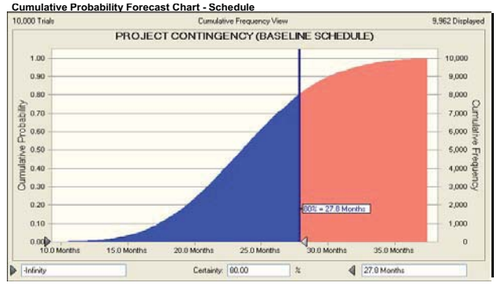
Risk No.	Risk/Opportunity Event	Project Schedule: Likelihood*	Impact*	Risk Level*	Variance Distribution	Correlation to Other(s)	Probability of Occurrence	Crystal Ball Simulation: Expected Values (Months) Low	Most Likely	High	Contingency Model	Notes	Expected Values (%s) Low	Most Likely	High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
PROJECT & PROGRAM MGMT															
PPM-6	Unplanned Work that Must Be Accommodated	Unlikely	Significant	Moderate	Uniform		100%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	4.80%
LANDS AND DAMAGES RISKS															
LD-1	Real Estate Plan Undefined (Corps) - Non RR	Unlikely	Significant	Moderate	Triangular	LD-2	100%	0.0 Months	0.0 Months	2.0 Months	0.0 Months		0.00%	0.00%	3.20%
LD-2	Real Estate Plan for Mitigation and Borrow Needs Identified	Unlikely	Significant	Moderate	Uniform	LD-1	100%	0.0 Months	0.0 Months	1.0 Months	0.0 Months		0.00%	0.00%	1.60%
LD-4	Railroad Involvement	Likely	Significant	High	Uniform		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	9.61%
LD-5	FHWA/Iowa DOT Involvement	Likely	Marginal	Moderate	Uniform		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	9.61%
REGULATORY AND ENVIRONMENTAL RISKS															
RE-1	Investigations and Surveys not complete	Likely	Significant	High	Triangular		100%	0.0 Months	0.0 Months	12.0 Months	0.0 Months		0.00%	0.00%	19.21%
RE-2	HTRW Concerns	Likely	Significant	High	Uniform		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months		0.00%	0.00%	9.61%
RE-6	Potential Archaeological Sites	Likely	Significant	High	NA	NA	NA	NA	NA	NA	NA	***This risk is already captured by Risk RE-1***	NA	NA	NA
CONSTRUCTION RISKS															
CON-6	Site Access/Transportation Issues	Very Likely	Marginal	Moderate	Triangular		100%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	4.80%
CON-MOD	Consideration for Post Award Cost Modifications	Likely	Marginal	Moderate	Triangular		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***	0.00%	0.00%	9.61%
CONSIDERATION FOR INTERNAL RISKS IDENTIFIED AS LOW OR NOT STUDIED ("UNKNOWN, UNKNOWNs")															
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	Moderate	Triangular		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***	0.00%	0.00%	9.61%
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
PR-2	Acts of God (Local)	Unlikely	Significant	Moderate	Uniform	PR-3	100%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	4.80%
PR-3	Acts of God (Region)	Unlikely	Significant	Moderate	Uniform		100%	0.0 Months	0.0 Months	3.0 Months	0.0 Months		0.00%	0.00%	4.80%
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	Moderate	Triangular		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***	0.00%	0.00%	9.61%
EXT-2	Differing/Changed Site Conditions	Unlikely	Significant	Moderate	Triangular		100%	0.0 Months	0.0 Months	6.0 Months	0.0 Months	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***	0.00%	0.00%	9.61%
EXT-3	Consideration for Seasonal Weather Impacts	Likely	Marginal	Moderate	Triangular		100%	0.0 Months	0.0 Months	2.0 Months	0.0 Months	***Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.***	0.00%	0.00%	3.20%
EXT-4	Market Conditions/Bidding Climate	Unlikely	Marginal	Low	Triangular	N/A	N/A	N/A	N/A	N/A	N/A	***N/A***	0.0 Months	0.0 Months	0.0 Months
											0.0 Months				

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

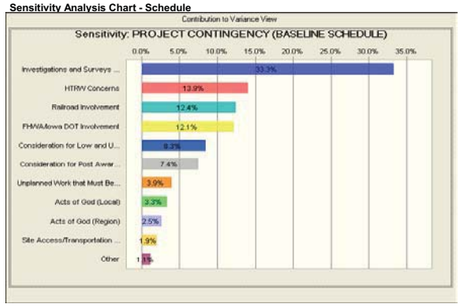
Contingency Summary Table - Schedule

PROJECT CONTINGENCY (BASELINE SCHEDULE)	Percentile	Baseline TPC	Contingency Amount	Baseline w/ Contingency	Contingency %
	0%	62.5 Months	6.7 Months	**69.1 Months**	**10.67%**
	5%	62.5 Months	15.9 Months	**78.4 Months**	**25.46%**
	10%	62.5 Months	17.4 Months	**79.9 Months**	**27.86%**
	15%	62.5 Months	18.6 Months	**81.0 Months**	**29.73%**
	20%	62.5 Months	19.5 Months	**82.0 Months**	**31.22%**
	25%	62.5 Months	20.3 Months	**82.7 Months**	**32.47%**
	30%	62.5 Months	21.0 Months	**83.5 Months**	**33.68%**
	35%	62.5 Months	21.7 Months	**84.2 Months**	**34.74%**
	40%	62.5 Months	22.3 Months	**84.8 Months**	**35.78%**
	45%	62.5 Months	23.0 Months	**85.5 Months**	**36.82%**
	50%	62.5 Months	23.6 Months	**86.1 Months**	**37.86%**
	55%	62.5 Months	24.2 Months	**86.7 Months**	**38.81%**
	60%	62.5 Months	24.9 Months	**87.3 Months**	**39.85%**
	65%	62.5 Months	25.6 Months	**88.0 Months**	**40.94%**
	70%	62.5 Months	26.3 Months	**88.7 Months**	**42.07%**
	75%	62.5 Months	27.1 Months	**89.6 Months**	**43.38%**
	80%	62.5 Months	27.8 Months	**90.3 Months**	**44.58%**
	85%	62.5 Months	28.8 Months	**91.3 Months**	**46.15%**
	90%	62.5 Months	30.1 Months	**92.5 Months**	**48.17%**
	95%	62.5 Months	32.1 Months	**94.6 Months**	**51.41%**
	100%	62.5 Months	41.3 Months	**103.8 Months**	**66.20%**

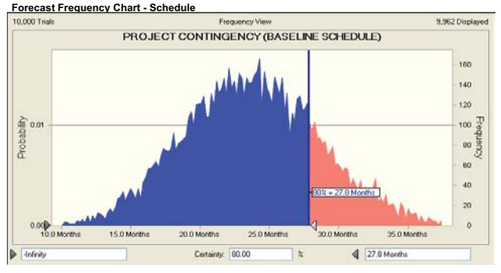
Cumulative Probability Forecast Chart - Schedule



Sensitivity Analysis Chart - Schedule



Forecast Frequency Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Enter Estimated Total Project Cost (Price Level)	**$80,765,309**
Max. Anticipated Annual Amount	**$15,526,068**
Enter Current OMB Escalation Rate	**1.80%**
Enter Current Project Location Escalation Rate	**1.80%**
Enter Assumed Monthly Recurring Cost Rate	**5.30%**

	Date	Escalation Delta Amount	Monthly Recurring Cost Amount	Total Schedule Contingency
Enter Current Project Start	3-Jan-11			
Enter Baseline Project Completion	17-Mar-16			
Project Completion at 0% Confidence	5-Oct-16		$456,929.49	$456,929.49
Project Completion at 5% Confidence	13-Jul-17		$1,090,163.46	$1,090,163.46
Project Completion at 10% Confidence	28-Aug-17		$1,193,010.82	$1,193,010.82
Project Completion at 15% Confidence	2-Oct-17		$1,272,986.16	$1,272,986.16
Project Completion at 20% Confidence	31-Oct-17		$1,336,577.30	$1,336,577.30
Project Completion at 25% Confidence	23-Nov-17		$1,390,058.74	$1,390,058.74
Project Completion at 30% Confidence	16-Dec-17		$1,442,172.41	$1,442,172.41
Project Completion at 35% Confidence	6-Jan-18		$1,487,485.76	$1,487,485.76
Project Completion at 40% Confidence	25-Jan-18		$1,532,055.18	$1,532,055.18
Project Completion at 45% Confidence	14-Feb-18		$1,576,410.53	$1,576,410.53
Project Completion at 50% Confidence	6-Mar-18		$1,620,909.12	$1,620,909.12
Project Completion at 55% Confidence	24-Mar-18		$1,661,641.25	$1,661,641.25
Project Completion at 60% Confidence	13-Apr-18		$1,706,109.60	$1,706,109.60
Project Completion at 65% Confidence	3-May-18		$1,753,034.86	$1,753,034.86
Project Completion at 70% Confidence	25-May-18		$1,801,215.31	$1,801,215.31
Project Completion at 75% Confidence	19-Jun-18		$1,857,132.72	$1,857,132.72
Project Completion at 80% Confidence	11-Jul-18		$1,908,546.62	$1,908,546.62
Project Completion at 85% Confidence	10-Aug-18		$1,975,818.19	$1,975,818.19
Project Completion at 90% Confidence	18-Sep-18		$2,062,555.01	$2,062,555.01
Project Completion at 95% Confidence	18-Nov-18		$2,201,330.73	$2,201,330.73
Project Completion at 100% Confidence	26-Aug-19		$2,834,350.96	$2,834,350.96

Entry Required
Do Not Overwrite
Summary Data -- Do Not Overwrite

Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-6	Unplanned Work that Must Be Accommodated	Unlikely	Significant	Moderate	Uniform	N/A	N/A	$0	$0	$4,331,210	

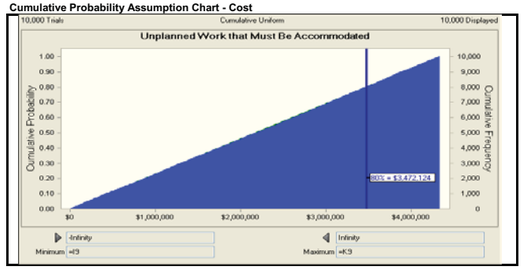
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PPM-6	Unplanned Work that Must Be Accommodated	Unlikely	Significant	Moderate	Uniform	N/A	N/A	0.0 Months	0.0 Months	3.0 Months	

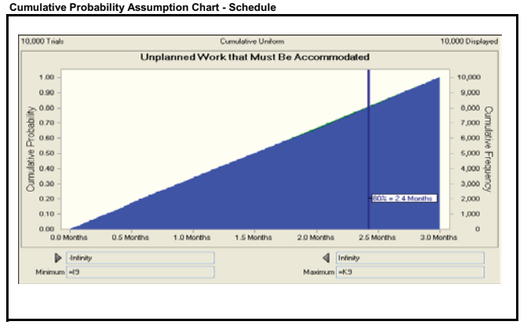
Description	This item captures the risk that unplanned work that must be accommodated may cause a variance to project cost and schedule. The MVR PDT notes that any work scope beyond the authorized level would be considered a betterment that must be funded by the local sponsor. Any contingency calculation considered herein pertains to the total of the federal and non-federal share, and should not be construed as a recommended breakdown of costs.
Development of Low Values	The best case scenario is that no additional work must be accommodated, creating no change to the current cost estimate or schedule.
Development of High Values	Assume that on the high end, the scope of the levees (1101) grows by 10%, the scope of the floodwalls, closure structures, and pumping plant grows by 5%, and the associated 01, 02, 30, and 31 accounts grow in direct proportion to the increase in the floodwalls. For schedule, assume a 5% increase to PED (1 month) and to construction (2 months).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$690	0.0 Months
10%	$420,156	0.3 Months
20%	$877,267	0.6 Months
30%	$1,303,182	0.9 Months
40%	$1,746,949	1.2 Months
50%	$2,181,318	1.5 Months
60%	$2,621,216	1.8 Months
70%	$3,042,013	2.1 Months
80%	$3,472,124	2.4 Months
90%	$3,883,148	2.7 Months
100%	$4,331,055	3.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CA-1	Contract Acquisition Strategy	Likely	Marginal	Moderate	Triangular	CA-2	N/A	($2,838,432)	$0	$5,676,864	Correlated to a low risk

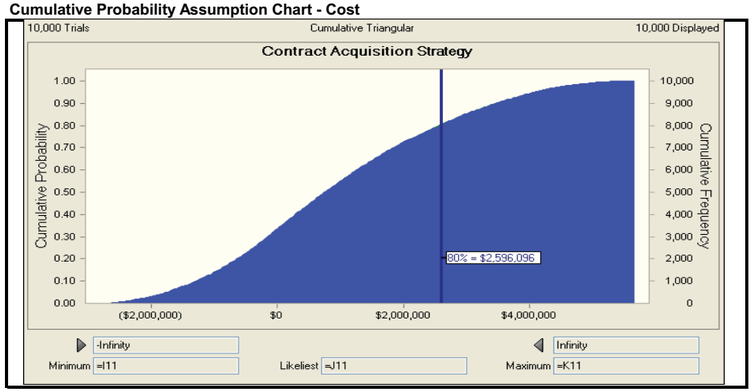
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CA-1	Contract Acquisition Strategy	Unlikely	Marginal	Low	Triangular	CA-2	N/A	N/A	N/A	N/A	Low - Not Studied for Schedule

Description	This item captures the risk that the lack of formal decisions and development on the contract acquisition strategy may cause a variance to project cost. This issue is not seen as having impact to the project schedule.
Development of Low Values	The best case scenario is that the ultimate contract acquisition strategy presents the opportunity for significant cost savings to the construction contracts. Assume up to 5% reduction in the construction costs (02, 11, and 13 accounts).
Development of High Values	The worst case scenario is that the ultimate contract acquisition strategy causes cost increase of up to 10% on the construction contracts (02, 11, and 13 accounts).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($2,801,616)	N/A
10%	($1,290,889)	N/A
20%	($639,331)	N/A
30%	($143,717)	N/A
40%	$289,913	N/A
50%	$756,720	N/A
60%	$1,260,376	N/A
70%	$1,847,601	N/A
80%	$2,596,096	N/A
90%	$3,477,367	N/A
100%	$5,617,843	N/A

Cumulative Probability Assumption Chart - Cost



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-2	Confidence in Investigations	Likely	Significant	High	Triangular	TL-6	N/A	($8,587,580)	$0	$3,872,625	Correlated to a low risk

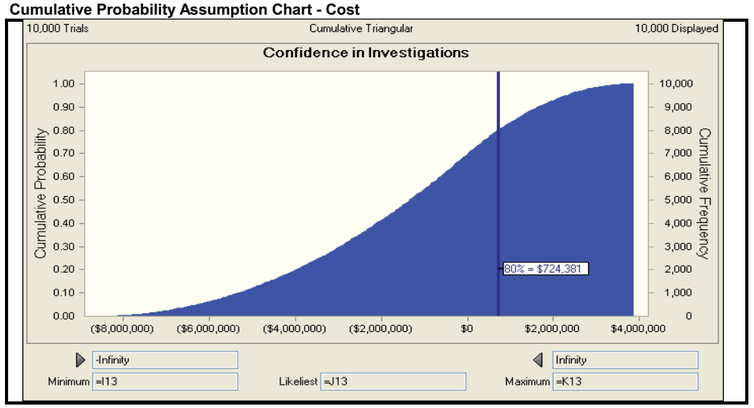
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-2	Confidence in Investigations	Likely	Negligible	Low	Triangular	TL-6	N/A	N/A	N/A	N/A	Low - Not Studied for Schedule

Description	This item captures the risk and opportunity that the level of confidence in the investigations may cause a variance (positive or negative) to project cost. This risk has no direct impact to project schedule.
Development of Low Values	The best case scenario is that the actual cost for the construction may be significantly less due to conservative assumptions made during the feasibility phase of the project. Assume up to 15% reduction of the levee costs and up to 20% reduction of the floodwall costs.
Development of High Values	The worst case scenario is that there is risk of cost increase in construction costs due to information gathered during the engineering and design regarding the assumptions made in prior investigations. Assume up to 15% increase in PED costs (30 account) and a 5% increase in the construction costs (11 account).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($8,470,862)	N/A
10%	($5,298,737)	N/A
20%	($3,979,312)	N/A
30%	($2,934,438)	N/A
40%	($2,097,012)	N/A
50%	($1,315,425)	N/A
60%	($613,094)	N/A
70%	$34,997	N/A
80%	$724,381	N/A
90%	$1,657,746	N/A
100%	$3,808,783	N/A

Cumulative Probability Assumption Chart - Cost



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

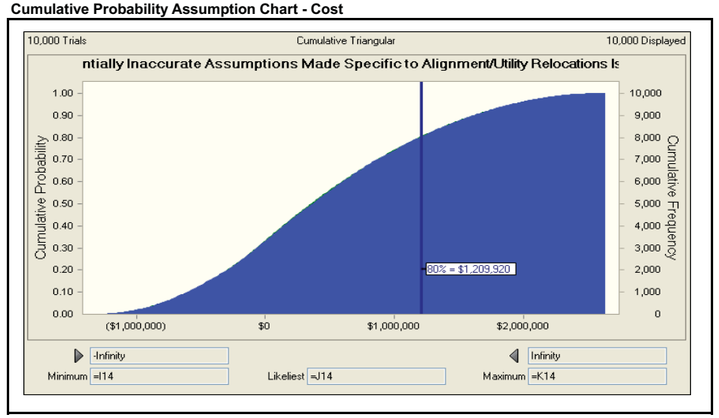
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	TL-3	**Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issues**	Likely	Marginal	Moderate	Triangular	N/A	N/A	($1,318,958)	$0	$2,637,917	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	TL-3	**Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issues**	Likely	Negligible	Low	Triangular	N/A	N/A	N/A	N/A	N/A	Low - Not Studied for Schedule

Description	This item captures the risk that potentially inaccurate assumptions made with respect to alignment and utility relocation issues may cause a variance to project cost. This risk has no direct impact to project schedule.
Development of Low Values	The best case scenario is that there will be efficiencies in the actual alignment that reduce the relocation costs (02 account) and the levee construction costs (1101 account). Assume up to 10% reduction in relocations costs (02 account) and up to 5% reduction in levee costs (1101 account).
Development of High Values	The worst case scenario is that there will be some alignment modifications that lead to cost growth. Assume up to 20% increase in relocation costs (02 account) and up to 10% increase in levee costs (1101 account).

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($1,294,104)	N/A
10%	($603,055)	N/A
20%	($292,583)	N/A
30%	($59,841)	N/A
40%	$148,344	N/A
50%	$374,018	N/A
60%	$608,658	N/A
70%	$876,889	N/A
80%	$1,209,920	N/A
90%	$1,624,450	N/A
100%	$2,608,744	N/A

Cumulative Probability Assumption Chart - Cost



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-5	**Uncertainty regarding obstructions/construction constraints (structural)**	Likely	Marginal	Moderate	Triangular	N/A	N/A	($1,229,987)	$0	$2,869,970	

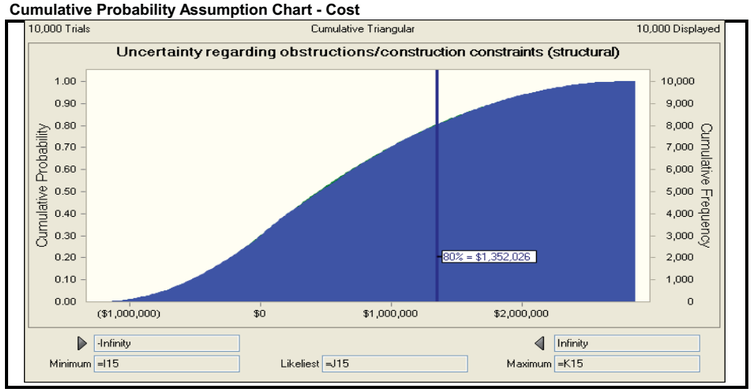
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
TL-5	**Uncertainty regarding obstructions/construction constraints (structural)**	Unlikely	Marginal	Low	Triangular	N/A	N/A	N/A	N/A	N/A	Low - Not Studied for Schedule

Description	This item captures the risk that uncertainty regarding obstructions/construction constraints may cause a variance to project cost. This risk has no direct impact to project schedule.
Development of Low Values	The best case scenario is that efficiencies are gained throughout the alignment, contributing to a gain in productivity up to 5%.
Development of High Values	The worst case scenario is that obstructions cause a decrease in the productivity up to 10%.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($1,218,532)	N/A
10%	($523,809)	N/A
20%	($223,529)	N/A
30%	$9,575	N/A
40%	$217,288	N/A
50%	$463,564	N/A
60%	$716,186	N/A
70%	$998,487	N/A
80%	$1,352,026	N/A
90%	$1,788,105	N/A
100%	$2,826,872	N/A

Cumulative Probability Assumption Chart - Cost



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

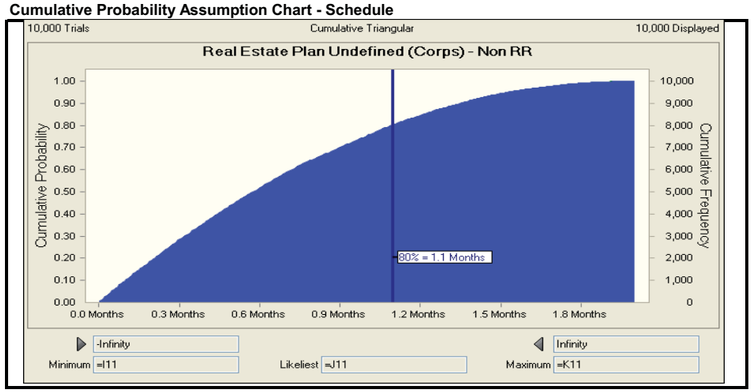
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	LD-1	Real Estate Plan Undefined (Corps) - Non RR	Unlikely	Marginal	Low	Triangular	N/A	N/A	N/A	N/A	N/A	Low - Not Studied for Cost

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	LD-1	Real Estate Plan Undefined (Corps) - Non RR	Unlikely	Significant	Moderate	Triangular	LD-2	0.67	0.0 Months	0.0 Months	2.0 Months	Correlated by a factor of 0.67

Description	This item captures the risk that lack of development of the REP plan may cause a variance to project schedule. This risk has no direct impact to project costs.
Development of Low Values	The best case scenario is that there are no impacts to the overall project schedule.
Development of High Values	The worst case scenario is that issues arising with assumptions made in the REP, or approvals may delay the project by up to 2 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.1 Months
20%	N/A	0.2 Months
30%	N/A	0.3 Months
40%	N/A	0.4 Months
50%	N/A	0.6 Months
60%	N/A	0.7 Months
70%	N/A	0.9 Months
80%	N/A	1.1 Months
90%	N/A	1.4 Months
100%	N/A	2.0 Months

Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

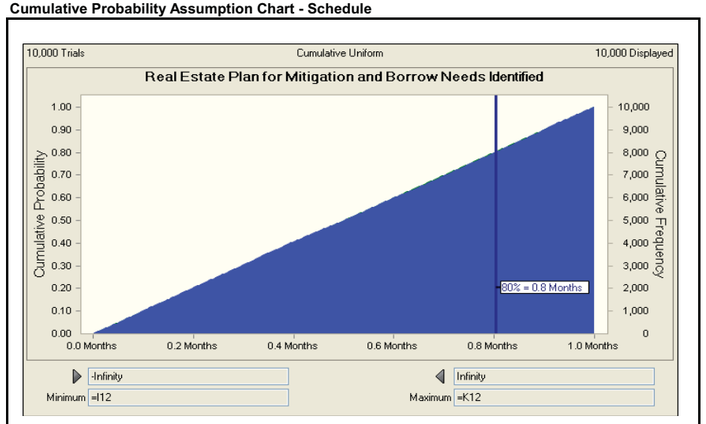
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	LD-2	Real Estate Plan for Mitigation and Borrow Needs Identified	Unlikely	Marginal	Low	Uniform	LD-1	N/A	N/A	N/A	N/A	Low - Not Studied for Cost

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	LD-2	Real Estate Plan for Mitigation and Borrow Needs Identified	Unlikely	Significant	Moderate	Uniform	LD-1	0.67	0.0 Months	0.0 Months	1.0 Months	Correlated by a factor of 0.67

Description	This item captures the risk that real estate needs for mitigation have not been fully identified may cause a variance to project schedule. This risk has no direct impact to project costs.
Development of Low Values	The best case scenario is that there are no impacts to the overall project schedule.
Development of High Values	The worst case scenario is that issues arising with assumptions made in the REP, or approvals may delay the project by up to 1 month.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.1 Months
20%	N/A	0.2 Months
30%	N/A	0.3 Months
40%	N/A	0.4 Months
50%	N/A	0.5 Months
60%	N/A	0.6 Months
70%	N/A	0.7 Months
80%	N/A	0.8 Months
90%	N/A	0.9 Months
100%	N/A	1.0 Months

Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

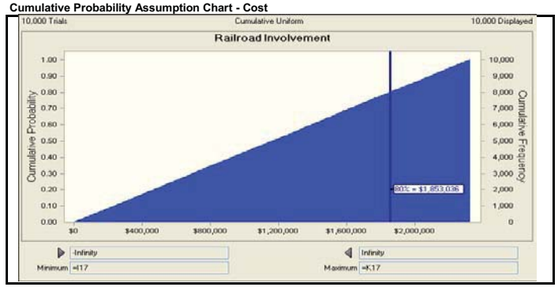
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	LD-4	Railroad Involvement	Likely	Marginal	Moderate	Uniform	N/A	N/A	$0	$0	$2,323,356	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	LD-4	Railroad Involvement	Likely	Significant	High	Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

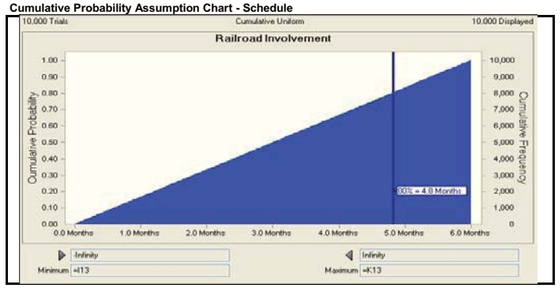
Description	This item captures the risk that involvement with the railroad could cause a variance in project cost and schedule.
Development of Low Values	The best case scenario is that there are no impacts to the overall project cost and schedule.
Development of High Values	The worst case scenario is that the railroad crossing cost doubles, and that project is delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$164	0.0 Months
10%	$236,783	0.6 Months
20%	$471,254	1.2 Months
30%	$698,256	1.8 Months
40%	$928,631	2.4 Months
50%	$1,164,659	3.0 Months
60%	$1,394,013	3.6 Months
70%	$1,620,295	4.2 Months
80%	$1,853,036	4.8 Months
90%	$2,094,331	5.4 Months
100%	$2,323,271	6.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
LD-5	FHWA/Iowa DOT Involvement	Unlikely	Negligible	Low	Uniform	N/A	N/A	N/A	N/A	N/A	Low - Not Studied for Cost

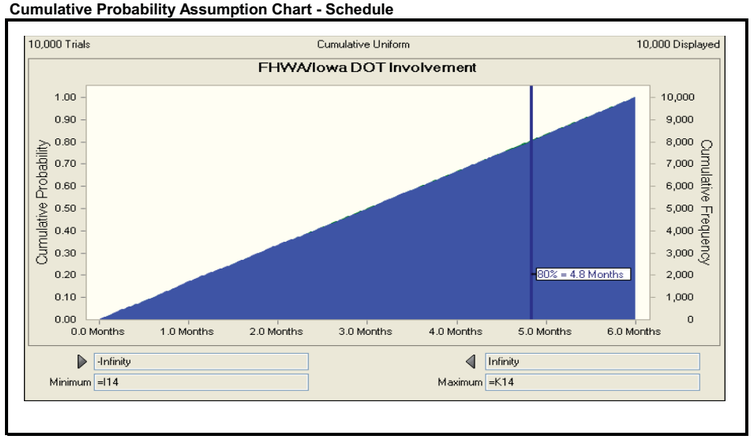
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
LD-5	FHWA/Iowa DOT Involvement	Likely	Marginal	Moderate	Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

Description	This item captures the risk that FHWA/Iowa DOT involvement may cause a variance to project schedule. This issue would not have a measurable impact on cost.
Development of Low Values	The best case scenario is that there are no impacts to the overall project schedule.
Development of High Values	The worst case scenario is that there would be up to 6 months of delay due to issues with the FHWA or Iowa DOT.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.6 Months
20%	N/A	1.2 Months
30%	N/A	1.8 Months
40%	N/A	2.4 Months
50%	N/A	3.0 Months
60%	N/A	3.6 Months
70%	N/A	4.2 Months
80%	N/A	4.8 Months
90%	N/A	5.4 Months
100%	N/A	6.0 Months

Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

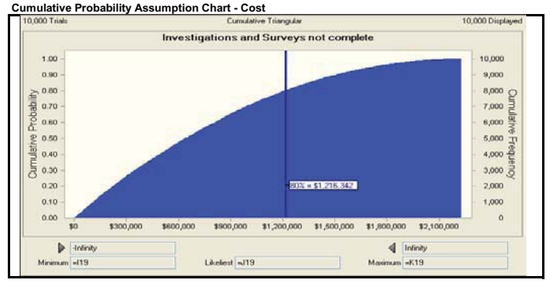
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	RE-1	Investigations and Surveys not complete	Likely	Marginal	Moderate	Triangular	N/A	N/A	$0	$0	$2,227,231	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	RE-1	Investigations and Surveys not complete	Likely	Significant	High	Triangular	N/A	N/A	0.0 Months	0.0 Months	12.0 Months	

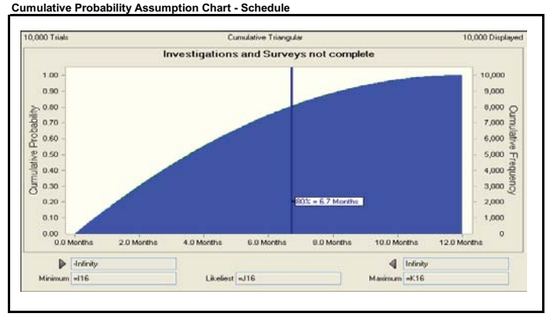
Description	This item captures the risk that cultural resource issues may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is that issues with historic/cultural sites will cause no impact to the project costs or schedule, as currently estimated.
Development of High Values	The worst case scenario is that the cost of cultural resource preservation is up to 5% of the 11 account, and that it adds up to 12 months of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$4	0.0 Months
10%	$112,680	0.6 Months
20%	$225,684	1.3 Months
30%	$352,976	2.0 Months
40%	$494,901	2.8 Months
50%	$639,812	3.6 Months
60%	$811,549	4.5 Months
70%	$989,604	5.5 Months
80%	$1,216,342	6.7 Months
90%	$1,513,508	8.3 Months
100%	$2,204,537	11.8 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

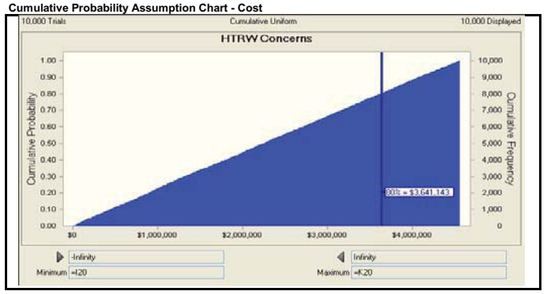
	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Cost	RE-2	HTRW Concerns	Likely	Marginal	Moderate	Uniform	N/A	N/A	$0	$0	$4,558,187	

	Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
Schedule	RE-2	HTRW Concerns	Likely	Significant	High	Uniform	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	

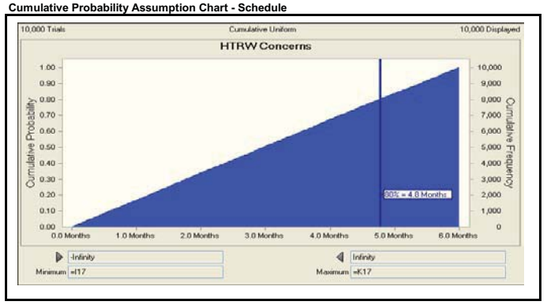
Description	This item captures the risk that HTRW issues may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is that there are no impacts to the overall project cost or schedule.
Development of High Values	The worst case scenario is that HTRW decreases productivity by up to 15%, and that it adds 6 months of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$764	0.0 Months
10%	$445,669	0.6 Months
20%	$897,992	1.2 Months
30%	$1,322,724	1.8 Months
40%	$1,813,833	2.4 Months
50%	$2,251,770	3.0 Months
60%	$2,719,074	3.6 Months
70%	$3,175,388	4.2 Months
80%	$3,641,143	4.8 Months
90%	$4,085,712	5.4 Months
100%	$4,557,881	6.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-5	Critical Fabrication Delivery	Likely	Marginal	Moderate	Triangular	N/A	N/A	$0	$0	$1,448,430	

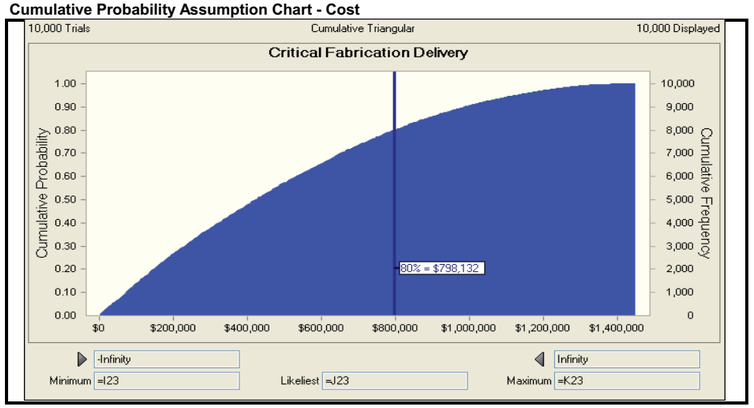
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-5	Critical Fabrication Delivery	Likely	Negligible	Low	Triangular	N/A	N/A	N/A	N/A	N/A	Low - Not Studied for Schedule

Description	This item captures the risk that critical fabrication and delivery of closure gates may cause a variance to project schedule. This risk has not direct impact to project schedule.
Development of Low Values	The best case scenario is that there are no impacts to the overall project cost or schedule.
Development of High Values	The worst case scenario is that the closure gates cost up to 15% more.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$85	N/A
10%	$74,108	N/A
20%	$147,250	N/A
30%	$232,699	N/A
40%	$324,093	N/A
50%	$422,272	N/A
60%	$532,453	N/A
70%	$653,807	N/A
80%	$798,132	N/A
90%	$988,695	N/A
100%	$1,437,547	N/A

Cumulative Probability Assumption Chart - Cost



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-6	Site Access/Transportation Issues	Very Likely	Marginal	Moderate	Triangular	N/A	N/A	$0	$0	$1,359,459	

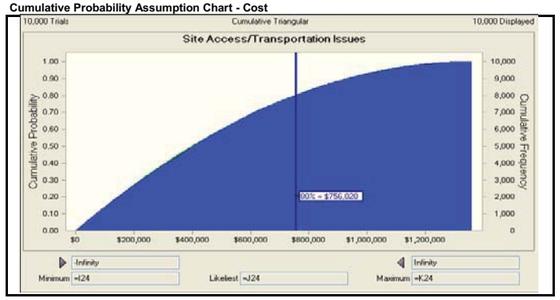
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-6	Site Access/Transportation Issues	Very Likely	Marginal	Moderate	Triangular	N/A	N/A	0.0 Months	0.0 Months	3.0 Months	

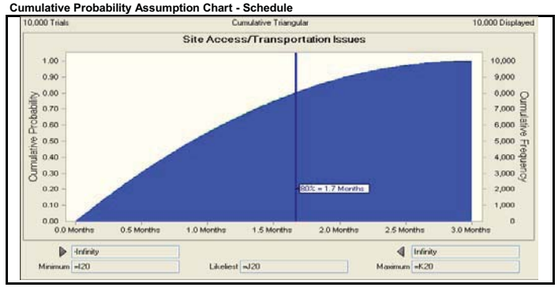
Description	This item captures the risk that site access and transportation issues may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is that there is no impact to cost or schedule.
Development of High Values	The worst case scenario is that productivity decreases by up to 5% and that the project is delayed by up to 3 months. The magnitude of this item has been reduced, as the estimators changed the average haul speed to 25 mph from 40 mph.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$52	0.0 Months
10%	$70,959	0.2 Months
20%	$146,142	0.3 Months
30%	$226,951	0.5 Months
40%	$314,631	0.7 Months
50%	$405,470	0.9 Months
60%	$506,410	1.1 Months
70%	$614,147	1.4 Months
80%	$756,020	1.7 Months
90%	$931,619	2.0 Months
100%	$1,342,127	3.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-MOD	Consideration for Post Award Cost Modifications	Likely	Marginal	Moderate	Triangular	N/A	N/A	$0	$0	$2,793,825	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

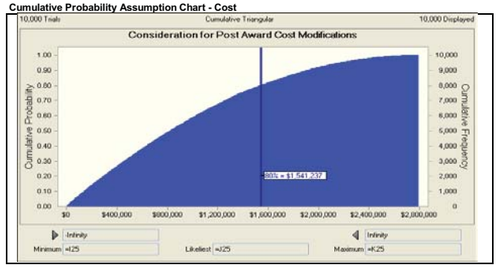
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
CON-MOD	Consideration for Post Award Cost Modifications	Likely	Marginal	Moderate	Triangular	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

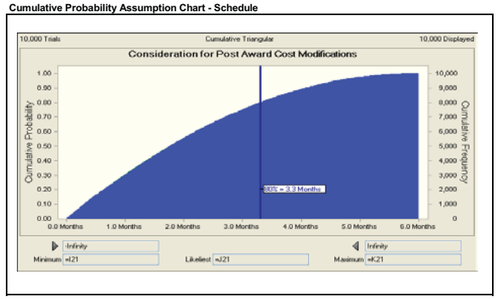
Description	This item captures the risk that post-award contract modifications may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is no change to the current estimate and schedule.
Development of High Values	The worst case scenario is that construction costs increase by up to 5% and S&A (31 account) costs increase by up to 10%. Assume that modifications add up to 6 months of cumulative delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$86	0.0 Months
10%	$136,992	0.3 Months
20%	$293,175	0.6 Months
30%	$458,290	1.0 Months
40%	$634,814	1.4 Months
50%	$820,135	1.8 Months
60%	$1,025,413	2.2 Months
70%	$1,259,542	2.7 Months
80%	$1,541,237	3.3 Months
90%	$1,911,103	4.1 Months
100%	$2,772,013	6.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	Moderate	Triangular	N/A	N/A	($2,422,959)	$0	$4,038,265	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

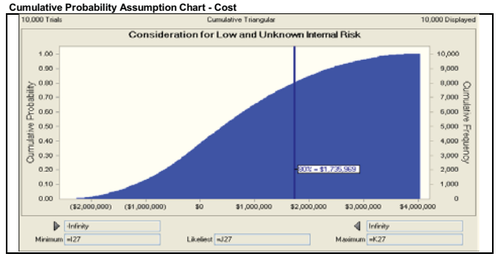
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
INT-1	Consideration for Low and Unknown Internal Risk	Likely	Marginal	Moderate	Triangular	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

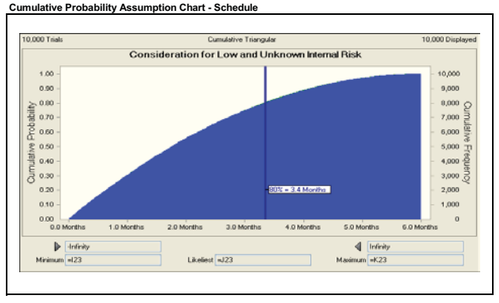
Description	This item captures the risk that low or unknown internal risks may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is that costs improve by up to 3% and schedule is improved by up to 3 months.
Development of High Values	The worst case scenario is that project costs increase by up to 5% and the overall schedule is delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($2,408,887)	0.0 Months
10%	($1,189,557)	0.3 Months
20%	($656,088)	0.6 Months
30%	($266,409)	1.0 Months
40%	$63,089	1.4 Months
50%	$419,867	1.8 Months
60%	$793,152	2.2 Months
70%	$1,212,117	2.7 Months
80%	$1,735,969	3.4 Months
90%	$2,391,944	4.1 Months
100%	$4,019,260	5.9 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-2	Acts of God (Local)	Unlikely	Negligible	Low	Uniform	PR-3	N/A	N/A	N/A	N/A	Low - Not Studied for Cost

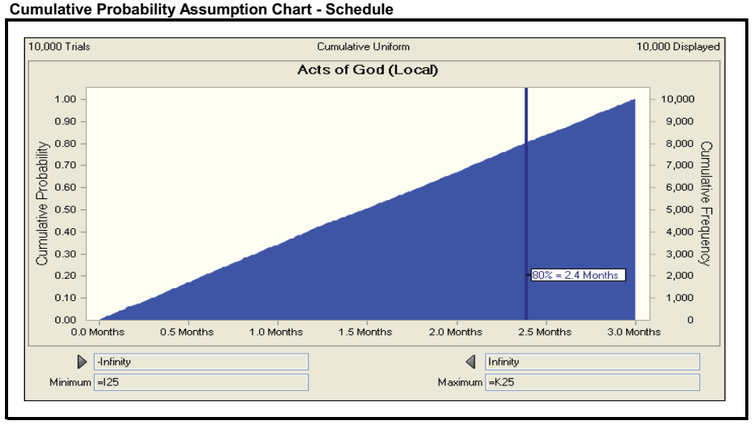
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-2	Acts of God (Local)	Unlikely	Significant	Moderate	Uniform	PR-3	0.50	0.0 Months	0.0 Months	3.0 Months	

Description	This item captures the risk that local severe weather/flooding events may cause a variance to project schedule.
Development of Low Values	The best case scenario is no adverse impact to cost or schedule.
Development of High Values	The worst case scenario is additional costs of up to 3 months of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.3 Months
20%	N/A	0.6 Months
30%	N/A	0.9 Months
40%	N/A	1.2 Months
50%	N/A	1.5 Months
60%	N/A	1.8 Months
70%	N/A	2.1 Months
80%	N/A	2.4 Months
90%	N/A	2.7 Months
100%	N/A	3.0 Months

Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-3	Acts of God (Region)	Unlikely	Negligible	Low	Uniform	PR-1	N/A	N/A	N/A	N/A	Low - Not Studied for Cost

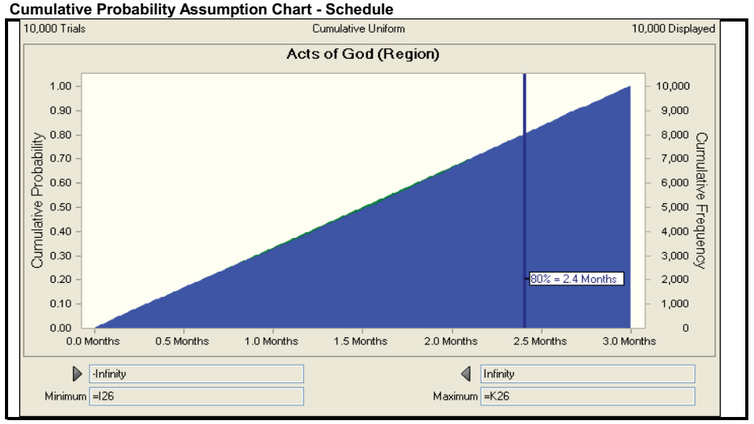
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
PR-3	Acts of God (Region)	Unlikely	Significant	Moderate	Uniform	PR-1	N/A	0.0 Months	0.0 Months	3.0 Months	

Description	This item captures the risk that local regional weather/flooding events may cause a variance to project schedule.
Development of Low Values	The best case scenario is no adverse impact to cost or schedule.
Development of High Values	The worst case scenario is additional costs of up to 3 months of delay.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	N/A	0.0 Months
10%	N/A	0.3 Months
20%	N/A	0.6 Months
30%	N/A	0.9 Months
40%	N/A	1.2 Months
50%	N/A	1.5 Months
60%	N/A	1.8 Months
70%	N/A	2.1 Months
80%	N/A	2.4 Months
90%	N/A	2.7 Months
100%	N/A	3.0 Months

Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	Moderate	Triangular	N/A	N/A	($2,422,959)	$0	$4,038,265	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

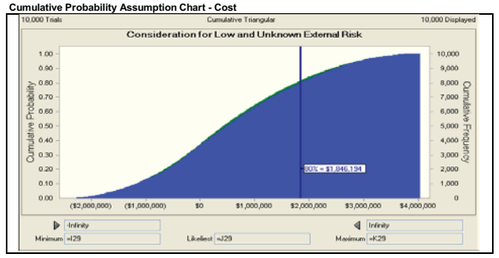
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-1	Consideration for Low and Unknown External Risk	Likely	Marginal	Moderate	Triangular	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

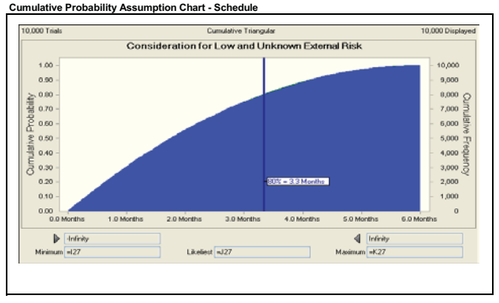
Description	This item captures the risk that low or unknown external risks may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is that costs improve by up to 3% and schedule is improved by up to 3 months.
Development of High Values	The worst case scenario is that project costs increase by up to 5% and the overall schedule is delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($2,402,564)	0.0 Months
10%	($1,159,810)	0.3 Months
20%	($608,805)	0.6 Months
30%	($229,153)	1.0 Months
40%	$117,866	1.3 Months
50%	$486,198	1.7 Months
60%	$878,533	2.2 Months
70%	$1,315,840	2.7 Months
80%	$1,846,194	3.3 Months
90%	$2,490,859	4.1 Months
100%	$4,019,624	6.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-2	Differing/Changed Site Conditions	Unlikely	Significant	Moderate	Triangular	N/A	N/A	($2,422,959)	$0	$4,038,265	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

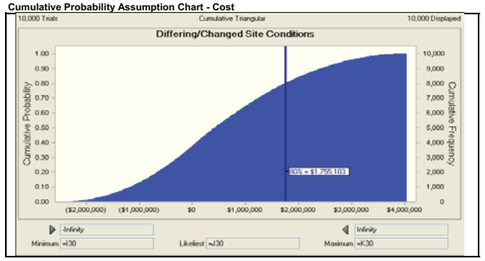
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-2	Differing/Changed Site Conditions	Unlikely	Significant	Moderate	Triangular	N/A	N/A	0.0 Months	0.0 Months	6.0 Months	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

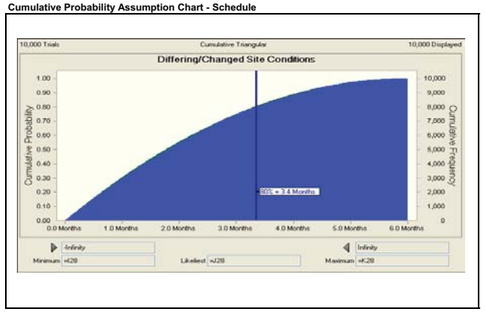
Description	This item captures the risk that differing or changed site conditions may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is that costs improve by up to 3% and schedule is improved by up to 3 months.
Development of High Values	The worst case scenario is that project costs increase by up to 5% and the overall schedule is delayed by up to 6 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($2,378,008)	0.0 Months
10%	($1,156,517)	0.3 Months
20%	($654,509)	0.7 Months
30%	($251,948)	1.0 Months
40%	$80,109	1.4 Months
50%	$428,778	1.8 Months
60%	$828,582	2.2 Months
70%	$1,254,209	2.7 Months
80%	$1,755,103	3.4 Months
90%	$2,444,938	4.1 Months
100%	$4,012,168	6.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-3	Consideration for Seasonal Weather Impacts	Likely	Marginal	Moderate	Triangular	N/A	N/A	$0	$0	$1,359,459	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

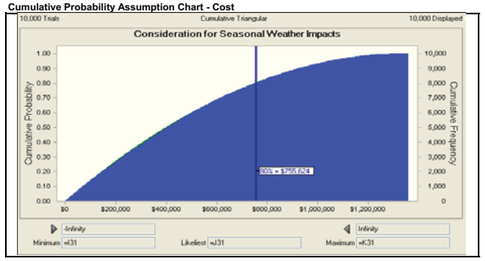
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-3	Consideration for Seasonal Weather Impacts	Likely	Marginal	Moderate	Triangular	N/A	N/A	0.0 Months	0.0 Months	2.0 Months	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

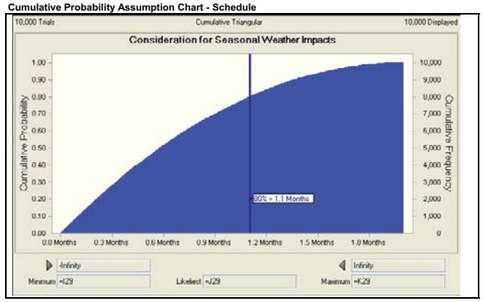
Description	This item captures the risk that seasonal weather impacts may cause a variance to project cost and schedule.
Development of Low Values	The best case scenario is no change to the current estimate and schedule.
Development of High Values	The worst case scenario is that seasonal weather issues decrease productivity by up to 5% and delays the project by up to 2 months.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	$105	0.0 Months
10%	$70,134	0.1 Months
20%	$146,634	0.2 Months
30%	$228,631	0.3 Months
40%	$316,153	0.4 Months
50%	$406,030	0.6 Months
60%	$503,505	0.7 Months
70%	$617,416	0.9 Months
80%	$755,624	1.1 Months
90%	$925,154	1.4 Months
100%	$1,348,133	2.0 Months

Cumulative Probability Assumption Chart - Cost



Cumulative Probability Assumption Chart - Schedule



Cedar Rapids Feasibility Study - Alternative 4C - Cost and Schedule Risk Analysis

Cost

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-4	**Market Conditions/Bidding Climate**	Unlikely	Significant	Moderate	Triangular	N/A	N/A	($5,676,864)	$0	$5,676,864	Added following evaluation during ATR review, reference Dr. Check Comment No. 3499587.

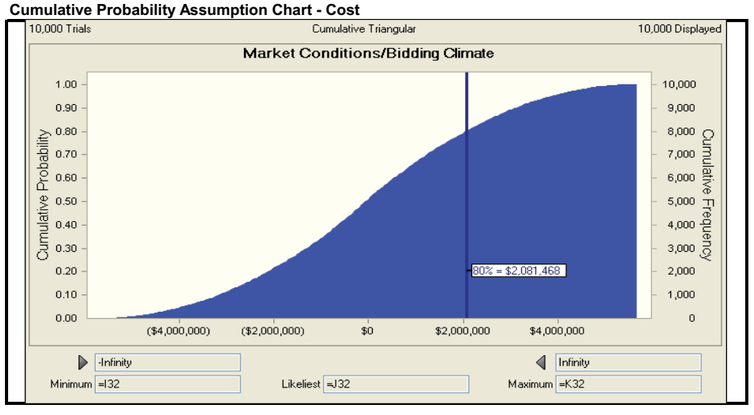
Schedule

Risk Reference No.	Risk Event	Likelihood	Impact	Risk Level	Distribution	Correlation	Correlation Factor	Low	Most Likely	High	Notes
EXT-4	**Market Conditions/Bidding Climate**	Unlikely	Marginal	Low	Triangular	N/A	N/A	N/A	N/A	N/A	N/A

Description	This item captures the risk that market conditions (bidding climate) may cause a variance to project cost. This risk would not have measurable effect on the project schedule.
Development of Low Values	The best case scenario is that constructions costs are up 10% lower than currently estimated.
Development of High Values	The worst case scenario is that construction costs are up to 10% more than currently estimated.

Confidence Percentile	Assumption values (in dollars)	Assumption values (in months)
0%	($5,647,316)	N/A
10%	($3,149,390)	N/A
20%	($2,111,565)	N/A
30%	($1,293,866)	N/A
40%	($628,007)	N/A
50%	($50,747)	N/A
60%	$550,814	N/A
70%	$1,250,871	N/A
80%	$2,081,468	N/A
90%	$3,143,456	N/A
100%	$5,560,716	N/A

Cumulative Probability Assumption Chart - Cost



Crystal Ball Report - Full

Simulation started on 10/20/2010 at 10:13 AM
Simulation stopped on 10/20/2010 at 10:13 AM

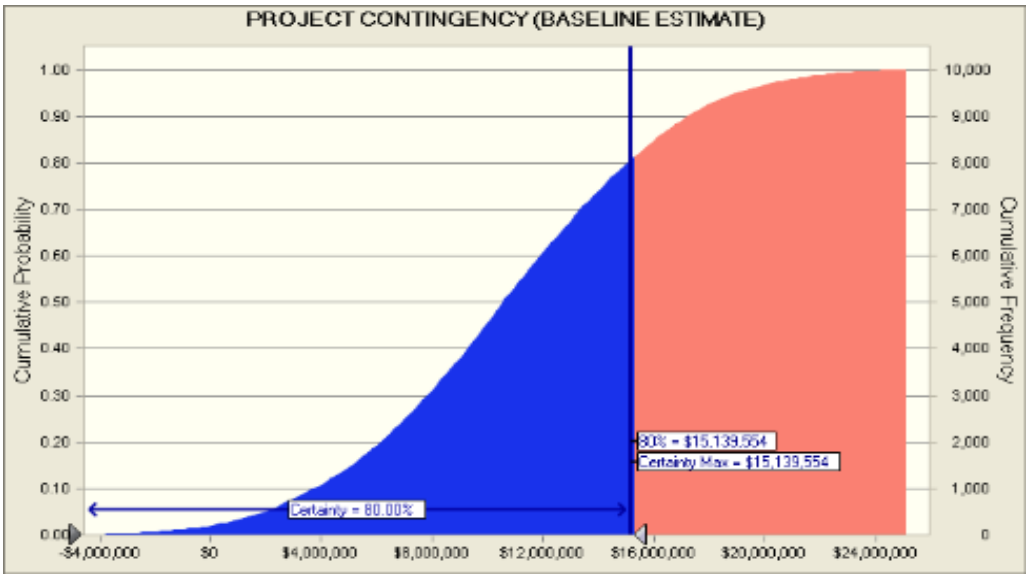
Run preferences:	
Number of trials run	10,000
Monte Carlo	
Seed	999
Precision control on	
Confidence level	95.00%
Run statistics:	
Total running time (sec)	16.50
Trials/second (average)	606
Random numbers per sec	18,792
Crystal Ball data:	
Assumptions	31
Correlations	0
Correlated groups	0
Decision variables	0
Forecasts	2

Forecasts

Worksheet: [Risk Analysis (CSRA) - Cedar Rapids Alt. 4C.xlsx]Cost Risk Model

Forecast: PROJECT CONTINGENCY (BASELINE ESTIMATE) **Cell: L34**

Summary:
Certainty level is 80.00%
Certainty range is from -Infinity to $15,139,554
Entire range is from -$11,427,562 to $28,309,881
Base case is $0
After 10,000 trials, the std. error of the mean is $51,784



Forecast: PROJECT CONTINGENCY (BASELINE ESTIMATE) (cont'd) **Cell: L34**

Statistics:	Forecast values
Trials	10,000
Base Case	$0
Mean	$10,644,191
Median	$10,633,424
Mode	---
Standard Deviation	$5,178,403
Variance	$26,815,862,697,262
Skewness	-0.0314
Kurtosis	2.82
Coeff. of Variability	0.4865
Minimum	-$11,427,562
Maximum	$28,309,881
Range Width	$39,737,443
Mean Std. Error	$51,784

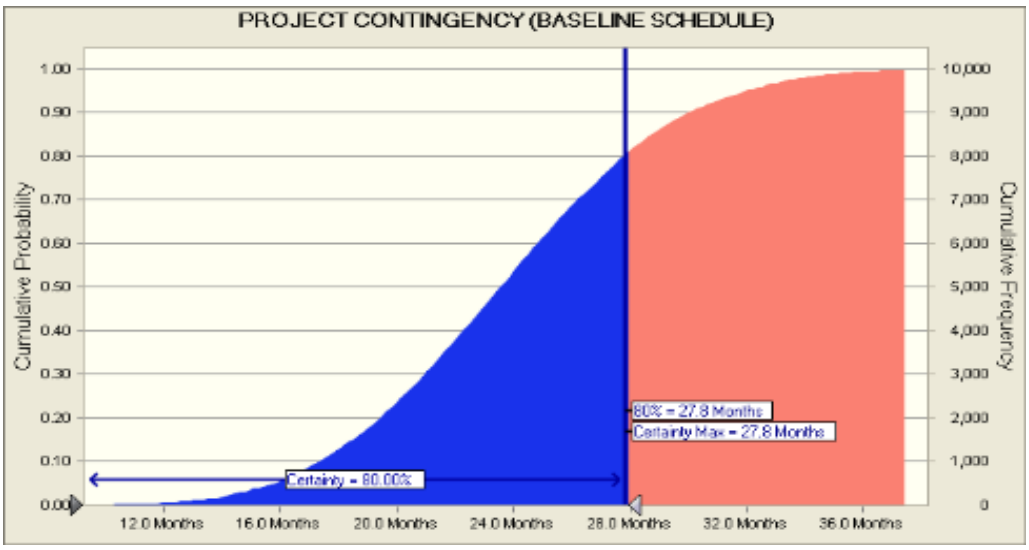
Percentiles:	Forecast values
0%	-$11,427,562
10%	$3,784,231
20%	$6,241,342
30%	$7,903,214
40%	$9,363,375
50%	$10,633,237
60%	$11,977,129
70%	$13,436,669
80%	$15,139,554
90%	$17,312,896
100%	$28,309,881

Worksheet: [Risk Analysis (CSRA) - Cedar Rapids Alt. 4C.xlsx]Schedule Risk Model

Forecast: PROJECT CONTINGENCY (BASELINE SCHEDULE) **Cell: L32**

Summary:

Certainty level is 80.00%
Certainty range is from -Infinity to 27.8 Months
Entire range is from 6.7 Months to 41.3 Months
Base case is 0.0 Months
After 10,000 trials, the std. error of the mean is 0.0 Months



Statistics:	Forecast values
Trials	10,000
Base Case	0.0 Months
Mean	23.7 Months
Median	23.6 Months
Mode	---
Standard Deviation	4.9 Months
Variance	24.1 Months
Skewness	0.1242
Kurtosis	2.85
Coeff. of Variability	0.2070
Minimum	6.7 Months
Maximum	41.3 Months
Range Width	34.7 Months
Mean Std. Error	0.0 Months

Forecast: PROJECT CONTINGENCY (BASELINE SCHEDULE) (cont'd) **Cell: L32**

Percentiles:	Forecast values
0%	6.7 Months
10%	17.4 Months
20%	19.5 Months
30%	21.0 Months
40%	22.3 Months
50%	23.6 Months
60%	24.9 Months
70%	26.3 Months
80%	27.8 Months
90%	30.1 Months
100%	41.3 Months

End of Forecasts

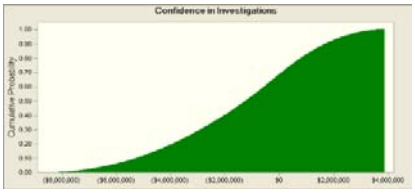
Assumptions

Worksheet: [Risk Analysis (CSRA) - Cedar Rapids Alt. 4C.xlsx]Cost Risk Model

Assumption: Confidence in Investigations **Cell: J13**

Triangular distribution with parameters:

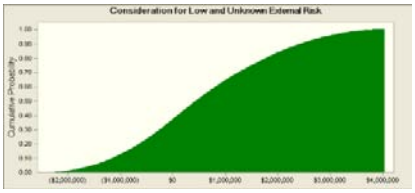
Minimum	($8,587,580)	(=I13)
Likeliest	$0	(=J13)
Maximum	$3,872,625	(=K13)



Assumption: Consideration for Low and Unknown External Risk **Cell: J29**

Triangular distribution with parameters:

Minimum	($2,422,959)	(=I29)
Likeliest	$0	(=J29)
Maximum	$4,038,265	(=K29)

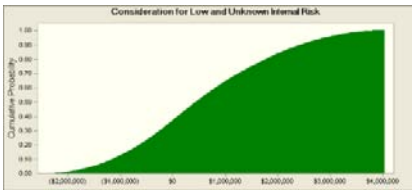


Assumption: Consideration for Low and Unknown Internal Risk **Cell: J27**

Triangular distribution with parameters:

Minimum	($2,422,959)	(=I27)
Likeliest	$0	(=J27)
Maximum	$4,038,265	(=K27)

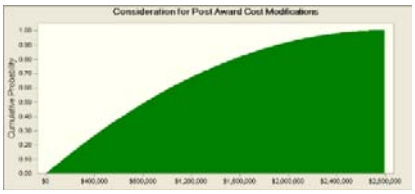
Assumption: Consideration for Low and Unknown Internal Risk (cont'd) **Cell: J27**



Assumption: Consideration for Post Award Cost Modifications **Cell: J25**

Triangular distribution with parameters:

Minimum	$0	(=I25)
Likeliest	$0	(=J25)
Maximum	$2,793,825	(=K25)



Assumption: Consideration for Seasonal Weather Impacts **Cell: J31**

Triangular distribution with parameters:

Minimum	$0	(=I31)
Likeliest	$0	(=J31)
Maximum	$1,359,459	(=K31)



Assumption: Contract Acquisition Strategy **Cell: J11**

Triangular distribution with parameters:

Minimum	($2,838,432)	(=I11)
Likeliest	$0	(=J11)
Maximum	$5,676,864	(=K11)

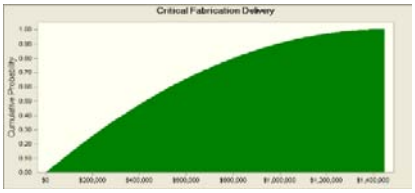
Assumption: Contract Acquisition Strategy (cont'd) **Cell: J11**



Assumption: Critical Fabrication Delivery **Cell: J23**

Triangular distribution with parameters:

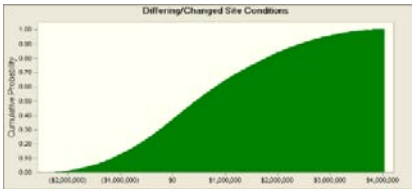
Minimum	$0	(=I23)
Likeliest	$0	(=J23)
Maximum	$1,448,430	(=K23)



Assumption: Differing/Changed Site Conditions **Cell: J30**

Triangular distribution with parameters:

Minimum	($2,422,959)	(=I30)
Likeliest	$0	(=J30)
Maximum	$4,038,265	(=K30)

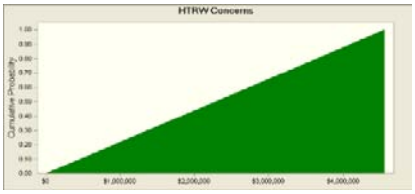


Assumption: HTRW Concerns **Cell: J20**

Uniform distribution with parameters:

Minimum	$0	(=I20)
Maximum	$4,558,187	(=K20)

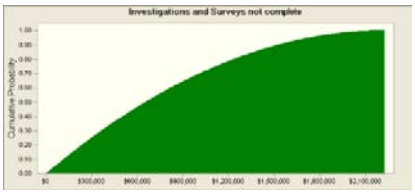
Assumption: HTRW Concerns (cont'd) **Cell: J20**



Assumption: Investigations and Surveys not complete **Cell: J19**

Triangular distribution with parameters:

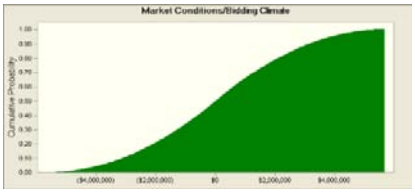
Minimum	$0	(=I19)
Likeliest	$0	(=J19)
Maximum	$2,227,231	(=K19)



Assumption: Market Conditions/Bidding Climate **Cell: J32**

Triangular distribution with parameters:

Minimum	($5,676,864)	(=I32)
Likeliest	$0	(=J32)
Maximum	$5,676,864	(=K32)

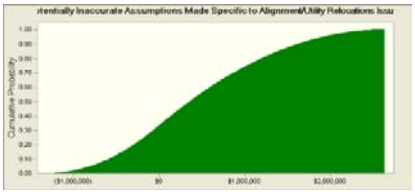


Assumption: Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Cell: J14

Triangular distribution with parameters:

Minimum	($1,318,958)	(=I14)
Likeliest	$0	(=J14)
Maximum	$2,637,917	(=K14)

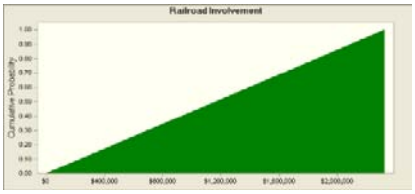
Assumption: Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issu **Cell: J14**



Assumption: Railroad Involvement **Cell: J17**

Uniform distribution with parameters:

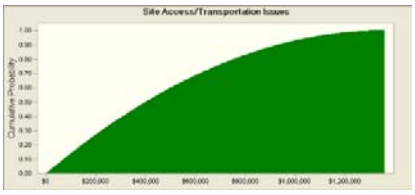
Minimum	$0	(=I17)
Maximum	$2,323,356	(=K17)



Assumption: Site Access/Transportation Issues **Cell: J24**

Triangular distribution with parameters:

Minimum	$0	(=I24)
Likeliest	$0	(=J24)
Maximum	$1,359,459	(=K24)

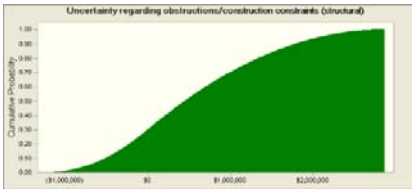


Assumption: Uncertainty regarding obstructions/construction constraints (structural) **Cell: J15**

Triangular distribution with parameters:

Minimum	($1,229,987)	(=I15)
Likeliest	$0	(=J15)
Maximum	$2,869,970	(=K15)

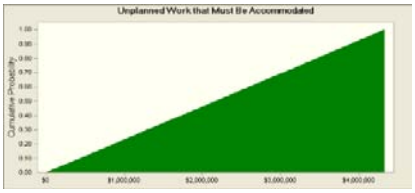
Assumption: Uncertainty regarding obstructions/construction constraints (structural) (cont'd) **Cell: J15**



Assumption: Unplanned Work that Must Be Accommodated **Cell: J9**

Uniform distribution with parameters:

Minimum	$0	(=I9)
Maximum	$4,331,210	(=K9)

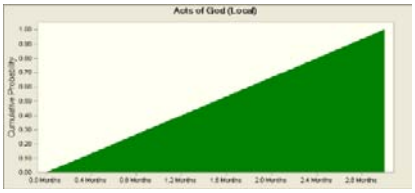


Worksheet: [Risk Analysis (CSRA) - Cedar Rapids Alt. 4C.xlsx]Schedule Risk Model

Assumption: Acts of God (Local) **Cell: J25**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I25)
Maximum	3.0 Months	(=K25)

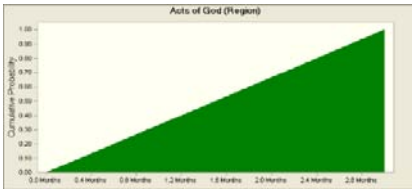


Assumption: Acts of God (Region) **Cell: J26**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I26)
Maximum	3.0 Months	(=K26)

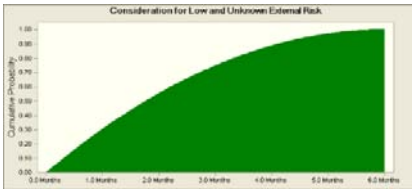
Assumption: Acts of God (Region) (cont'd) **Cell: J26**



Assumption: Consideration for Low and Unknown External Risk **Cell: J27**

Triangular distribution with parameters:

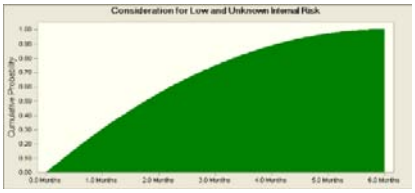
Minimum	0.0 Months	(=I27)
Likeliest	0.0 Months	(=J27)
Maximum	6.0 Months	(=K27)



Assumption: Consideration for Low and Unknown Internal Risk **Cell: J23**

Triangular distribution with parameters:

Minimum	0.0 Months	(=I23)
Likeliest	0.0 Months	(=J23)
Maximum	6.0 Months	(=K23)

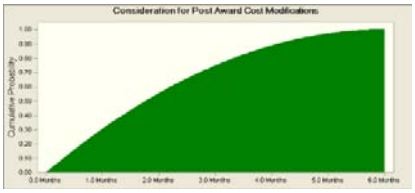


Assumption: Consideration for Post Award Cost Modifications **Cell: J21**

Triangular distribution with parameters:

Minimum	0.0 Months	(=I21)
Likeliest	0.0 Months	(=J21)
Maximum	6.0 Months	(=K21)

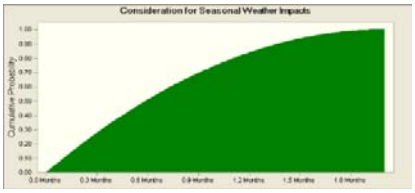
Assumption: Consideration for Post Award Cost Modifications (cont'd) **Cell: J21**



Assumption: Consideration for Seasonal Weather Impacts **Cell: J29**

Triangular distribution with parameters:

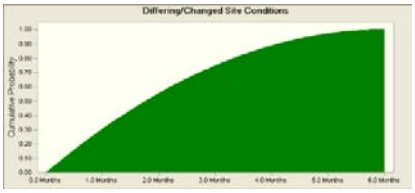
Minimum	0.0 Months	(=I29)
Likeliest	0.0 Months	(=J29)
Maximum	2.0 Months	(=K29)



Assumption: Differing/Changed Site Conditions **Cell: J28**

Triangular distribution with parameters:

Minimum	0.0 Months	(=I28)
Likeliest	0.0 Months	(=J28)
Maximum	6.0 Months	(=K28)

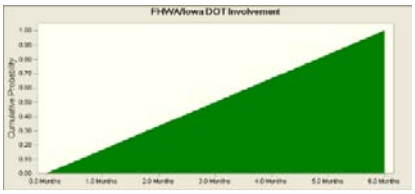


Assumption: FHWA/Iowa DOT Involvement **Cell: J14**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I14)
Maximum	6.0 Months	(=K14)

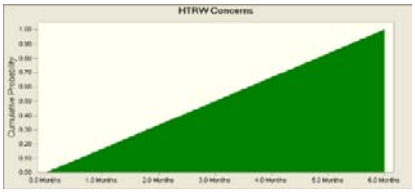
Assumption: FHWA/Iowa DOT Involvement (cont'd) **Cell: J14**



Assumption: HTRW Concerns **Cell: J17**

Uniform distribution with parameters:

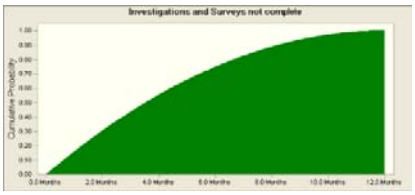
Minimum	0.0 Months	(=I17)
Maximum	6.0 Months	(=K17)



Assumption: Investigations and Surveys not complete **Cell: J16**

Triangular distribution with parameters:

Minimum	0.0 Months	(=I16)
Likeliest	0.0 Months	(=J16)
Maximum	12.0 Months	(=K16)

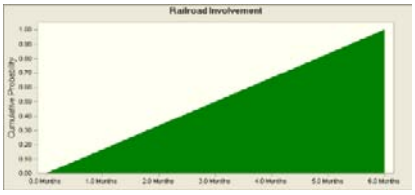


Assumption: Railroad Involvement **Cell: J13**

Uniform distribution with parameters:

Minimum	0.0 Months	(=I13)
Maximum	6.0 Months	(=K13)

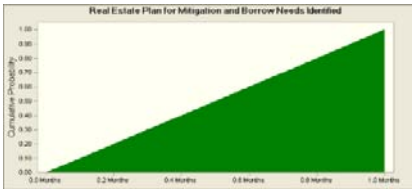
Assumption: Railroad Involvement (cont'd) **Cell: J13**



Assumption: Real Estate Plan for Mitigation and Borrow Needs Identified **Cell: J12**

Uniform distribution with parameters:

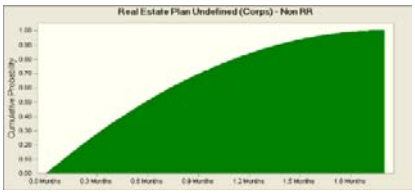
Minimum	0.0 Months	(=I12)
Maximum	1.0 Months	(=K12)



Assumption: Real Estate Plan Undefined (Corps) - Non RR **Cell: J11**

Triangular distribution with parameters:

Minimum	0.0 Months	(=I11)
Likeliest	0.0 Months	(=J11)
Maximum	2.0 Months	(=K11)



Assumption: Site Access/Transportation Issues **Cell: J20**

Triangular distribution with parameters:

Minimum	0.0 Months	(=I20)
Likeliest	0.0 Months	(=J20)
Maximum	3.0 Months	(=K20)

Assumption: Site Access/Transportation Issues (cont'd) **Cell: J20**



Assumption: Unplanned Work that Must Be Accommodated **Cell: J9**

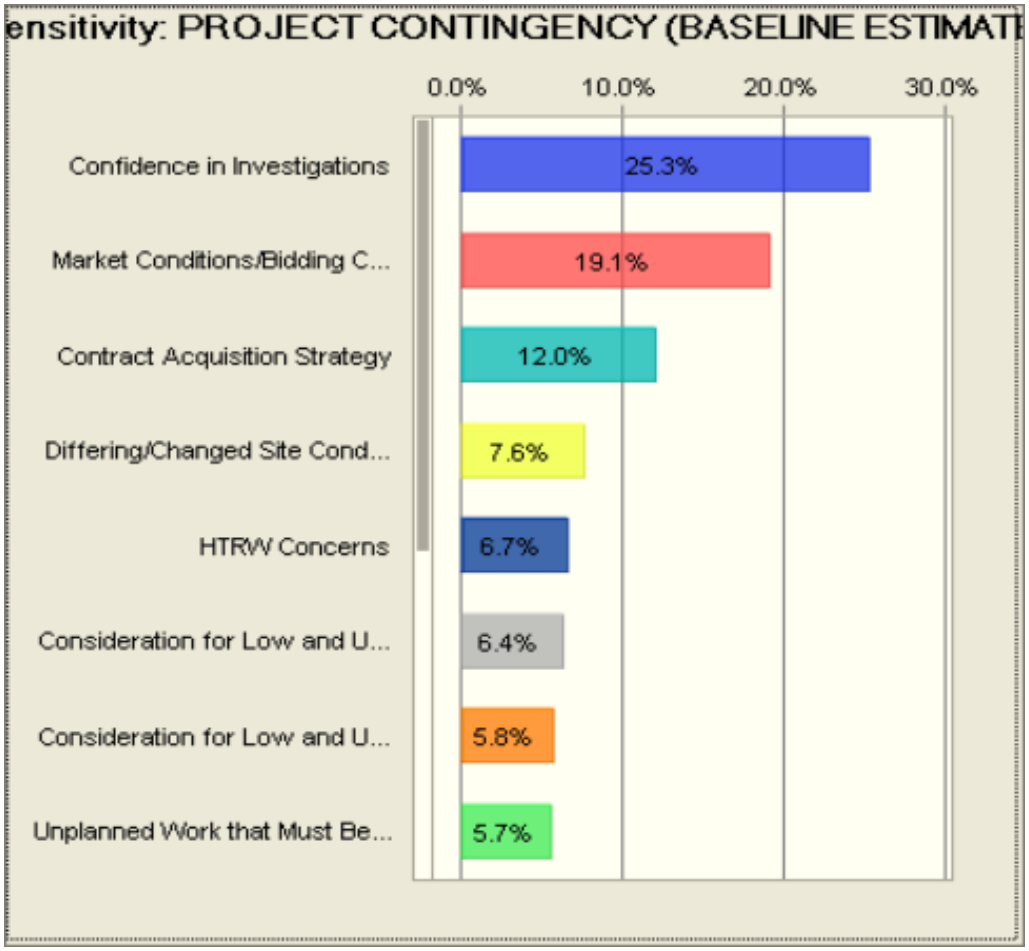
Uniform distribution with parameters:

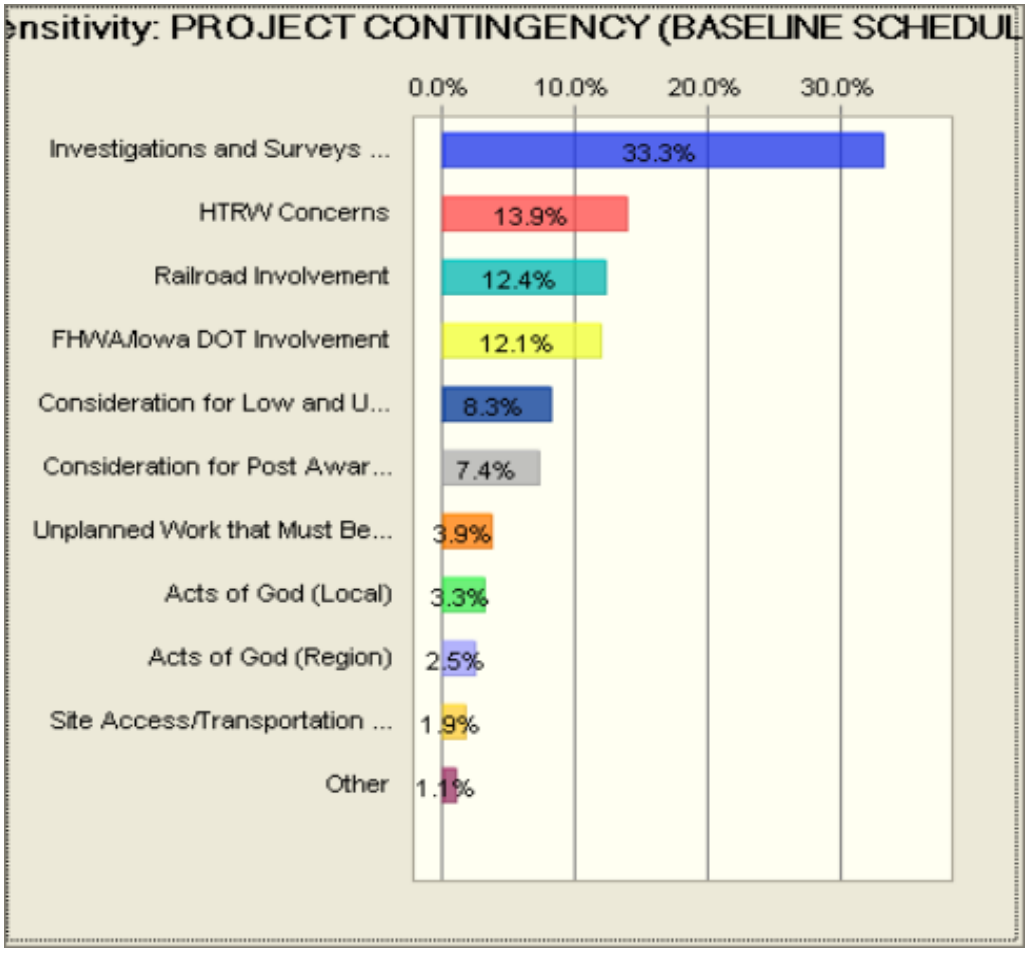
Minimum	0.0 Months	(=I9)
Maximum	3.0 Months	(=K9)



End of Assumptions

Sensitivity Charts





End of Sensitivity Charts

Statistics	PROJECT CONTINGENCY (BASELINE ESTIMATE)	PROJECT CONTINGENCY (BASELINE SCHEDULE)
Trials	10000	10000
Base Case	$0	0.0 Months
Mean	$10,644,191	23.7 Months
Median	$10,633,424	23.6 Months
Mode	---	---
Standard Deviation	$5,178,403	4.9 Months
Variance	$26,815,862,697,262	24.1 Months
Skewness	-0.0314	0.1242
Kurtosis	2.82	2.85
Coeff. of Variability	0.4865	0.2070
Minimum	-$11,427,562	6.7 Months
Maximum	$28,309,881	41.3 Months
Range Width	$39,737,443	34.7 Months
Mean Std. Error	$51,784	0.0 Months

Percentiles	PROJECT CONTINGENCY (BASELINE ESTIMATE)	PROJECT CONTINGENCY (BASELINE SCHEDULE)
0%	-$11,427,562	6.7 Months
5%	$2,068,516	15.9 Months
10%	$3,784,231	17.4 Months
15%	$5,197,072	18.6 Months
20%	$6,241,342	19.5 Months
25%	$7,098,618	20.3 Months
30%	$7,903,214	21.0 Months
35%	$8,629,565	21.7 Months
40%	$9,363,375	22.3 Months
45%	$10,010,538	23.0 Months
50%	$10,633,237	23.6 Months
55%	$11,292,468	24.2 Months
60%	$11,977,129	24.9 Months
65%	$12,701,774	25.6 Months
70%	$13,436,669	26.3 Months
75%	$14,260,320	27.1 Months
80%	$15,139,554	27.8 Months
85%	$16,114,020	28.8 Months
90%	$17,312,896	30.1 Months
95%	$19,064,083	32.1 Months
100%	$28,309,881	41.3 Months

Sensitivity Data Assumptions	PROJECT CONTINGENCY (BASELINE ESTIMATE)	PROJECT CONTINGENCY (BASELINE SCHEDULE)
Confidence in Investigations	0.49	0.01
Consideration for Low and Unknown External Risk	0.25	-0.01
Consideration for Low and Unknown Internal Risk	0.24	0.01
Consideration for Post Award Cost Modifications	0.11	-0.01
Consideration for Seasonal Weather Impacts	0.08	0.01
Contract Acquisition Strategy	0.34	-0.01
Critical Fabrication Delivery	0.08	0.01
Differing/Changed Site Conditions	0.27	0.01
HTRW Concerns	0.25	0.01
Investigations and Surveys not complete	0.11	0.01
Market Conditions/Bidding Climate	0.43	0.01
Potentially Inaccurate Assumptions Made Specific to Alignment/Utility Relocations Issues	0.15	0.00
Railroad Involvement	0.13	-0.01
Site Access/Transportation Issues	0.06	0.00
Uncertainty regarding obstructions/construction constraints (structural)	0.18	0.01
Unplanned Work that Must Be Accommodated	0.23	0.01
Acts of God (Local)	0.01	0.18
Acts of God (Region)	0.01	0.15
Consideration for Low and Unknown External Risk	0.01	-0.01
Consideration for Low and Unknown Internal Risk	0.02	0.28
Consideration for Post Award Cost Modifications	0.01	0.26
Consideration for Seasonal Weather Impacts	0.00	-0.01
Differing/Changed Site Conditions	-0.01	0.01
FHWA/Iowa DOT Involvement	0.00	0.34
HTRW Concerns	0.00	0.36
Investigations and Surveys not complete	0.01	0.56
Railroad Involvement	0.00	0.34
Real Estate Plan for Mitigation and Borrow Needs Identified	-0.02	0.06
Real Estate Plan Undefined (Corps) - Non RR	-0.01	0.07
Site Access/Transportation Issues	0.01	0.14
Unplanned Work that Must Be Accommodated	0.01	0.19

Most Likely Cost Estimate	Most Likely		
Confidence Level	Project Cost	Contingency	Contingency %
0%	$70,998,476	($9,766,833)	-12.09%
5%	$85,127,789	$4,362,479	5.40%
10%	$86,946,351	$6,181,041	7.65%
15%	$88,439,167	$7,673,858	9.50%
20%	$89,547,028	$8,781,719	10.87%
25%	$90,457,786	$9,692,476	12.00%
30%	$91,314,496	$10,549,186	13.06%
35%	$92,086,160	$11,320,851	14.02%
40%	$92,864,539	$12,099,230	14.98%
45%	$93,556,058	$12,790,748	15.84%
50%	$94,223,255	$13,457,946	16.66%
55%	$94,923,218	$14,157,909	17.53%
60%	$95,652,347	$14,887,038	18.43%
65%	$96,423,918	$15,658,609	19.39%
70%	$97,206,994	$16,441,685	20.36%
75%	$98,086,562	$17,321,253	21.45%
80%	$99,017,210	$18,251,901	22.60%
85%	$100,058,947	$19,293,638	23.89%
90%	$101,344,561	$20,579,251	25.48%
95%	$103,234,523	$22,469,214	27.82%
100%	$113,113,341	$32,348,032	40.05%

APPENDIX I-B

TOTAL PROJECT COST SUMMARY

October 20, 2010

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: Cedar Rapids Flood Study, Alternative 4C - 500 YR Level
LOCATION: Cedar Rapids, Iowa

DISTRICT: Rock Island District PREPARED: 10/20/2010
POC: CHIEF, COST ENGINEERING,

This Estimate reflects the scope and schedule in report; Cedar Rapids Flood Study, Alternative 4C - 500 YR Level

Program Year (Budget EC): 2011
Effective Price Level Date: 1 OCT 10

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Spent Thru: 1-Oct-10 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
02	RELOCATIONS	$9,976	$2,104	21%	$12,080		$9,976	$2,104	$12,080			$10,552	$2,225	$12,778
11	LEVEES & FLOODWALLS	$44,545	$9,394	21%	$53,939		$44,545	$9,394	$53,939			$47,118	$9,937	$57,055
13	PUMPING PLANT	$2,248	$474	21%	$2,722		$2,248	$474	$2,722			$2,338	$493	$2,831
	CONSTRUCTION ESTIMATE TOTALS:	$56,769	$11,973		**$68,741**		$56,769	$11,973	$68,741			$60,008	$12,656	$72,664
01	LANDS AND DAMAGES	$8,667	$3,033	35%	$11,700		$8,667	$3,033	$11,700			$8,827	$3,089	$11,916
18	CULTURAL RESOURCE PRESERVATION	$568	$120	21%	$687		$568	$120	$687			$583	$123	$706
30	PLANNING, ENGINEERING & DESIGN	$10,220	$2,155	21%	$12,375		$10,220	$2,155	$12,375			$10,706	$2,258	$12,964
31	CONSTRUCTION MANAGEMENT	$4,542	$958	21%	$5,500		$4,542	$958	$5,500			$5,211	$1,099	$6,309
	PROJECT COST TOTALS:	$80,765	$18,239	23%	**$99,004**		$80,765	$18,239	$99,004			$85,334	$19,225	$104,559

ESTIMATED FEDERAL COST:	65%	**$67,963**
ESTIMATED NON-FEDERAL COST:	35%	**$36,596**
ESTIMATED TOTAL PROJECT COST:		**$104,559**

_____ CHIEF, COST ENGINEERING,

_____ PROJECT MANAGER, xxx

_____ CHIEF, REAL ESTATE, xxx

_____ CHIEF, PLANNING,xxx

_____ CHIEF, ENGINEERING, xxx

_____ CHIEF, OPERATIONS, xxx

_____ CHIEF, CONSTRUCTION, xxx

_____ CHIEF, CONTRACTING,xxx

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, xxx

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Cedar Rapids Flood Study, Alternative 4C - 500 YR Level
LOCATION: Cedar Rapids, Iowa
This Estimate reflects the scope and schedule in report; Cedar Rapids Flood Study, Alternative 4C - 500 YR Level

DISTRICT: Rock Island District PREPARED: 10/20/2010
POC: CHIEF, COST ENGINEERING,

Estimate Prepared: 20-Oct-10
Effective Price Level: 20-Oct-10

Program Year (Budget EC): 2011
Effective Price Level Date: 1 OCT 10

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	STUDY													
02	RELOCATIONS	$9,976	$2,104	21%	$ 12,080		$9,976	$2,104	$12,080	2014Q3	5.8%	$10,552	$2,225	$12,778
11	LEVEES & FLOODWALLS	$44,545	$9,394	21%	$ 53,939		$44,545	$9,394	$53,939	2014Q3	5.8%	$47,118	$9,937	$57,055
13	PUMPING PLANT	$2,248	$474	21%	$ 2,722		$2,248	$474	$2,722	2013Q3	4.0%	$2,338	$493	$2,831
	CONSTRUCTION ESTIMATE TOTALS:	$56,769	$11,973	21%	**68,741**		$56,769	$11,973	$68,741			$60,008	$12,656	$72,664
01	LANDS AND DAMAGES	$8,667	$3,033	35%	$ 11,700		$8,667	$3,033	$11,700	2012Q2	1.8%	$8,827	$3,089	$11,916
18	CULTURAL RESOURCE PRESERVATION	$568	$120	21%	$ 687		$568	$120	$687	2012Q4	2.7%	$583	$123	$706
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$1,135	$239	21%	1,374		$1,135	$239	$1,374	2011Q4	2.3%	$1,162	$245	$1,407
1.0%	Planning & Environmental Compliance	$568	$120	21%	688		$568	$120	$688	2011Q4	2.3%	$581	$123	$704
8.5%	Engineering & Design	$4,825	$1,018	21%	5,843		$4,825	$1,018	$5,843	2011Q4	2.3%	$4,938	$1,041	$5,980
1.5%	Engineering Tech Review ITR & VE	$852	$180	21%	1,032		$852	$180	$1,032	2011Q4	2.3%	$872	$184	$1,056
1.5%	Contracting & Reprographics	$852	$180	21%	1,032		$852	$180	$1,032	2011Q4	2.3%	$872	$184	$1,056
1.5%	Engineering During Construction	$852	$180	21%	1,032		$852	$180	$1,032	2014Q4	14.7%	$977	$206	$1,184
1.0%	Planning During Construction	$568	$120	21%	688		$568	$120	$688	2014Q4	14.7%	$652	$137	$789
1.0%	Project Operations	$568	$120	21%	688		$568	$120	$688	2011Q4	14.7%	$652	$137	$789
31	CONSTRUCTION MANAGEMENT													
5.5%	Construction Management	$3,122	$658	21%	3,780		$3,122	$658	$3,780	2014Q4	14.7%	$3,582	$755	$4,337
1.0%	Project Operation:	$568	$120	21%	688		$568	$120	$688	2014Q4	14.7%	$652	$137	$789
1.5%	Project Management	$852	$180	21%	1,032		$852	$180	$1,032	2014Q4	14.7%	$977	$206	$1,184
	CONTRACT COST TOTALS:	$80,765	$18,239		**99,004**		$80,765	$18,239	$99,004			$85,334	$19,225	**$104,559**

Filename: 2010-10-20 ATR_TPCS Cedar Rapids Flood Study.xlsx
TPCS

APPENDIX I-C

COST ESTIMATE

October 19, 2010

Cedar Rapids Flood Study Alternative 4-C - 500 Level 19OCT10 Cost Estimate

Cost Estimate encompasses costs for Alternative 4-C at the 500 Year Level. Costs included are for Demolition, Traffic Control, Utility Relocations, Floodwalls (T-walls) and (I-walls), Earthen Levees, Removable Walls, Gate Monoliths and Surface Restoration. IA20100001 03/12/2010, IA20100037 04/16/2010, IA20100104 03/12/2010

Estimated by	Stanley Consultants
Designed by	Stanley Consultants
Prepared by	Glenn Jensen & Matt Whittington
Preparation Date	10/19/2010
Effective Date of Pricing	10/19/2010
Estimated Construction Time	1,095 Days

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Designed by
Stanley Consultants
Estimated by
Stanley Consultants
Prepared by
Glenn Jensen & Matt Whittington

Design Document	Feasibility Study
Document Date	10/19/2010
District	Rock Island
Contact	
Budget Year	2011
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost

Timeline/Currency

Preparation Date	10/19/2010
Escalation Date	10/19/2010
Eff. Pricing Date	10/19/2010
Estimated Duration	1095 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB08EB: MII English Cost Book 2008

Labor LINN2010: Labor National - Linn County Iowa 2010

abor Rates!!!!! Fringes paid to the laborers are taxable. In a non-union job the whole fringes are taxable. In union job, the vacation pay fringes is taxable. The current average vacation pay is approximately

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP07R05: MII Equipment Region 5r 2007

05 MIDWEST

Sales Tax	7.00
Working Hours per Year	1,400
Labor Adjustment Factor	1.00
Cost of Money	3.25
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.083
Gas	2.700
Diesel Off-Road	2.680
Diesel On-Road	2.900

Shipping Rates

Over 0 CWT	10.65
Over 240 CWT	10.00
Over 300 CWT	8.23
Over 400 CWT	7.51
Over 500 CWT	4.48
Over 700 CWT	4.15
Over 800 CWT	3.18

Date	Author	Note
8/18/2009	Wage Rates and Markups	Costs were derived from local contractors and suppliers where applicable. Means Cost data was also used in the cost development. Taxes: Local taxes will be applied to all materials, this includes vendor prices. The computed tax rate in Cedar Rapids, Iowa is 7% on materials. Reference the Iowa Department of Revenue website: https://www.idr.iowa.gov/salestaxlookup/allresults.asp. CONTINGENCY IS NOT INCLUDED IN THIS ESTIMATE. Contingency is determined using the CSRA analysis. The current CSRA quantitative analysis determined a 17.32% contingency provided by the Rock Island District and will be included in the TPCS report Prime Contractor mark ups are included: JOOH - 15% JOOH-Subwork - 5% HOOH-5% HOOH-Subwork - 5% Profit - 8.70% Profit-Subwork - 8.0% To 10.0% Bond - 1% Bond-Subwork - 1%
8/18/2009	Cost Estimator Contact Information	Glenn Jensen: (563) 264-6478, jensenglenn@stanleygroup.com Matt Whittington: (563) 264-6451, whittingtonmatthew@stanleygroup.com
8/31/2009	Assumptions	Material excavated from existing levees is assumed to be suitable for use in the new levee embankment. Demolition costs include pavement removal, underground utilities, and building and structure removal. Hauling costs are based on the use of the borrow sites near the Eastern Iowa Airport Properties. It is assumed that the material at the potential borrow sites contain suitable clay for levee construction. The value of the borrow material is included in the real estate costs and is not included in the construction cost estimate. Land Acquisition and HTRW costs will be added to the cost estimate by the USACE Levees a. Assume a 6' deep inspection trench backfilled with impervious clay material will be constructed continuously along the levee. This assumes that the soils are fairly good against resisting seepage under the levee. Floodwalls (T-walls) a. Assume a 15' deep continuous sheet pile wall will be constructed under the floodwalls. This would cut off any utilities that were in the area. We will assume that the foundation for the T-walls will be supported by the soils without additional support provided by structural sheet piling. b. Assume a 10' deep inspection trench backfilled with impervious clay material will be constructed continuously along the Floodwalls and Removable Walls. 50% of the excavated material for the inspection trench can be re-used for inspection trench backfill. The other 50% can be used for flattening the slopes on the wet side per City desire. Floodwalls (I-Walls) a. Assume a 10' deep (for 3 foot wall) & 20' deep (for 6 foot wall) continuous sheet pile wall will be constructed under the floodwalls. This would cut off any utilities that were in the area. b. Assume no inspection trench will be used on the I-walls. Utility relocation costs are determined based on estimator's experience. Quantities are based on current utility maps provided by the USACE.

Date	Author	Note
8/31/2009	Assumptions	Floodwalls and Removable Walls assume a width of 80' for pavement demolition and surface restoration along the length of the walls. As directed by the USACE in SC Meeting Notes on September 1, 2009, 50% of the excavated material for the inspection trench can be re-used for inspection trench backfill. The other 50% can be used for flattening the slopes on the wet side per City desire. During detailed design, the alignment downstream of the bridge at 16th Ave SW/14th Ave SE will be shifted slightly towards the river, as necessary, to avoid having to relocate the entire length of the 42” and 60” sanitary sewer pipes that run under A St SW.

Direct Cost Markups	Category	Method
DirectCost1	Productivity	Running % on Selected Costs
Sales Tax	TaxAdj	Running % on Selected Costs

Overtime

	Days/Week	Hours/Shift	Shifts/Day	1st Shift	2nd Shift	3rd Shift
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*7.00*	*8.00*	*1.00*	*10.00*	*0.00*	*0.00*

Day	OT Factor	Working	OT Percent	FCCM Percent
Monday	*1.50*	*Yes*	*28.57*	*(42.86)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*Yes*		
Sunday	*2.00*	*Yes*		

Productivity	Productivity	Productivity

Contractor Markups	Category	Method
Mobilization	MiscContract	Running %
JOOH %	Allowance	Running %
HOOH	HOOH	Running %
Profit Weighted	Profit	Profit Weighted Guidelines

Guideline	Value	Weight	Percentage
Risk	*0.100*	*20*	*2.00*
Difficulty	*0.100*	*15*	*1.50*
Size	*0.030*	*15*	*0.45*
Period	*0.120*	*15*	*1.80*
Invest (Contractor's)	*0.120*	*5*	*0.60*
Assist (Assistance by)	*0.070*	*5*	*0.35*
SubContracting	*0.080*	*25*	*2.00*
Total		*100*	*8.70*

Profit	Profit	Running %
Bond	Bond	Running %
Contractor1	MiscContract	Running %
Insurance	MiscContract	Direct %

Owner Markups	Category	Method
Contingency	Contingency	Running %
Owner1	Escalation	Escalation

StartDate	StartIndex	EndDate	EndIndex	Escalation
6/15/2010	*0.00*	*6/15/2010*	*0.00*	*0.00*

Description	Contractor	Quantity	UOM	DirectCost	CostToPrime	ContractCost	Escalation	Contingency	ProjectCost
Project Owner Summary				61,429,240	67,207,134	80,765,309	0	0	80,765,309
01 Lands & Damages	Prime Alt.	1.0	LS	8,666,667	8,666,667	8,666,667	0	0	8,666,667
02 Relocations	Unrestricted Prime	1.0	LS	6,216,987	8,242,006	9,976,137	0	0	9,976,137
0203 Utility Relocates	Utility Subcontractor	1.0	LS	6,216,987	8,242,006	9,976,137	0	0	9,976,137
020301 Storm Sewer	Utility Subcontractor	1.0	LS	1,584,103	2,100,083	2,541,944	0	0	2,541,944
020302 Potable Water	Utility Subcontractor	1.0	LS	855,654	1,134,361	1,373,032	0	0	1,373,032
020303 Sanitary Sewer	Utility Subcontractor	1.0	LS	258,512	342,715	414,823	0	0	414,823
				3,518,717.71	*4,664,846.83*	*5,646,338.42*			*5,646,338.42*
020304 Electrical & Gas Utility Demolition & Relocations	Unrestricted Prime	1.0	EA	3,518,718	4,664,847	5,646,338	0	0	5,646,338
11 Levee & Floodwalls	Unrestricted Prime	1.0	LS	29,812,501	33,111,324	44,544,622	0	0	44,544,622
				26.74	*35.90*	*43.46*			*43.46*
1101 Levees	Levee Subcontractor	147,884.0	CY	3,954,049	5,309,718	6,426,892	0	0	6,426,892
110101 Demolition	Demolition Subcontractor	1.0	LS	731,138	969,287	1,173,227	0	0	1,173,227
				21.95	*29.36*	*35.53*			*35.53*
110102 Earthen Levees	Levee Subcontractor	94,646.0	BCY	2,077,383	2,778,457	3,363,049	0	0	3,363,049
				3.86	*5.27*	*6.38*			*6.38*
110103 Surface Restoration	Surface Restoration Subcontractor	296,560.0	SF	1,145,528	1,561,974	1,890,616	0	0	1,890,616
				785.63	*865.52*	*1,170.20*			*1,170.20*
1102 Floodwall Construction	Unrestricted Prime	24,322.0	CY	19,108,081	21,051,236	28,461,530	0	0	28,461,530
				785.63	*865.52*	*1,170.20*			*1,170.20*
110201 Floodwalls	Unrestricted Prime	24,322.0	CY	19,108,081	21,051,236	28,461,530	0	0	28,461,530
				519,259.26	*519,259.26*	*742,784.64*			*742,784.64*
1103 Closure Structures	Unrestricted Prime	13.0	EA	6,750,370	6,750,370	9,656,200	0	0	9,656,200
				103.13	*103.13*	*147.53*			*147.53*
110301 Removable Floodwall Storage Building	Unrestricted Prime	1,350.0	SF	139,230	139,230	199,164	0	0	199,164
110302 Closure Structure 1	Unrestricted Prime	1.0	LS	836,507	836,507	1,196,598	0	0	1,196,598
110303 Closure Structure 2	Unrestricted Prime	1.0	LS	402,998	402,998	576,477	0	0	576,477

Description	Contractor	Quantity	UOM	DirectCost	CostToPrime	ContractCost	Escalation	Contingency	ProjectCost
110304 Closure Structure 3	Unrestricted Prime	1.0	LS	1,190,448	1,190,448	1,702,899	0	0	1,702,899
110305 Closure Structure 4	Unrestricted Prime	1.0	LS	285,188	285,188	407,953	0	0	407,953
110306 Closure Structure 5	Unrestricted Prime	1.0	LS	273,685	273,685	391,498	0	0	391,498
110307 Closure Structure 6	Unrestricted Prime	1.0	LS	481,154	481,154	688,276	0	0	688,276
110308 Closure Structure 7	Unrestricted Prime	1.0	LS	417,511	417,511	597,236	0	0	597,236
110309 Closure Structure 8	Unrestricted Prime	1.0	LS	447,783	447,783	640,540	0	0	640,540
110310 Closure Structure 9	Unrestricted Prime	1.0	LS	362,668	362,668	518,785	0	0	518,785
110311 Closure Structure 10	Unrestricted Prime	1.0	LS	207,216	207,216	296,417	0	0	296,417
110312 Closure Structure 11	Unrestricted Prime	1.0	LS	434,220	434,220	621,138	0	0	621,138
110313 Closure Structure 12	Unrestricted Prime	1.0	LS	373,648	373,648	534,493	0	0	534,493
110314 Closure Structure 13	Unrestricted Prime	1.0	LS	898,115	898,115	1,284,726	0	0	1,284,726
13 Pumping Plant	Unrestricted Prime	1.0	LS	1,403,085	1,857,138	2,247,883	0	0	2,247,883
				233,847.53	*309,522.94*	*374,647.08*			*374,647.08*
1301 Pump Stations	Unrestricted Prime	6.0	EA	1,403,085	1,857,138	2,247,883	0	0	2,247,883
				216,136.89	*286,043.52*	*346,227.56*			*346,227.56*
130101 Storm Sewer Pump Station	Unrestricted Prime	5.0	EA	1,080,684	1,430,218	1,731,138	0	0	1,731,138
				322,400.76	*426,920.04*	*516,744.73*			*516,744.73*
130102 Sanitary Sewer Pump Station	Unrestricted Prime	1.0	EA	322,401	426,920	516,745	0	0	516,745
18 Cultural Resources Preservation	Prime Alt.	1.0	LS	568,000	568,000	568,000	0	0	568,000
30 Planning, Engineering & Design	Prime Alt.	1.0	LS	10,220,000	10,220,000	10,220,000	0	0	10,220,000
31 Construction Management	Prime Alt.	1.0	LS	4,542,000	4,542,000	4,542,000	0	0	4,542,000

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020303 Sanitary Sewer	1
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1101 Levees	1
110101 Demolition	1
110102 Earthen Levees	1
110103 Surface Restoration	1
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110303 Closure Structure 2	1
110304 Closure Structure 3	1
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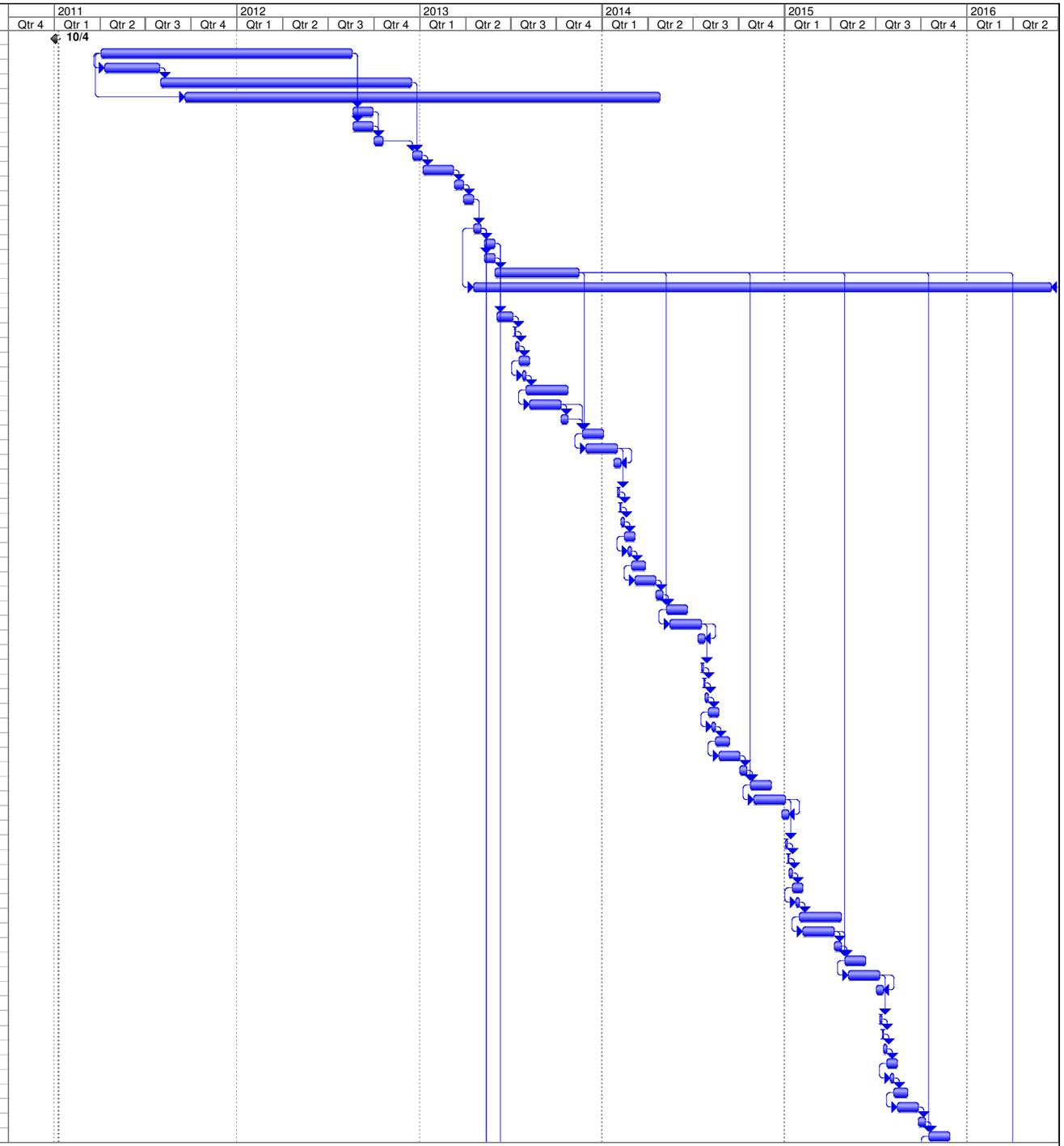
110309 Closure Structure 8	2
110310 Closure Structure 9	2
110311 Closure Structure 10	2
110312 Closure Structure 11	2
110313 Closure Structure 12	2
110314 Closure Structure 13	2
13 Pumping Plant	2
1301 Pump Stations	2
130101 Storm Sewer Pump Station	2
130102 Sanitary Sewer Pump Station	2
18 Cultural Resources Preservation	2
30 Planning, Engineering & Design	2
31 Construction Management	2

APPENDIX I-D

FISCAL YEAR SCHEDULE

ID	Task Name	Duration	Start	Finish	Predecessors
1	Start of Fiscal Year	0 days	Mon 10/4/10	Mon 10/4/10	
2	Project Engineering & Design	18 mons	Mon 1/3/11	Fri 5/18/12	
3	Cost share agreement	4 mons	Mon 1/10/11	Fri 4/29/11	2SS+5 days
4	Real Estate acquisition	18 mons	Mon 5/2/11	Fri 9/14/12	3
5	Cultural Resource Preservation	34 mons	Mon 6/20/11	Fri 1/24/14	2SS+6 mons
6	ITR	30 days	Mon 5/21/12	Fri 6/29/12	2
7	BCOE Review	30 days	Mon 5/21/12	Fri 6/29/12	2
8	Final Signatures and Approvals	14 days	Mon 7/2/12	Thu 7/19/12	7,6
9	Presolicitation (FedBizOps)	15 days	Mon 9/17/12	Fri 10/5/12	8,4
10	Contract Solicitation	45 days	Mon 10/8/12	Fri 12/7/12	9
11	Proposal Evaluation	14 days	Mon 12/10/12	Thu 12/27/12	10
12	Contract Award	14 days	Fri 12/28/12	Wed 1/16/13	11
13					
14	**Notice to Proceed**	11 days	Thu 1/17/13	Thu 1/31/13	12
15	Mobilization	15 days	Fri 2/8/13	Thu 2/28/13	14FS+5 days
16	Equipment Shop Drawings	15 days	Fri 2/8/13	Thu 2/28/13	14FS+5 days
17	Equipment Order & Deliver	120 days	Fri 3/1/13	Thu 8/15/13	16
18	S & A (Supervision & Administration during construction)	826 days	Thu 1/17/13	Thu 3/17/16	14SS,90FF
19					
20	**Gates & Remove Walls - Street Closure (1 of 6)**	24 days	Tue 3/5/13	Fri 4/5/13	15FS+2 days
21	Utility Locates	2 days	Tue 4/9/13	Wed 4/10/13	20FS+1 day
22	Demolition	5 days	Thu 4/11/13	Wed 4/17/13	21
23	Excavation	15 days	Thu 4/18/13	Wed 5/8/13	22
24	Utility Relocates	5 days	Thu 4/25/13	Wed 5/1/13	23SS+5 days
25	Foundation	60 days	Thu 5/2/13	Wed 7/24/13	24
26	Abutment Construction	45 days	Thu 5/9/13	Wed 7/10/13	25SS+5 days
27	Roadway surface reconstruction	10 days	Thu 7/11/13	Wed 7/24/13	26
28	Gate Installation	30 days	Fri 8/23/13	Thu 10/3/13	27FS+5 days,17FS+5 days,26
29	Gate/Wall Operational Test	45 days	Fri 8/30/13	Thu 10/31/13	28SS+5 days
30	Clean-Up & Landscaping	10 days	Fri 10/25/13	Thu 11/7/13	29FF+5 days
31					
32	**Gates & Remove Walls - Street Closure (2 of 6)**	2 days	Fri 11/1/13	Mon 11/4/13	29
33	Utility Locates	2 days	Wed 11/6/13	Thu 11/7/13	32FS+1 day
34	Demolition	5 days	Fri 11/8/13	Thu 11/14/13	33
35	Excavation	15 days	Fri 11/15/13	Thu 12/5/13	34
36	Utility Relocates	5 days	Fri 11/22/13	Thu 11/28/13	35SS+5 days
37	Foundation	20 days	Fri 11/29/13	Thu 12/26/13	36
38	Abutment Construction	30 days	Fri 12/6/13	Thu 1/16/14	37SS+5 days
39	Roadway surface reconstruction	10 days	Fri 1/17/14	Thu 1/30/14	38
40	Gate Installation	30 days	Fri 2/7/14	Thu 3/20/14	39FS+5 days,17
41	Gate/Wall Operational Test	45 days	Fri 2/14/14	Thu 4/17/14	40SS+5 days
42	Clean-Up & Landscaping	10 days	Fri 4/11/14	Thu 4/24/14	41FF+5 days
43					
44	**Gates & Remove Walls - Street Closure (3 of 6)**	2 days	Fri 4/18/14	Mon 4/21/14	41
45	Utility Locates	2 days	Wed 4/23/14	Thu 4/24/14	44FS+1 day
46	Demolition	5 days	Fri 4/25/14	Thu 5/1/14	45
47	Excavation	15 days	Fri 5/2/14	Thu 5/22/14	46
48	Utility Relocates	5 days	Fri 5/9/14	Thu 5/15/14	47SS+5 days
49	Foundation	20 days	Fri 5/16/14	Thu 6/12/14	48
50	Abutment Construction	30 days	Fri 5/23/14	Thu 7/3/14	49SS+5 days
51	Roadway surface reconstruction	10 days	Fri 7/4/14	Thu 7/17/14	50
52	Gate Installation	30 days	Fri 7/25/14	Thu 9/4/14	51FS+5 days,17
53	Gate/Wall Operational Test	45 days	Fri 8/1/14	Thu 10/2/14	52SS+5 days
54	Clean-Up & Landscaping	10 days	Fri 9/26/14	Thu 10/9/14	53FF+5 days
55					
56	**Gates & Remove Walls - Street Closure (4 of 6)**	2 days	Fri 10/3/14	Mon 10/6/14	53
57	Utility Locates	2 days	Wed 10/8/14	Thu 10/9/14	56FS+1 day
58	Demolition	5 days	Fri 10/10/14	Thu 10/16/14	57
59	Excavation	15 days	Fri 10/17/14	Thu 11/6/14	58
60	Utility Relocates	5 days	Fri 10/24/14	Thu 10/30/14	59SS+5 days
61	Foundation	60 days	Fri 10/31/14	Thu 1/22/15	60
62	Abutment Construction	45 days	Fri 11/7/14	Thu 1/8/15	61SS+5 days
63	Roadway surface reconstruction	10 days	Fri 1/9/15	Thu 1/22/15	62
64	Gate Installation	30 days	Fri 1/30/15	Thu 3/12/15	62,63FS+5 days,17
65	Gate/Wall Operational Test	45 days	Fri 2/6/15	Thu 4/9/15	64SS+5 days
66	Clean-Up & Landscaping	10 days	Fri 4/3/15	Thu 4/16/15	65FF+5 days
67					
68	**Gates & Remove Walls - Street Closure (5 of 6)**	2 days	Fri 4/10/15	Mon 4/13/15	65
69	Utility Locates	2 days	Wed 4/15/15	Thu 4/16/15	68FS+1 day
70	Demolition	5 days	Fri 4/17/15	Thu 4/23/15	69
71	Excavation	15 days	Fri 4/24/15	Thu 5/14/15	70
72	Utility Relocates	5 days	Fri 5/1/15	Thu 5/7/15	71SS+5 days
73	Foundation	20 days	Fri 5/8/15	Thu 6/4/15	72
74	Abutment Construction	30 days	Fri 5/15/15	Thu 6/25/15	73SS+5 days
75	Roadway surface reconstruction	10 days	Fri 6/26/15	Thu 7/9/15	74
76	Gate Installation	30 days	Fri 7/17/15	Thu 8/27/15	75FS+5 days,17

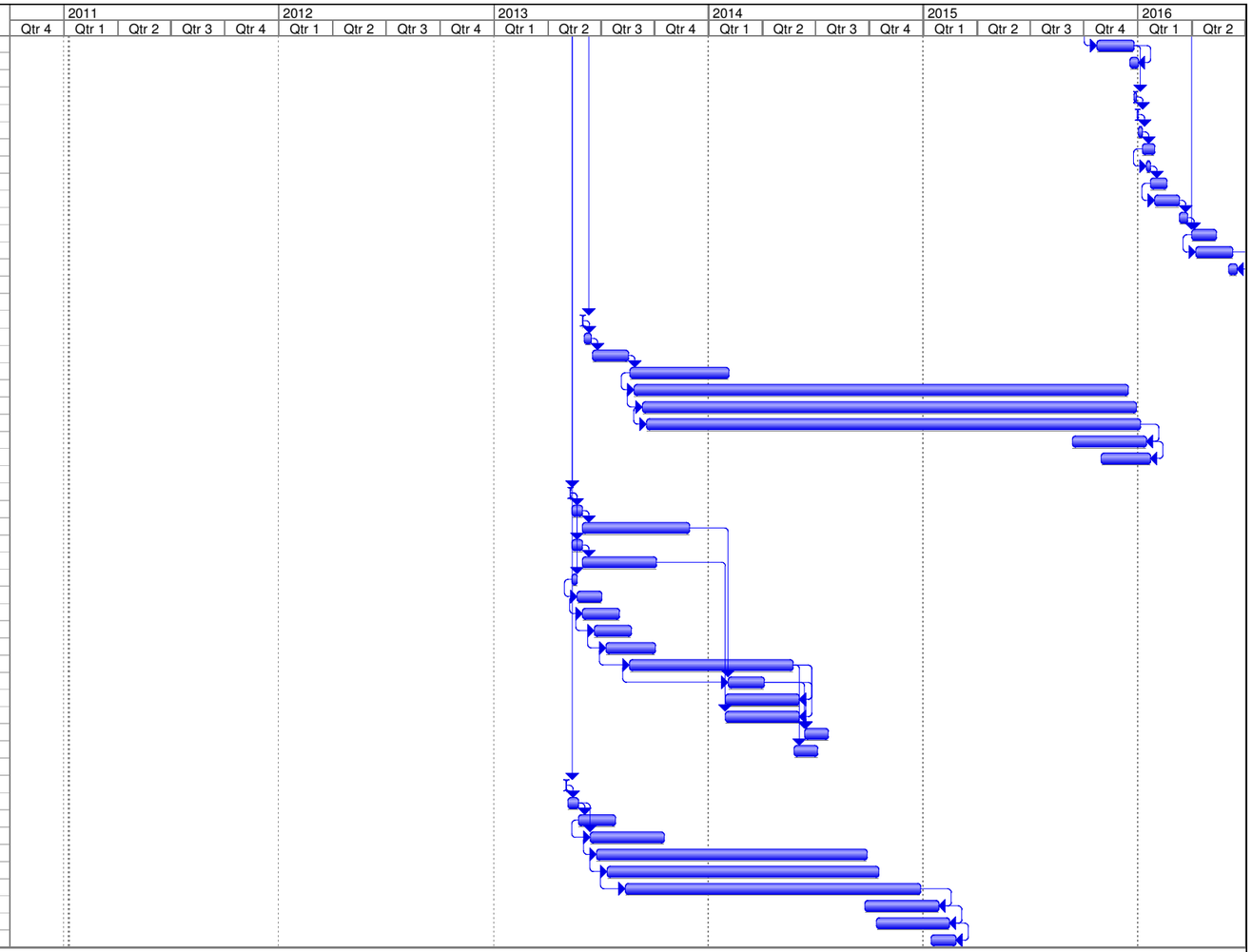


Cedar Rapids Flood Study
Measure 27B - 500 Year Flood
One Contract

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Project Schedule
Appendix I-D

ID	Task Name	Duration	Start	Finish	Predecessors
77	Gate/Wall Operational Test	45 days	Fri 7/24/15	Thu 9/24/15	76SS+5 days
78	Clean-Up & Landscaping	10 days	Fri 9/18/15	Thu 10/1/15	77FF+5 days
79					
80	**Gates & Remove Walls - Street Closure (6 of 6)**	2 days	Fri 9/25/15	Mon 9/28/15	77
81	Utility Locates	2 days	Wed 9/30/15	Thu 10/1/15	80FS+1 day
82	Demolition	5 days	Fri 10/2/15	Thu 10/8/15	81
83	Excavation	15 days	Fri 10/9/15	Thu 10/29/15	82
84	Utility Relocates	5 days	Fri 10/16/15	Thu 10/22/15	83SS+5 days
85	Foundation	20 days	Fri 10/23/15	Thu 11/19/15	84
86	Abutment Construction	30 days	Fri 10/30/15	Thu 12/10/15	85SS+5 days
87	Roadway surface reconstruction	10 days	Fri 12/11/15	Thu 12/24/15	86
88	Gate Installation	30 days	Fri 1/1/16	Thu 2/11/16	87FS+5 days,17
89	Gate/Wall Operational Test	45 days	Fri 1/8/16	Thu 3/10/16	88SS+5 days
90	Clean-Up & Landscaping	10 days	Fri 3/4/16	Thu 3/17/16	89FF+5 days
91					
92					
93	**"T" Wall Construction (10,102 LF)**	1 day	Fri 3/1/13	Fri 3/1/13	15
94	Utility Locates	10 days	Mon 3/4/13	Fri 3/15/13	93
95	Clearing & Grubbing	45 days	Mon 3/18/13	Fri 5/17/13	94
96	Utility Relocates	120 days	Tue 5/21/13	Mon 11/4/13	95FS+1 day
97	Remove & replace existing soil	600 days	Tue 5/28/13	Mon 9/14/15	96SS+5 days
98	Drive Sheet Piling	600 days	Tue 6/11/13	Mon 9/28/15	97SS+10 days
99	"T" Wall Construction (4 crews working simultaneously)	600 days	Tue 6/18/13	Mon 10/5/15	98SS+5 days
100	Landscaping	90 days	Fri 6/12/15	Thu 10/15/15	99FF+8 days
101	Clean-Up	60 days	Fri 7/31/15	Thu 10/22/15	100FF+5 days
102					
103	**Pump Stations (6)**	1 day	Fri 2/8/13	Fri 2/8/13	14FS+5 days
104	Pump Shop Drawings	14 days	Mon 2/11/13	Thu 2/28/13	103
105	Pump Order & Delivery	130 days	Fri 3/1/13	Thu 8/29/13	104
106	Electrical & Controls Shop Dwgs	14 days	Mon 2/11/13	Thu 2/28/13	103
107	Electrical & Controls Order & Delivery	90 days	Fri 3/1/13	Thu 7/4/13	106
108	Utility Locates	7 days	Mon 2/11/13	Tue 2/19/13	103
109	Demolition	30 days	Wed 2/20/13	Tue 4/2/13	108SS+7 days
110	Excavation	45 days	Fri 3/1/13	Thu 5/2/13	109SS+7 days
111	Pile Driving	45 days	Thu 3/21/13	Wed 5/22/13	110SS+14 days
112	Foundation	60 days	Wed 4/10/13	Tue 7/2/13	111SS+14 days
113	Building Construction	200 days	Mon 5/20/13	Fri 2/21/14	112SS+28 days
114	Pump Installation	45 days	Mon 11/4/13	Fri 1/3/14	105FS+7 days,113SS+120 days
115	Mechanical - Piping & HVAC	90 days	Wed 10/30/13	Tue 3/4/14	113FF+7 days,114FF+14 days
116	Electrical & Controls	90 days	Wed 10/30/13	Tue 3/4/14	113FF+7 days,107
117	Pump Commissioning, Start-Up & Testing	28 days	Fri 3/14/14	Tue 4/22/14	114FS+7 days,115FS+7 days,116FS+7 days
118	Landscaping & Clean-Up	30 days	Mon 2/24/14	Fri 4/4/14	113
119					
120	**Earth Levees (3,796 LF)**	1 day	Fri 2/1/13	Fri 2/1/13	14
121	Utility Locates	14 days	Mon 2/4/13	Thu 2/21/13	120
122	Clearing & Grubbing	45 days	Fri 2/22/13	Thu 4/25/13	121
123	Utility Relocates	90 days	Thu 3/14/13	Wed 7/17/13	122SS+14 days,121
124	Inspection Trench Excavation	330 days	Mon 3/25/13	Fri 6/27/14	123SS+7 days
125	Inspection Trench Backfill	330 days	Fri 4/12/13	Thu 7/17/14	124SS+14 days
126	Levee Construction	360 days	Mon 5/13/13	Fri 9/26/14	125SS+21 days
127	Levee Stone Surfacing	90 days	Tue 6/24/14	Mon 10/27/14	126FF+21 days
128	Landscaping	90 days	Mon 7/14/14	Fri 11/14/14	127FF+14 days
129	Clean-Up	30 days	Wed 10/15/14	Tue 11/25/14	128FF+7 days



Cedar Rapids Flood Study
Measure 27B - 500 Year Flood
One Contract

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Project Schedule
Appendix I-D

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX J
PUBLIC INVOLVEMENT

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX J
PUBLIC INVOLVEMENT

This appendix describes public involvement activities for the *Cedar River Cedar Rapids, Iowa Flood Risk Management Project Feasibility Study Report With Integrated Environmental Assessment* (Study) public open houses held by the City of Cedar Rapids (City) and the US Army Corps of Engineers (Corps), Rock Island District (District). The public meeting and open houses were a cooperative effort of the City and the District. This report will discuss the findings and public comments received.

Following the flood of 2008, several meetings were held by the City in coordination with Sasaki consulting firm. These meetings were determined to be in line with what the Corps would conduct for National Environmental Policy Act (NEPA) public scoping and workshop meetings. Thus, the City will receive in-kind-credit for conducting the meetings.

The City and Sasaki held three public meetings in 2008:

July 29, 2008
- Identifying and Reviewing Issues and Concerns
  - Approximately 700 attended
  - Approximately 300 comments were received

September 11, 2008
- Options to Address Those Issues and Evaluation
  - Approximately 950 attended
  - Approximately 300 comments were received

October 16, 2008
- Feedback on Final Draft Framework and Revitalization
  - Approximately 1,030 attended
  - Approximately 300 comments were received

When the flood occurred, the City mobilized and embarked on multiple phases of community engagement for future flood protection and recovery. Strategic goals were established and an inclusive community-based process to achieve a supportable flood management plan was developed.

The planning process was a partnership between community members, multiple City departments, the Cedar Rapids City Council, an interdisciplinary consultant team, and numerous agencies ranging from the local to the Federal level, including the Downtown District; the Chamber of Commerce; Linn

County; multiple departments of the State of Iowa; the Federal Emergency Management Agency (FEMA); and US Department of Housing and Urban Development (HUD).

Phase I sought to establish the framework for reinvestment and revitalization of Cedar Rapids. Between June and October 2008, consultants and City staff led a series of open houses that engaged over 2,680 residents in evaluating several options for flood management and community revitalization. The first open house presented a rigorous analysis of pre-flood community assets, an inventory of flood impacts, and sustainable principles for the City's recovery. An interdisciplinary consulting team subsequently worked with the District to test and synthesize community feedback into a series of options for the second open house. These options included three radically different approaches: a floodwall lining the Cedar River (River) throughout the City; a drastically expanded floodplain that would displace most of the downtown neighborhoods; and a combination of a floodplain greenway with levees and floodwalls which would displace about 650 properties at the River's edge. Ultimately, a preferred alignment for future flood management was presented at the third Open House.

Community members favored the floodplain Greenway option, noting that it would allow for the best visual and spatial connection to the River. The Phase I public participation process also resulted in the development of nonstructural measures, including improvements to evacuation planning, interim flood protection, floodproofing, and flood warning systems, as well as advocacy for a larger civic initiative to address the River's watershed issues.

Comments in their entirety can be found at the City's website: http://www.cedar-rapids.org/-development/hot_topics_rcrp.asp.

The Phase I public process resulted in a River Corridor Redevelopment Plan (Plan) which outlines a flood management strategy to minimize future risk and improve the City's relationship to the Cedar River. The City Council formally adopted the Plan in November 2008 with the support of the public. Since then, the Plan has guided ongoing flood recovery initiatives. Other outcomes of Phase I included a community process to prioritize replacement and rehabilitation of flood-damaged City Facilities and a public process to shape the Parks and Recreation Master Plan and to integrate the future 220-acre floodplain greenway into the Parks system.

Phase II of the River Corridor Redevelopment Plan was the Neighborhood Planning Process. This community engagement process involved more than 1,400 citizens, 6,070 hours of planning time, and 8 public meetings. The 5-month planning process included a community kick-off meeting held in January 2009, three interactive workshops, and four area meetings, culminating in the presentation of an Action Plan to the City Council. This collaborative effort resulted in the development of a Framework for Neighborhood Reinvestment in the City's nine flood-affected neighborhoods. In Phase II, the consulting team and 70 trained staff members facilitated the public meetings. The community and the City developed 11 goals for the Neighborhood Planning Process that represent their vision for the future of the neighborhoods. These 11 goals were grouped into six categories to be used to support the community goals throughout the process:

1) Transportation and Connectivity
2) Arts and Culture

3) Business Reinvestment

4) Community Services

5) Neighborhood Reinvestment. In June 2009, an open house was held. Two hundred attendees made 276 comments; in addition, three on-line comments were received. The link to the open house can be found at Neighborhood Planning Process Executive Summary September 2009 http://www.cedar-rapids.org/development/hot_topics_npp.asp.

6) Parks and Recreation. The Parks and Recreation Master Plan (Master Plan) addressed issues such as parks and open space needs for the community; development and recreation uses for the greenway and riverfront; trails and connectivity between parks; and indoor recreation. The City began the process of developing its first Master Plan in 2008 prior to the flooding that occurred in June. In August of 2008, the Neighborhood Planning Process resumed with a post-flood inventory of parks and recreational facilities. The first of three open houses to gather public input on the Master Plan was held in June of 2009.

The goals of the Master Plan include: ensuring a system which the City and its taxpayers can afford; meeting needs to attract and retain residents and the next generation of workers; enhancing the use of the riverfront and attracting residents to the river; ensuing indoor recreational facility needs are met and are affordable for the community; addressing flood damage to the parks and recreational system; providing a community-wide perspective to the parks and recreation system as priorities are set to meet operation funding constraints; and enhancing connectivity of the parks and open space through the trail system.

Future steps in creating a Master Plan include developing options utilizing the feedback gathered at the first open house, hosting the second open house on facility and programming options, and presenting the final Master Plan at the third open house in October of 2009.

The website to the Master Plan is: http://www.corridorrecovery.org/cropenhouse/scribd/default.asp?-objectID=doc_370276828582915&DocID=22786859&docKey=key-1wj4ldaaq2dcbkwfmqr8-&section=Parks&Title=November%20Facilities%20Board.

Throughout these processes, the City worked to engage all residents in an intensive flood recovery planning process immediately following the flood, and all citizens were afforded the opportunity to participate by providing input and feedback at the open house events.

I. Open House - District. The District held an informational open house on April 28, 2009. This meeting was held to explain the Study process and answer questions related to the study initiative.

A. Medium. The public was informed of the open house through several different communication avenues. A printed announcement was mailed to 815 Federal, state, and local governmental agencies, businesses, the media, and the general public inviting them to attend the open house. The announcement was also posted on the City's website. The District's Corporate Communications Office sent a news release to area television and radio stations and newspapers.

Public Meeting Format

- **Location:** Crowne Center Plaza Five Seasons Hotel, Grand Ballroom, 350 1st Ave NE, Cedar Rapids, Iowa
- **Date:** April 28, 2009
- **Time:** 5:00 – 8:00 p.m.
- **Set-up:** Representatives from the District and the City were on hand to provide information and answer questions on a one-to-one basis. Displays provided information on the Study timeline; the study scope; project objectives; the feasibility study planning process; the report review process; Congressional authorization and appropriation process; the City's project goals; and how to be part of the process. Handouts included a comment sheet and a copy of the display boards.

B. Attendance. Staff from the District, the City, Stanley Consultants and Sasaki were present. Approximately 150 members of the public attended. Included were: Senator Rob Hogg, Cedar Rapids; Kirsten Running-Marquardt, representative for Congressman Dave Loebsack; Mary Day, representative for Senator Charles Grassley; Beth Freeman, representative for Senator Tom Harkin; Mayor Kay Halloran, Cedar Rapids. Media representatives present were from KGAN-TV, KCRG-TV, WMT Radio, Iowa Public Radio, Cedar Rapids Gazette, plus one radio station and one newspaper that did not register.

C. Public Comments. Forty-two comment sheets were returned by meeting attendees. The following table is a summary of the responses.

Question	Response	
	Yes	**No**
This meeting provided an opportunity to gain information and a better understanding of the COE feasibility study process.	92%	8%
I understand how public input into the City's redevelopment planning process will contribute to the COE feasibility study.	70%	30%
I understand how the COE flood damage reduction study process differs from the Cedar Rapids river corridor redevelopment plan.	74%	26%
I understand that the focus of the COE feasibility study is flood damage reduction options.	92%	8%
I understand that benefit-to-cost justifications with subsequent Congressional authorization and funding are required in order to proceed to construction of a COE project.	89%	11%

In addition to the responses noted in the table, the following comments were also received:

Please provide any comments or concerns you have regarding this study.

- It's very important to study, model and evaluate many scenarios for mitigation of future flooding. There must be a physical basis for decisions superseding political views. I would hope the hydrology models are checked thoroughly against prior flood knowledge prior to dependence on the process of model usage for each scenario evaluation.

- My concern is quite high in elimination of the restrictive action of current bridges. A suspension bridge construction will hopefully be the only evaluated to provide maximum flow at high flood levels. Many advantages can be found there from.
- We would like a presentation of what the COE has done thus far and the different plans and techniques they are considering using to control future floods.
- This "Open House" style of disseminating information is very inefficient and boring.
- Handout was not informative enough.
- A better timeline with rough months/years and range for each step would be desired.
- What happens after authorization? Steps & time.
- If report is 2011 then at best 1 Oct 2011 for authorization and 1-year design so 2012? What about environmental impact study or historical impact study?
- Failed to give time range of possible project. Is it 3 or 13 years?
- How much is cost to City?
- I feel the City has a plan that needs some "amendments."
- I own 1845 Ellis Blvd NW. In that area there are many homeowners that would like to stay. I also understand the benefit of having levees. There can be a cost benefit. I have submitted a request to introduce a removable flood wall.
- I paid for flood insurance for 30 years now. I've been flooded and collected insurance money and have rebuilt my home. I find out that this insurance money will be deducted from the money I receive for my home if I'm forced into a buyout. This is not in any flood policy I have read.
- Patiently awaiting alternatives and preliminary hydraulic recommendations.
- Pay your flood insurance.
- Contact me regarding any focus groups that could benefit from the input of a flood zone survivor and his company.
- We appreciate the work of the City of Cedar Rapids and the relationship that they have cultivated with the Army Corps.
- Cedar River Downtown District has already begun promoting the formation of temporary to permanent flood protection plans as a key reason to keep business located downtown.
- We look forward to continuing to promote the work of the City and the Corps on behalf of downtown.

- Feel free to over-communicate each step of this process. Downtown businesses and property owners are anxiously awaiting additional information.
- I do not understand how the City of Cedar Rapids and the Corps of Engineers are going to work together and agree on a plan that will be beneficial to all the affected citizens of the flooding.
- I feel the process is business as usual. The process should not take the time it is said to take.
- President Obama said there is too much red tape in government. This proves it.
- There should be better ways to the process to speed it up. Remove some of the overhead and repetitive of what has to be done.
- This plan should be completed sooner. Too many questions were answered with "ifs" – "if a levee is built then this or that may happen." When will we know a levee will be built?
- I would hope that the leveraged working between the Corps of Engineers and the City (Sasaki) will streamline the process.
- Unless another flood has run me out, all I want is for you to leave me a gate to get out when, of if, ever you build the wall.
- We plan on staying at our home so leave us where we are. Our house is not in the 500-year but we are right on the river. We have a FEMA home.
- There are a lot of people that want to build in the construction area and greenway. We feel you are being mitigated into approving yes or no - the City plan. I feel the over six square blocks of houses taken in one area only constitutes plans by the City to impose their will.
- The construction/greenway is a big deterrent to construction presently.
- All the commercial property has been rebuilt along 1st Street NW.
- Continue open and frequent public informational sessions. Suggest coordinating with City to allow opportunity for: 1) COE to present updates on feasibility study; 2) City to provide updates on any mitigation activities in progress that are independent of COE; and 3) public feedback/input.
- Anything that the City and COE can do to encourage and solicit public involvement and input should be considered.
- I would like to see more of a plan. I know it will be a while, but to determine cost-benefit I want to know what is being given up and what it is saving. There are an awful lot of us coming back to the "Blvd."
- I also want to know how insurance benefits will affect our buyout options.

- Please do a cost/benefit study on Ellis Blvd (1700-1900 blocks). If you demolish the houses along the river to save the small houses on the west side of 8th Street, you will be spending more than you are saving.

- I think a better plan would be to turn the levee at Penn Ave. or Q Ave. and run it up to the hill on 9th Street. This would require less levee construction and fewer buyouts because a lot of people on Ellis would like to, or have, rebuilt.

- Originally thought this meeting was going to be about answers but instead learned it was just to inform everyone about how the decision process will occur concerning floodwalls, etc.

- I've been to all neighborhood Crowne Plaza meetings and was disappointed to see on one of the billboards that emphasis is being made on connecting the medical facilities. Every time I sat at one of the tables, the general consensus was brought up time and time again - why concentrate on medical district? Don't see the significance. Is Sasaki pushing this instead of the attending public?

- I think this would have been better presented as a program on Channel 18 or at Crowne Plaza where people explain as they're viewing each point.

- Believe the citizens and opposition to what the City council is up to have been shut out of the process from the beginning. City hall makes a run at our property by Ellis Park every 10 to 15 years, but hasn't had the money or the support; so they're using the flood as an excuse to get federal dollars to take the neighborhoods of working class people for their own recreational desires. It's a pork barrel boondoggle that would be a tremendous waste of taxpayers' money. Nothing could have stopped this flood. The dyke along 1st Street West actually held. I t should be strengthened and raised some. In an emergency, a temporary dyke can be thrown up straight up Penn Ave. Nobody's home needs be taken and it would save a fortune.

- Keep the levee at the Timecheck area on the river. Use 1st Street to widen it and make it taller. Instead of the gate system, use the roadover system like in Guttenberg, Iowa. It has worked well for them. Please do not take out the Timecheck neighborhood.

- Dredge the river. Some areas are only 2 feet deep. How can the water stay in the river?

- Thank you for answering some of my questions. The City of Cedar Rapids is proceeding as if they think a 35' floodwall is a done deal. I live on the west side of the river. A 24-foot river level would not flood my house. I have rebuilt and am hoping to stay put. If houses are protected to 100-year flood level, then flood insurance becomes affordable.

- Had the flood forecast been anywhere near accurate damage would have been a lot less as valuables would have been moved. I lost a 7-day-old new car and all my furniture. Could have all been saved.

- Cedar Rapids had virtually no historic resources studies along the river except downtown. The post flood event resources studies are just now coming to light as required for buyout programs. Thank you for coming. We need to hear the truth about what is going to happen

and in the time frame. I was very concerned about what was true when City council members told us construction zone lines and homes to be bought out were under the direction of COE. Truth is, the City and Sasaki came up with most of this acquisition push. This is not COE keeping people in limbo, it is the City. We were never encouraged to rebuild, only leave and wait for buyout. Thank goodness my family helped me rebuild starting right after the flood- we did not wait. Not encouraging people to rebuild was a disservice to citizens.

- My concern is about another flood. I think the existing flood protection did a very poor job. I would like to see the flood risk management (FRM) project recommended and approved by Congress to help us start construction on levees and floodwalls, early as spring of 2012.

- A City where I grew up built their levees and flood. Thanks to Army Corps of Engineers for helping Dubuque. For Cedar Rapids, they will do a wonderful job.

- Thanks for holding the open house and giving us the opportunity to meet with you and discuss our particular desires concerning the feasibility study. We are fully supportive of what you are proposing for Cedar River flood risk management. As a resident of Sun Valley neighborhood, am hoping you would also be looking at Indian Creek watershed. In 2002 Indian Creek overtopped the Cottage Grove Bridge and severely impacted 30 to 40 homes with a damage estimate of $2 M. Nothing substantive has been done since then to remedy the Indian Creek flood threat. There has been continued development in the watershed area, including construction on the floodplain. We were evacuated during the June 2008 floods, but this time flood waters only reached our sidewalks and a few basements. Your representatives indicated a separate Indian Creek proposal is being evaluated.

D. Study Team Feedback. The Study Team members also recorded the issues and concerns expressed by members of the public. This feedback is summarized as follows:

E. Areas of Concern and Comments

Real Estate Issues

- Buyouts might be based on tax valuation rather than appraised values.
- Uncertainty about which action to take: repair or buyout.
- Buyout conditions (process/legalities/)
- Residents concerned about making a decision (regarding property) prior to COE determining if a Federal project is justified.
- Why is right-of-entry needed? Don't want to provide one as my wife works nights.
  Study Team Response: The District can work around your schedule (for entering your property.)
- Impacts of City's "construction zone" on homes and businesses in that area.
- How were yellow and green areas on map chosen, and what do they represent?

- Residential property values (assessed values; pre-flood condition; current condition value).
- Relocation benefits (FEMA vs. HUD vs. State vs. Corps).
- Difference between potential COE right-of-way and acquisition vs. City relocation and development in yellow zone.
- Compensation for buyout of homes; what different agencies have to offer.
- Corps participation in moratorium - not to rebuild in yellow area was City's decision.
- Insurance issues.
- Concerns that buyouts would be based on assessed tax valuation rather than appraised values.
- Can Corps buyout my house and force me to move?

Study Issues

- It is important that study proceed quickly.
- Why do you need soil exploration on my property?
  Study Team Response: to determine the structural capability of the soil
- More green space (i.e., buy more property to use as floodway).
- Project timeline-when feasibility study would be completed and if a COE project could be predicted.
- What elements comprise construction cost and how are benefits derived (real estate values vs. flood protection benefits).
- Levee concerns (location; how big; level of protection provided).
- Concerns about greenway space not going to be enough to let the "river breath."
- Why does it take so long for the study? We need answers now.
- Corps needs to hear the citizens' concerns not just the City's plan.

Hydrology Issues

- Dredge river channel and provide green space and parks for recreation along riverbanks.
- Dredging the bottom of the river would go a long way to reduce flood stages.
- Improper operation of the 5-in-1 dam contributed to the flood heights.
- Impacts on upstream and downstream river stages caused by any floodwall/levee construction through Cedar Rapids.
- Need to study control measures upstream of Cedar Rapids.

- Raise bridges to provide for more flow downstream; this could also maintain access to Mays Island.
- Edgewood Bridge constricts flow; under current flows there is a 2-foot change in elevation between the upstream and downstream water surfaces.
- Study will not adequately consider alternatives to retain floodwaters upstream of Cedar Rapids on agricultural land.
- Build retention ponds in the watershed as a solution to flooding.
- Study may not adequately consider alternatives upstream of Cedar Rapids on agricultural lands. Use small Minute-men reservoirs?
- Corps should consider dredging options.

Ellis Blvd (above existing Time Check levee tie-off)

- Regarding yellow "Construction Zone" as termed by the City: confusion on whether to rebuild or not rebuild; understand that flood protection system (if built) would not fill up the entire yellow zone; aware of the timeframe required for USACE to determine if a project is justified
- Perception City is using flood to clear out "undesirable" areas to allow new development.
- Concern CDBG funds being directed to buyouts instead of repairs for damaged structures.
- Too much green space; homeowners oppose selling homes for the creation of wide open green space.
- Will houses be allowed to stay on wet side of levee?
  Study Team Response: not a USACE decision-we would be critical of any utility penetrations of a Federal system.)

Other Issues

- What is status of Indian Creek study?
  Study Team Response: The Scope of Work is being revised and should be delivered to City about mid-May.
- Czech Museum
- Difference between PL 91-646, Stafford Act and other programs.

II. Newsletter. A newsletter was sent out to 815 to Federal, state, and local governmental agencies, businesses, media, and the general public in October 2009. The newsletter contained project status and what was going on in the Cedar Rapids area.

III. Website. A website (http://www.mvr.usace.army.mil/PublicAffairsOffice/CedarRapids-CedarRapids.htm) was established as the projects primary website. The purpose of this site was to deliver information to the public that was made available at meetings and for distribution of information as part of the NEPA process

IV. Archeologist and Consulting Parties Meeting. The District hosted a meeting and field trip for the interested and consulting parties for the Cedar Rapids project. Seventy-one individuals were invited to attend with 23 attending. The meeting was held at the Crowne Plaza Five Seasons Hotel in Cedar Rapids, Iowa, on October 28, 2009. The meeting began with a PowerPoint presentation on the background of Cedar Rapids followed by discussion of the alignments and then the cultural resources status. A bus tour of Czech Village and the east side flood protection management measures and borrow areas were conducted in the afternoon.

V. District's Informational Meeting. On June 23, 2010, the District hosted an informational meeting along with the City. This meeting explained the District's Recommended Plan for flood risk management in Cedar Rapids.

A. Medium. The public was informed of the informational meeting through several different communication avenues. A printed announcement was mailed to 815 Federal, state, and local governmental agencies, businesses, media, and the general public inviting them to attend the open house. The announcement was also posted on the City's website and the City released a news release. The District's Corporate Communications Office sent a news release to area television and radio stations and newspapers.

Informational Meeting

- **Location:** Crowne Center Plaza Five Seasons Hotel, Grand Ballroom, 350 1st Ave NE, Cedar Rapids, Iowa
- **Date:** June 23, 2010
- **Time:** 11:00 AM-1:00 PM with a presentation at 11:30 AM and 4:00 PM – 7:00 PM with a presentation at 4:30 PM
- **Set-up:** District Program Manager gave a presentation highlighting the Corps' planning process, the alternatives evaluated, and the screening process used to arrive at the Recommended Plan. An open house followed where the attendees were given the opportunity to look at display boards showing the information provided in the presentation. The City also had display boards positioned around the room explaining the City's preferred flood management strategy, as described in the River Corridor Redevelopment Plan that was adopted by the City Council in November 2008. City and Corps staff was available to talk on a one-on-one basis to attendees and to answer any questions or concerns.

B. Attendance. Staff from the District and the City were in attendance. Approximately 200 members of the public attended the sessions. Included were Senator Rob Hogg, Cedar Rapids; Mary Day, representative for Senator Charles Grassley; Dan Smith, representative for Senator Harkin; Mayor Ron Corbett, Cedar Rapids. Media representatives present were KGAN-TV, Iowa Public Radio, and Cedar Rapids Gazette.

C. Public Comments. Comments provided by meeting attendees are summarized by main issue category:

Recommended Plan Issues

- Concern that the Recommended Plan protects only the east side of the river
- Concern for what will happen to residents and businesses on the west side of the river
- Agree that the Recommended Plan is the best cost-effective strategy
- Concern about closure of roads during flooding with removable floodwalls
- Concern about the risk associated with only protecting one side of the river

Study-Related Issues

- Need a more comprehensive set of solutions, not just floodwalls and levees
- Damages cannot be measured in monetary costs alone
- Prefer FRM strategy that includes and preserves existing neighborhoods

Other Issues

- Better watershed management along with floodwalls and levee system are essential to prevent future flooding
- Consider green infrastructure within the watershed and cooperative approaches to manage water runoff in the watershed

VI. District's Final Public Meeting. The District hosted a public meeting on September 21, 2010. This meeting explained the District's Recommended Plan.

A. Medium. The public was informed of the informational meeting through several different communication avenues. A printed announcement was mailed to 815 Federal, State, and local governmental agencies, businesses, media, and the general public inviting them to attend the open house. The announcement was also posted on the City's website and the City released a news release. The District's Corporate Communications Office sent a news release to area television and radio stations and newspapers.

Information Meeting Format

- Location – Crowne Center Plaza Five Seasons Hotel, Grand Ballroom, 350 1st Ave NE, Cedar Rapids, Iowa
- Date –September 21, 2010
- Time – 6:00 PM – 8:00 PM with a presentation beginning at 6:30 PM
- Set-up – Col McGinley gave a presentation highlighting the District's Recommended Plan. An open house followed where the attendees were given the opportunity to look at display boards showing the information provided in the presentation. The City also had display boards positioned around the room explaining the City's preferred FRM strategy, as described in the River Corridor Redevelopment Plan that was adopted by the City

Council in November 2008. City and Corps staff was available to talk on a one-on-one basis to attendees and to answer any questions or concerns.

B. Attendance. Staff from the District and the City were in attendance. Approximately 138 members of the public attended the sessions. Included were Mary Day, representative for Senator Charles Grassley; Mayor Ron Corbett, Cedar Rapids. Media representatives present were KCRG-TV, Neighborhood Network News, and Cedar Rapids Gazette.

C. Public Comments. Written comments received during the 30-day public review period, including the public meeting for the draft report, are summarized by main issue category.

Recommended Plan Issues

- Lack of citizen support for a plan that only protects the east side of the river in Cedar Rapids.
- Impacts of an east-side only plan on west side residents, particularly the low-income, minority, and elderly populations, are felt to be inequitable and unjust.
- Concern about the economic impacts of an east-side only plan on business viability and future growth potential.
- An east-side only plan should also consider the human factors involved.
- Given a chance, this plan will reduce flooding in the future.

Engineering Issues

- Desire to raise and reinforce existing west side berm.
- What will be done to ensure Cedar Rapid levee will not fail?
- Need more access through the flood walls to enjoy river when flooding is not a problem.
- Concerns with pumping capacity/pump size.
- Realignment of Cedar River Recreational Trail should provide a safer route, access to downtown areas.

Hydrology Issues

- An east-side levee will increase water levels on west side and heighten probability for additional flooding.
- Amount of change in 100-yr and 500-yr floodplains, on both sides of river, resulting from a levee/floodwall protecting east side only.
- Concerns about probabilities of the proposed levee/floodwall being overtopped.

Economic Issues

- The cost-benefit analysis fails to put value on people and disruption to neighborhoods.
- The cost-benefit analysis should include properties rebuilt after the flood.

- The cost-benefit analysis favors business and industry, but not homes and small neighborhood businesses.

Study-related Issues

- Consider measures to retain water using green infrastructure.
- Citizens desire a plan to protect both sides of the river.

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

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LINN COUNTY BOARD OF SUPERVISORS
195 BRAYBROOK SE
CEDAR RAPIDS IA 52403

RODD BAXTER
LINN COUNTY
930 1ST ST
CEDAR RAPIDS IA 52402

LINN CO ENGINEER STEVE GANNON
COUNTY ENGINEER
LINN COUNTY
1390 ELMHURST DR NE
CEDAR RAPIDS IA 52402

DENNIS GOEMAAT
DEPUTY DIR
LINN CO CONSERVATION
930 1ST ST SW
CEDAR RAPIDS IA 52404-2161

JAMES HOUSER
SUPERVISOR
LINN COUNTY COURTHOUSE
LINN COUNTY BOARD OF SUPERVISORS
930 1ST ST SW
CEDAR RAPIDS IA 52404

ADAM LINDENLAUB
COMMUNITY DEVELOP
CITY OF CEDAR RAPIDS
3851 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

CEDAR RAPIDS AREA CHAMBER OF COMMERCE
424 1ST AVE SE
CEDAR RAPIDS IA 52402

CEDAR RAPIDS AREA CONVENTION AND VISITORS BUREAU
119 1ST AVE SE
CEDAR RAPIDS IA 52402

CITY CLERK
CITY OF CEDAR RAPIDS
AEGON BLDG 3851 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

ECONOMIC DEVELOPMENT DIVISON
PRIORITY ONE - CEDAR RAPIDS AREA CHAMBER OF COMMERCE
424 1ST AVE NE
CEDAR RAPIDS IA 52041

HONORABLE RON CORBETT
MAYOR
CITY OF CEDAR RAPIDS
3851 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

SANDI FOWLER
CITY MANAGER
CITY OF CEDAR RAPIDS
3851 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

DANIEL GIBBINS
PARKS SUPERINTENDENT
CITY PARKS & RECREATION DEPT
CITY OF CEDAR RAPIDS
3601 42ND ST NE
CEDAR RAPIDS IA 52404

KRIS GULIC
CITY COUNCIL DIST 1
CITY OF CEDAR RAPIDS
2103 LINMAR DR NE
CEDAR RAPIDS IA 52402

DON KARR
COUNCIL MEMBER AT LARGE
CITY OF CEDAR RAPIDS
1627 HARMER DR NW
CEDAR RAPIDS IA 52405

STEPHEN KRUG ASLA
LANDSCAPE ARCHITECT
CEDAR RAPIDS PARK & RECREATION DEPARTMENT
3601 42ND ST NE
CEDAR RAPIDS IA 52402

RICHARD LUTHER
CULTURAL AND HISTORICAL
CITY OF CEDAR RAPIDS
3851 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

DEANNA PEDERSEN
CEDAR RAPIDS MUSEUM OF ART
410 3RD AVE SE
CEDAR RAPIDS IA 52401-1606

TOM PODZIMEK
COUNCIL MEMBER AT LARGE
CITY OF CEDAR RAPIDS
1044 MAPLEWOOD DR NEW
CEDAR RAPIDS IA 52402

SANDY PUMPHREY
CIVIL ENGINEER
PUBLIC WORKS
CITY OF CEDAR RAPIDS
3851 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

RITA RASMUSSEN
REAL ESTATE
CITY OF RAPIDS CITY
1201 6TH ST SW
CEDAR RAPIDS IA 52404

PAT SHEY
CITY COUNCIL DIST 3
CITY OF CEDAR RAPIDS
501 KNOLLWOOD DR SE
CEDAR RAPIDS IA 52403

JUSTIN SHIELDS
CITY COUNCIL DIST 4
CITY OF CEDAR RAPIDS
3201 PEBBLE DRIVE SW
CEDAR RAPIDS IA 52404

JULIE SINA
DIRECTOR
PARKS & REC
CITY OF CEDAR RAPIDS
3601 42ND ST NE
CEDAR RAPIDS IA 52402

DAVID SMITH
PARKS & RECREATION
CITY OF CEDAR RAPIDS
3601 42ND ST NE
CEDAR RAPIDS IA 52402

DAN SWARTZENDRUBER
PLANNING & ZONING MGR
LINN COUNTY
930 1ST ST SW
CEDAR RAPIDS IA 52404-2161

CHUCK SWORE
COUNCIL MEMBER AT LARGE
CITY OF CEDAR RAPIDS
2609 IRIS AVE NW
CEDAR RAPIDS IA 52405

MONICA VERNON
CITY COUNCIL DIST 2
CITY OF CEDAR RAPIDS
326 23RD ST DR SE
CEDAR RAPIDS IA 52402

PEGGY WHITWORTH
PRESIDENT
BOYLE WHITWORTH & ASSOCIATES
2402 D AVE NE
CEDAR RAPIDS IA 52402

CHUCK WIENEKE
CITY COUNCIL DIST 4
CITY OF CEDAR RAPIDS
2191 WES CT NW
CEDAR RAPIDS IA 52405

VERNON ZAKOSTELECKY
LAND DEVE COORD
CITY OF CEDAR RAPIDS
6301 BERRY RD SE
CEDAR RAPIDS IA 52403

TODD TAYLOR
IA STATE REPRESENTATIVE DIST 34
IA HOUSE OF REPRESENTATIVE
1416 A AVE NW
CEDAR RPAIDS IA 52405-4834

JIM KILL
Stanley Consultants, Inc.
225 Iowa Ave.
Muscatine IA

MINDER GENE E REV TRUST, MINDER GENE
140 35TH ST DR SE APT 2
CEDAR RAPIDS IA 52403-1356

A-1 RENTAL WEST
731 1ST ST SW
CEDAR RAPIDS IA 52402

ADFINITY MARKETING GROUP
800 1ST AVE NE
CEDAR RAPIDS IA 52402

AMENT INC
625 32ND AVE SW
CEDAR RAPIDS IA 52402

ANH'S TAILOR SHOP
626 1ST AVE
CEDAR RAPIDS IA 52402

ARNOLD OLSON ASSOC
3840 BEVER AVE SE
CEDAR RAPIDS IA 52402

B A LAND COMPANY LLC
PO BOX 5075
CEDAR RAPIDS IA 52406

BANK OF AMERICA
475 CROSS POINT PKWY PO BOX 9000
GETZVILLE NY 14058

BENDA FINANCIAL DESIGNS
222 3RD AVE SE STE 105
CEDAR RAPIDS IA 52402

BENEFIT SOLUTIONS INC
425 2ND ST SE STE 1150
CEDAR RAPIDS IA 52402

BEST WESTERN COOPER'S MILL HOTEL & RESTAURANT
100 F AVE NW
CEDAR RAPIDS IA 52402

BEST WESTERN LONGBRANCH
90 TWIXT TOWN RD NE
CEDAR RAPIDS IA 52402

BILLS BROTHERS
303 8TH AVE SE
CEDAR RAPIDS IA 52402

BREMS JAMES ACCOUNTING
111 1ST AVE SE
CEDAR RAPIDS IA 52402

BROWN & STUEFEN LCC
211 3RD AVE SW
CEDAR RAPIDS IA 52402

C & NW TRANS CO
1700 FRANAN ST 10TH FLR
OMAHA NE 68102

CDR ENTERPRISES LLC
PO BOX 19102
CEDAR RAPIDS IA 52404

CEDAR RAPIDS ASSOCIATION OF REALTORS
1860 1ST AVE NE
CEDAR RAPIDS IA 52402

CEDAR RAPIDS BANK AND TRUST
500 1ST AVE NE STE 100
CEDAR RAPIDS IA 52402

CEDAR RAPIDS FREEDOM FESTIVAL
226 2ND ST SE
CEDAR RAPIDS IA 52402

CEDAR RAPIDS KERNELS
950 ROCKFORD RD SW
CEDAR RAPIDS IA 52402

CEDAR RAPIDS PIANO LOUNGE
208 2ND AVE SE
CEDAR RAPIDS IA 52402

CEDAR RAPIDS/LINN COUNTY SOLID
1201 6TH ST SW
CEDAR RAPIDS IA 52404-5835

COFFEE EMPORIUM AND CAFÉ
220 3RD AVE SE
CEDAR RAPIDS IA 52402

COLLINS COMMUNITY CREDIT UNION
1755 1ST AVE SE
CEDAR RAPIDS IA 52402

COLLISON-GOOD, WILLIAMS & DUNNIGAN
101 2ND ST SE STE 700
CEDAR RAPIDS IA 52402

D & J SCHOETTMER TRUST
302 W HILTON
MARENGO IA 52301

D P PROPERTIES LLC
507 CIRCLEVIEW DR
ATKINS IA 52206-6261

D.A. BUNCH COMPANY
4003 J ST SW STE 4
CEDAR RAPIDS IA 52404

DAKOTA RED CORPORATION
650 12TH AVE SW
CEDAR RAPIDS IA 52402

DIVERSITY FOCUS
222 2ND ST SE
CEDAR RAPIDS IA 52401

RUNDLE JOHN & SHELLEY SALES
DP PROPERTIES LLC
926 G AVE NW
CEDAR RAPIDS IA 52405-2621

EASTERN IOWA AIRPORT
2515 ARTHUR COLLINS PARKWAY SW
CEDAR RAPIDS IA 52402

EASTON ENTERPRISES
500 TOWER TERRACE RD STE 200
CEDAR RAPIDS IA 52402

ELKS LODGE
801 33RD AVE SW
CEDAR RAPIDS IA 52402

F & F INVESTMENET CORP
1400 2ND AVE SE STE 101
CEDAR RAPIDS IA 52403

FAT TIRE LLC
3500 F AVE NW STE 1
CEDAR RAPIDS IA 52405

STONE RIDGE INVESTMENTS LLLP
FEDERAL FAMILY CREDIT UNION
219 COBBLE STONE DR NW
CEDAR RAPIDS IA 52405

FUTIO LLC
1953 GRANDEE AVE SE
CEDAR RAPIDS IA 52403

GRINGO'S
207 1ST AVE SE
CEDAR RAPIDS IA 52402

GURANTY BANK & TRUST CO
302 3RD AVE SE
CEDAR RAPIDS IA 52402

HALL BICYCLE CO
419 2ND AVE SE
CEDAR RAPIDS IA 52402

HEITAGE ASSOCIATES CORPORATION
313 3RD AVE SE
CEDAR RAPIDS IA 52402

HILLS BANK AND TRUST CO
3610 WILLIAMS BLVD SW
CEDAR RAPIDS IA 52402

HOME APPLIANCE
706 2ND AVE SE
CEDAR RAPIDS IA 52402

HORIZONS
819 5TH ST SE
CEDAR RAPIDS IA 52402

HUBBARD INDUSTRIAL PARK LC
PO BOX 9376
CEDAR RAPIDS IA 52409

ILTEN VENTURES
106 2ND AVE SW
CEDAR RAPIDS IA 52404

IMON COMMUNICATIONS
625 1ST SE
CEDAR RAPIDS IA 52402

INFORMATICS INC
118 2ND ST SE STE 200
CEDAR RAPIDS IA 52402

ING FINANCIAL PARTNERS
123 3RD ST NE
CEDAR RAPIDS IA 52402

IOWA COMMUNITY CREDIT UNION
501 4TH AVE SE
CEDAR RAPIDS IA 52402

IOWA CULTURAL CORRIDOR ALLIANCE
SPORTWEAR
2121 ARTHUR COLLINS PARKWAY SW
CEDAR RAPIDS IA 52402

IOWA SCREENPRINT CO/BIMM RIDDER

817 2ND AVE SE
CEDAR RAPIDS IA 52403-2401

JACKSON & JACKSON PLC
222 3RD AVE SE STE 250
CEDAR RAPIDS IA 52402

JAMES T BREMS
PO BOX 1386
CEDAR RAPIDS IA 52402

JAR PROPERTIES & INVESTMENTS LLC
PO BOX 569
MARION IA 52302

JONES PARKING COMPANY INC
116 2ND ST NE
CEDAR RAPIDS IA 52402

JULIA-N-LE CHEF
PO BOX 2045
CEDAR RAPIDS IA 52406-2045

JUNIOR ACHIEVEMENT OF EASTERN IOWA INC
315 3RD AVE SE STE 209
CEDAR RAPIDS IA 52401-1506

KLINGER PAINT CO
333 5TH AVE SE
CEDAR RAPIDS IA 52402

LANGHAM KEN R REVOC TRUST
3646 RICHMOND RD NE
CEDAR RAPIDS IA 52402

LINDEMAN LAW
3500 F AVE NW STE 1
CEDAR RAPIDS IA 52405-1980

LINN STAR TRANSFER INC
9440 WRIGHT BROS CT SW
CEDAR RAPIDS IA 52404

LOCAL P-3 RETIREES INC
116 14TH AVE SE
CEDAR RAPIDS IA 52401

MACHO & ASSOCIATES INC
4640 BLARNEY DR
CEDAR RAPIDS IA 52411

MANAGEMENT RECRUITERS CEDAR RAPIDS
305 2ND ST SE STE 300
CEDAR RAPIDS IA 52402

MDG HOLDINGS LLC
110 3RD AVE SW
CEDAR RAPIDS IA 52401

MODERN GALLERY & FRAMING
701 3RD AVE SE
CEDAR RAPIDS IA 52402

MR BUBBLES INC
PO BOX 2607
CEDAR RAPIDS IA 52406

NAPA AUTO PARTS
410 1ST AVE NW
CEDAR RAPIDS IA 52402

NAZETTE MERNER LLP
100 1ST ST SW #100
CEDAR RAPIDS IA 52402

NORDSTROM OIL COMPANY
1400 6TH ST SW
CEDAR RAPIDS IA 52402

OPN ARCHITECTS
200 5TH AVE SE
CEDAR RAPIDS IA 52402

PAULSON ELECTRIC COMPANY
PO BOX 1170
CEDAR RAPIDS IA 52406-1170

PFEILER DONALD H ET AL
750 STAUF CT NE
CEDAR RAPIDS IA 42403

PHILIPP TRUCKING INC
2555 OLD RIVER RD SW PO BOX 2454
CEDAR RAPIDS IA 52404

PICKENS, BARNES & ABERNATHY
PO BOX 74170 101 2ND ST SE
CEDAR RAPIDS IA 52402

PIERSONS INC
1800 ELLIS BLVD NW
CEDAR RAPIDS IA 52401

PRINCIPAL FINANCIAL
711 HIGH ST
DES MOINES IA 50309

PROFESSIONAL MUFFLER
624 3RD ST SE
CEDAR RAPIDS IA 52401

RHODES & ASSOCIATES LLC
3403 12TH AVE SW
CEDAR RAPIDS IA 52404

RICCOLO & SEMELROTH PC
425 2ND ST SE STE 1140
CEDAR RAPIDS IA 52401

ROBERT W BAIRD & CO INC
200 5TH AVE SE STE 102
CEDAR RAPIDS IA 52401-1856

RYAN COMPANIES US INC
625 1ST ST SE STE 460
CEDAR RAPIDS IA 52402

SALVATION ARMY
1000 C AVE NW
CEDAR RAPIDS IA 52405

SAXTON INC DESIGN GROUP PC
600 3RD ST SE STUDIO 300
CEDAR RAPIDS IA 52402

SCHEDLRUP, BLADES, SCHROCK SAND ARANZA

225 2ND ST SE
CEDAR RAPIDS IA 52402

SCOTT E OLSON & DOUGLAS D LAIRD
1540 W MAIN ST
ROBINS IA 52328

SMULEKOFF'S
PO BOX 74090
CEDAR RAPIDS IA 52402

SOUND CONCEPTS
1001 3RD AVE SW
CEDAR RAPIDS IA 52402

SOUVENIR INC NORWOOD PROMOTIONS INC
10 WEST MARKET ST
INDIANAPOLIS IN 46204

ST LUKE'S HEALTH CARE FOUNDATION
1026 A AVE NE
CEDAR RAPIDS IA 52402-5036

ST LUKES HOSPITALS AND CLINICS
1026 A AVE NE
CEDAR RAPIDS IA 52402

ST MARTIN LAND COMPANY
115 3RD ST SE STE 500
CEDAR RAPIDS IA 52402

STONEFIELD INVESTMENT ADVISORY
425 2ND ST SE STE 610
CEDAR RAPIDS IA 52402

STRATEGIC FINANCIAL SOLUTIONS LCC
200 2ND AVE SE
CEDAR RAPIDS IA 52402

STRATOSFOUR
230 2ND ST SE STE 400
CEDAR RAPIDS IA 52402

THE HALL-PERRINE FOUNDATION
115 3RD ST SE STE 803
CEDAR RAPIDS IA 52402

THEATRE CEDAR RAPIDS
102 3RD ST SE
CEDAR RAPIDS IA 52401

TU-ANH THI NGO/ANH'S TAILOR SHOP
626 1ST AVE NW
CEDAR RAPIDS IA 52402

UNITED FIRE GROUP
116 2ND AVE SE
CEDAR RAPIDS IA 52402

UNITED WAY OF EAST CENTRAL IOWA
1030 5TH AVE SE #100
CEDAR RAPIDS IA 52402

US BANK
222 2ND AVE SE
CEDAR RAPIDS IA 52402

US CELLULAR CENTER
370 1ST AVENUE
CEDAR RAPIDS IA 52401

VOLUME
329 2ND AVE SE
CEDAR RAPIDS IA 52402

WATER TOWER PLACE
FAMILES
900 2ND ST SE
CEDAR RAPIDS IA 52401

WAYPOINT SRVCS FOR WOMEN CHILDREN &

318 5TH ST SE
CEDAR RAPIDS IA 52402

WELLS FARGO BANK
150 1ST AVE NE STE 100
CEDAR RAPIDS IA 52401-1110

GODWIN RONALD J TRUST
WEST-END ACQUISITION CO
925 2ND ST SE
CEDAR RAPIDS IA 52401

WITWER CENTER OFFICE
AREA
605 2ND AVE SE
CEDAR RAPIDS IA 52401

YMCA OF THE CEDAR RAPIDS METROPOLITAN

207 7TH AVE SE
CEDAR RAPIDS IA 52402

YOU WIN LLC
2326 BLAKE BLVD SE
CEDAR RAPIDS IA 52403

NICOLAS ABOU-ASSALY
ATTORNEY
115 3RD ST SE STE 1200
CEDAR RAPIDS IA 52403

COURTNEY BALL
EXEC DIR
MATTHEW 25 MINISTRY HUB
1236 8TH ST NW
CEDAR RAPIDS IA 52405

WILLIAM J & THERESA L BARNES JR
2936 SOUTHLAND ST SW
CEDAR RAPIDS IA 52404

CURIS BARTON
637 22ND AVE SW
CEDAR RAPIDS IA 52404

BOB BEMBENEK
BOB BEMBENECK INVESTMENTS LC
4089 21ST AVE SW
CEDAR RAPIDS IA 52404

JOHN BENDER
PRES
AMENT INC
625 32ND AVE SW
CEDAR RAPIDS IA 52404

DR DAVID BENN
BEAR CREEK ARCHAEOLOGY INC
PO BOX 347
CRESCO IA 52136

BILL BOGERT
PRES
ANDERSON-BOGERT ENGINEERS
4001 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402

GIB & MARY BOXA
HEARTHSTONE HOMES
607 HILLVIEW DR
FAIRFAX IA 52228

JAMES H BRIGHT
BRIGHT'S PROPERTY MANAGEMENT LLC
171 1/2 JACQLYN DR NW
CEDAR RAPIDS IA 52405

PAUL BRUNDELL
PRES
ALLAN DEVELOPMENT COMPANY
350 MILLER RD #2
HIWATHA IA 52233

LISA BURCH
CIVIL ENGINEER
AMENT
5825 DRY CREEK LN NE
CEDAR RAPIDS IA 52402

MICHAEL BUTTERFIELD
HDR INC
1860 BOYSON ROAD
HIAWATHA IA 52233

PAT CARGIN
CEDAR RAPIDS PRESERVATION COM
2325 MEADOWBROOK DR SE
CEDAR RAPIDS IA 52403-4221

BARB CONNELLY
CONNELLY INVESTMENTS
785 ELBOW CREEK RD
MT VERNON IA 52314

CAMILLA DEIBER
ARCHITECTURAL HISTORIAN
THE LOUIS BERGER GROUP
950 50TH ST
MARION IA 52302

KELLY EDMONDS
COR
PBS
US GENERAL SERVICES ADMIN
C/O JACOBS PO BOX 2455
CEDAR RAPIDS IA 52406

MARVIN FADLEY
BETTER BUILT INVESTMENT PROPERTIES LLC
PO BOX 196
CEDAR RAPIDS IA 52351

P FILLERMORE
CANINE CORNER AND CATS TOO
1201 8TH ST NW
CEDAR RAPIDS IA 52405-2509

LEO FOLEY
VEENSTRA & KIMM INC
1530 46TH AVE STE 28
MOLINE IL 61265

ANDRE GALLET
PRINCIPAL
TERRACON CONSULTANTS
2640 12TH ST SW
CEDAR RAPIDS IA 52404-3440

CLAY GISH
SHIVE-HATTERY
312 2ND ST STE 500
CEDAR RAPIDS IA 52402

RON GODWIN
US BANK
2222 1ST AVE NE #807
CEDAR RAPIDS IA 52402

MARY GOOD
MGRHAB LLC
1512 BERRYS RUN
MARION IA 52351

KRIS GULICK
CPA, P.L.C.
222 3RD AVE SE STE 299
CEDAR RAPIDS IA 52402

MARVIN H
HALL AND HALL ENGINEERS
1850 BOYSON RD
HIAWATHA IA 62233-2316

KEVIN HEINBUCH
BERRY INVESTMENTS INC
PO BOX 10073
CEDAR RAPIDS IA 52410

JOHN HELBLING
PRES
JK HELBLING CONSTRUCT
721 BEAVER RIDGE CT SE
CEDEAR RAPIDS IA 52403-2087

JASON HELLENDRUNG
PRINCIPAL/PM
SASAKI & ASSOCIATE
64 PLEASANT ST
WATERTOWN MA 02472

DAVE HOGAN
CARPENTERS LOCAL #308
UNITED BROTHERHOOD OF CARPENTERS & JOINERS OF AMERICA
1637 27TH ST NW
CEDAR RAPIDS IA 52405

MARVIN HOUG
HALL & HALL ENGINEERS INC
1860 BOYSEN RD
HIAWATHA IA 52233

TIM KRIZ
DIR
IMON COMMUNICATIONS LLC
625 1ST ST SE STE 520
CEDAR RAPIDS IA 52401-2004

GREG KUNKEL
CEDAR RAPIDS TRANSMISSIONS INC
426 8TH AVE SE
CEDAR RAPIDS IA 52403

KEITH LONG
ONE WORLD INVESTMENT GROUP LLC
100 ATWOOD DR SW
CEDAR RAPIDS IA 52404

MARK LONG
PRESIDENT
WELLS FARGO BANK
150 1ST AVE NE STE 100
CEDAR RAPIDS IA 52401-1110

JOANN MCNIEL
TREES FOREVER
770 7TH AVE STE B
MARION IA 52302-5773

HEINZ MUNZ
PRESIDENT
EKO FLOOD SYSTEM
PO BOX 7475
JACKSON WY 83002

ERV MUSSMAN
SHIVE-HATTERY INC
201 3RD AVE SE STE 500
CEDAR RAPIDS IA 52401

RICHARD NEY
DIRECTOR
SEBESTA BLOMBERG & ASSOC INC
305 2ND ST SE
CEDAR RAPIDS IA 52401

KEVIN PLATE
CRAAR
1860 1ST AVE NE
STE 100
CEDAR RAPIDS IA 52402

TERRY POE BUSCHKAMP
URBAN NEIGHBORHOOD DISTRICT
NEW BOHEMIA MAIN STREET 329 10TH AVE SE

CEDAR RAPIDS IA 52401

TOM & KATHY POTTS
PRES
BUILDERS ASSOC
POTTS ENGINEERING & CONSULTING
1118 1ST ST SW
CEDAR RAPIDS IA 52404

DREW RETZ
GREATER CEDAR RAPIDS AREA HOME

350 MILLER ROAD STE 1
HIAWATHA IA 52233-2364

GREG REXWINKLE
SWISS VALLEY FARMS CO
3076 HWY 28
HOPKINTON IA 52237-7693

CHARLE ROHDE
PRES
KINGS MATERIAL INC
355 50TH AVE DR SW
CEDAR RAPIDS IA 52402

PATRICK SAUTER
MANAGER
KINGS MATERIAL
650 17TH AVE SW
CEDAR RAPIDS IA 52403

JEFF SCHERRMAN
PRES
ACME GRAPHICS
201 3RD AVE SW
CEDAR RAPIDS IA 52404-5716

PACE STACEY
SHUTTLEWORTH & INGERSOLL PLC
115 3RD ST SE STE 500 PO BOX 2107
CEDAR RAPIDS IA 52406

DAVID STANLEY
PRESIDENT
BEAR CREEK ARCHEOLOGY INC
PO BOX 347
CRESCO IA 52136

JOE THOMPSON
ARCHEOLOGIST
BEAR CREEK ARCHEOLOGY INC
PO BOX 347
CRESCO IA 52136

ARBUTUS D WALTON
BRIGHT'S PROPERTY MANAGEMENT LLC
1421 1ST ST SW
CEDAR RAPIDS IA 52404-2905

TIM WEITZEL
HISTORIC PRESERVATION SPECIALIST
COMMUNITY DEVELOPMENT DIV IA
IA DEPT OF ECONOMIC DEVELOPMENT
PO BOX 686
IOWA CITY IA 52244-0686

TIM WILES
BRAUN
5915 4TH ST SW
CEDAR RAPIDS IA 52405

MICHAEL HELMS
SENIOR PROJECT MANAGER
STANLEY CONSULTSNTS INC
225 IOWA AVE
MUSCATINE IA 52761

JAMES KILL PE
VICE PRESIDENT
STANLEY CONSULTANTS INC
225 IOWA AVE
MUSCATINE IA 52761

MICHAEL MCKENNA
VICE PRESIDENT
STANLEY CONSULTANTS INC
225 IOWA AVE
MUSCATINE IA 52761

MARK WERNER PE
CIVIL ENGINEER
STANLEY CONSULTANTS INC
225 IOWA AVE
MUSCATINE IA 52761 20

ALLIANT ENERGY
200 1ST ST SE
CEDAR RAPIDS IA 52406

IOWA RENEWABLE ENERGY ASSOC
PO BOX 3405
IOWA CITY IA 52244-3405

LEE HANSON
DIRECTOR - CACP
ALLIANT TOWER
PO BOX 351
CEDAR RAPIDS IA 52406-0351

DAN BIECHLER
DIRECTOR
LINN COUNTY CONSERVATION BOARD
1890 COUNTY HOME RD
MARION IA 52302-9753

CHARLES ALDRICH
WINNEBAGO TRIBE OF NEBRASKA
PO BOX 687
WINNEBAGO NE 68071

TWEN BARTON
CHARIMAN
SAC & FOX NATION OF MISSOURI
305 N MAIN ST
RESERVE KS 66434

FRANCIS BERNEY
YANKTON SIOUX TRIBAL BUSINESS AND CLAIMS COMMITTEE
PO BOX 248
MARTY SD 57361

JOHN BLACKHAWK
TRIBAL CHAIRPERSON
WINNEBAGO TRIBAL COUNCIL
PO BOX 687
WINNEBAGO NE 68071

JOHNATHAN BUFFALO
HISTORIC PRESERVATION OFFICER
SAC & FOX TRIBE OF THE MISSISSIPPI IN IA
COMMITTEE
349 MESKWAKI RD
TAMA IA 52339-9629

LEON CAMPBELL
CHAIRMAN
IOWAY OF NEBRASKA AND KANSAS EXE

3345B THRASHER RD
WHITE CLOUD KS 66094

WILFRID CLEVELAND
PRESIDENT
HO-CHUNK NATION
PO BOX 667
BLACK RIVER FALLS WI 54675

ROBERT COURNOYER
CHAIRMAN
YANKTON SIOUX TRIBAL BUS & CLAIMS COM
PO BOX 248
MARTY SD 57361

LARRY GARVIN
EXECUTIVE DIRECTOR
HERITAGE PRESERVATION
HO-CHUNK NATION
PO BOX 687
BLACK RIVER FALLS WI 54615

LANA GRAVATT
TRIBAL HISTORIC PRESERVATION OFFICE
YANKTON SIOUX
BOX 248
MARTY SD 57361

EDMORE GREEN
SAC & FOX NATION OF MISSOURI
305 N MAIN ST
HIAWATHA KS 66434

DAVE GRIGNON
TRIBAL HISTORIC PRESERVATION OFFICER
WI INTER-TRIBAL REPATRIATION COMMITT
MENOMINEE INDIAN TRIBE OF WISCONSIN
PO BOX 910
KESHENA WI 54135-0910

CHARLES MICHAEL HARWELL
CHAIRPERSON
OTOE-MISSOURIA TRIBAL COUNCIL
8151 HWY 177
RED ROCK OK 74651

MILDRED HUDSON
OTOE-MISSOURIA TRIBE OF OKLAHOMA
8151 HWY 177
RED ROCK OK 74651

ALLAN KELLEY
CULTURAL RESOURCE REP
IOWAY TRIBE OF KANSAS & NEBRASKA
3345 B THRASHER
WHITE CLOUD KS 66094

SANDRA MASSEY
NAGPRA COORDINATOR
CULTURAL RESOURCES
SAC AND FOX NATION
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KIRWOOD COMMUNITY COLLEGE
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CEDAR RAPIDS PUBLIC LIBRARY
2600 EDGWOOD RD SW
CEDAR RAPIDS IA 52404

AMERICORPS
502 E 9TH ST
DES MOINES IA 50319-0034

BOYS/GIRLS CLUB
PO BOX 8866
CEDAR RAPIDS IA 52408-8855

CEDAR VALLEY HABITAT FOR HUMANITY
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HIAWATHA IA 52233

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KNIGHTS OF COLUMBUS
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RIVER NEIGHBORHOODS ALLIANCE
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FED BLDG ROOM 917 201 WALNUT ST
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CEDAR RAPIDS MUSEUM OF ART
410 3RD AVE SE
CEDAR RAPIDS IA 52402

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MARION HERITAGE CENTER
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DE WALD AMBER & JEREMY TEEL
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CEDAR RAPIDS IA 52402-8309

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CEDAR RAPIDS IA 52404

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CEDAR RAPIDS IA 52402-1887

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BEGLEY SUSAN E & DANIEL R
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CEDAR RAPIDS IA 52404-4514

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CRAIG AUGUSTINE
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SOLON IA 52333

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CENTERVILLE IA 52544

DE BALSTER ET AL

PHYLLIS BARBER

C/O RONNA O'CONNER
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SHELLSBURG IA 52332

29

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CEDAR RAPIDS IA 52402

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CEDAR RAPIDS IA 52405-3135

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CEDAR RAPIDS IA 52404

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1563 5TH AVE SE
CEDAR RAPIDS IA 52403

MATT BEHM
CARGILL
1710 16TH ST SE
CEDAR RAPIDS IA 52401

JERRY D BEMER
905 37TH ST NE
CEDAR RAPIDS IA 52402

ROBERT L BENSON
1505 14TH AVE SW
CEDAR RAPIDS IA 52404-1729

DONALD R BENSON
1131 20TH AVE SW
CEDAR RAPIDS IA 52404

SAM BERGUS
1800 B AVE NE APT #3
CEDAR RAPIDS IA 52402

JOHN BEVINGS
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CEDAR RAPIDS IA 52402

NORMA J BIERL
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CEDAR RAPIDS IA 52401

CLIFF & MARCIE BISHOP
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CEDAR RAPIDS IA 52405

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CEDAR RAPIDS IA 52404-5066

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7 36TH AVE SW
CEDAR RAPIDS IA 52404

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605 ROSEDALE RD SE
CEDAR RAPIDS IA 52403

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212 7TH AVE
HIAWATHA IA 52233

JOHN BOGERT
4001 RIVER RIDGE DR NE
CEDAR RAPIDS IA 52402-7544

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CEDAR RAPIDS IA 52404

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C/O NANCY BRIGHT
1537 BIG CREEK RD
MT VERNON IA 52314

BENJAMIN P & MEGAN D BRITTEN
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2663 FRUITLAND BLVD SW
CEDAR RAPIDS IA 52404

GREGORY C BROWN
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CEDAR RAPIDS IA 52405-3636

LARRY D BROWN
1516 SIERRA DR NE
CEDAR RAPIDS IA 52402

JOHANNA BROWNLOW
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CEDAR RAPIDS IA 52404

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MARCELLA BRUNS ET AL
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OTIS E BURGER
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1127 6TH ST NW
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1127 6TH ST NW
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TODDVILLE IA 52341

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3114 VAN BUREN DR SW
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RON GOODWIN
PO BOX 2805
CEDAR RAPIDS IA 52406

BRANDY J GRAHAM
2485 8TH AVE
MARION IA 52302

LORI & JON GRAY
6718 CEDAR VIEW CT NE
CEDAR RAPIDS IA 52411

JODI L GRIFFITH
1281 CURTIS BRIDGE RD NE
SWISHER IA 52338

GRANT C & DEBRA K GRIMM
443 ZELDA DR NW
CEDAR RAPIDS IA 52405

GARRY E & DOROTHY E GRIMM
1848 3RD AVE SE
CEDAR RAPIDS IA 52403

HOWARD R & GLADYS M GRIMM
1869 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

PAUL L & CATHY L GROTH
BLACK RICHARD R & DEBRA L
44 29TH AVE SW
CEDAR RAPIDS IA 52404

JAY S HAHN
700 PRAIRIE ROSE ST
NORWAY IA 52318

KARL HAIBLE
PO BOX 145
PALO IA 52324

MATTHEW J HALE
1000 ABBE VIEW RD
MOUNT VERNON IA 52314

KATHLEEN HALLORAN
825 17TH ST SE
CEDAR RAPIDS IA 52403-2609

KENNETH M HALM
225 GRAND AVE
MARION IA 52302

EMMITT M HAMED
1268 JAMES AVE NE
SWISHER IA 52338

STEVE HAMMES
HAMMES BUSINESS PLANNING
222 3RD AVE SE STE 299
CEDAR RAPIDS IA 52401

MARVIN D HANSEN
8774 DEER CREST DR
CEDAR RAPIDS IA 52411

CRAIG HANSON
7425 NORMANDY DR NE
CEDAR RAPIDS IA 52402

C HANSON
1201 6TH ST SW
CEDAR RAPIDS IA 52404

LOIS HANSON
5908 WABASH ST SW
CEDAR RAPIDS IA 52404

JAMES L HANSON JR
525 2ND ST SW
CEDAR RAPIDS IA 52401

WALT HARGRAVES
327 TRAILRIDGE RD SE
CEDAR RAPIDS IA 52403

JUDITH C HARRIS
410 16TH AVE NE APT J2
INDEPENDENCE IA 50644-2260

RUTH HART
12 SUMMER CIRCLE NE
CEDAR RAPIDS IA 52402

HERMAN F HARTIN
PO BOX 88
SWISHER IA 52338

DONALD D HARTMAN
1715 OAKLAND RD NE
CEDAR RAPIDS IA 52402-4769

CHARLES & ROSEMARY HARVEY
427 F AVE NW
CEDAR RAPIDS IA 52405

JOYCE HAYZLETT CLARK
816 N ST SW
CEDAR RAPIDS IA 52404

MOLLY HEALEY
830 17TH ST SW
CEDAR RAPIDS IA 52404

MICHAEL HEBERT
2448 2ND ST SW
CEDAR RAPIDS IA 52404

VIRGIL & JANICE F HENLEY
2944 OAKLAND RD NE
CEDAR RAPIDS IA 52402

RONALD HENNEBERRY
116 BRENTWOOD DR NE
CEDAR RAPIDS IA 52402-1506

JUDITH K HENSLEY
2407 BUCKINGHAM DR NW APT #327
CEDAR RAPIDS IA 52405

STEVE HERSHNER
6920 WINTHROP RD NE
CEDAR RAPIDS IA 52402

DAVE & DOROTHY HIGDON
7035 BOXWOOD LN NE
CEDAR RAPIDS IA 52402

LARRY J & SHARON L HODGDEN
1645 D AVE NE
CEDAR RAPIDS IA 52492

DAVID HODGIN
2115 1ST AVE SE #3225
CEDAR RAPIDS IA 52402

LELAND & ERIN HOEGER
1824 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

CHRIS G & AMBER HOFFMAN
2067 63RD ST
VINTON IA 52349-9445

RAYMOND HOLDER
1229 2ND ST SE PO BOX 5761
CEDAR RAPIDS IA 52401

KEVIN A & SUE A HOLLIS
300 W REEDER ST
MECHANICSVILLE IA 52306

BRIAN J HOLMES
2910 SOUTHLAND ST SW
CEDAR RAPIDS IA 52404-4526

TIM HOLT
245 22ND ST NW
CEDAR RAPIDS IA 52405

KURT HOLUB
2246 SHADY OAKS CT NE
CEDAR RAPIDS IA 52402

JOHN HOUCK
7450 COMMUNE CT
CEDAR RAPIDS IA 52411

CLARK J HRUBY
7012 MILBURN RD NEW
CEDAR RAPIDS IA 52411

JEFFREY J HUBER
3142 COUNTY HOME RD
MARION IA 52302

BILL & SELINA HUCKINS
RICHARD R SWARTHOUT LIVING TRUST
2704 MORNINGDOVE LANE
HIAWATHA IA 52233 42

TONY HUEBSCH
4248 SUNLAND CT SE
CEDAR RAPIDS IA 52403

RHINARD M & HOPE M HUGH
780 5TH AVE
MARION IA 52302

DAVID O & MARY A HUGHES
1641 8TH ST NW
CEDAR RAPIDS IA 52405

RUTHANNE HUGHES
641 34TH ST SE
CEDAR RAPIDS IA 52403

LARRY W HULEN
234 NORMANDY DR
MARION IA 52302-6922

RHONDALEE R HULTS
1247 4TH ST NW
CEDAR RAPIDS IA 52401

DAVID W HUNTER
PO BOX 24544
LEXINGTON KY 40524

STEVE HUNTER
1911 RIDGEWAY DR SE
CEDAR RAPIDS IA 52403

ROB HURSH
1720 34TH ST SE
CEDAR RAPIDS IA 52403

JOHN HUSTON
HUSTON ENTERPRISES
2541 27TH ST SW
CEDAR RAPIDS IA 52404

ISAAC J HYKE
1317 19TH AVE SW
CEDAR RAPIDS IA 52404-2514

MELISSA JENSEN
KIRKWOOD COMMUNITY COLLEGE
6301 KIRWOOD BLVD
CEDAR RAPIDS IA 52402

BRIAN T JEROME
5314 PRAIRIEBURG RD
MONTICELLO IA 52310

TILLIE & LENORE J JIROUTEK
1685 FUHRNEISTER ST
ELY IA 52227

GEORGE A & CAROL A JOENS
59 16TH AVE SW
CEDAR RAPIDS IA 52404

COMMODORE P & ALMA P JOHNSON
C/O JESSICA BURNELL
3387 56TH ST TRAIL
CENTER POINT IA 52213

SHIRLEY J JOHNSON
1137 18TH AVE SW
CEDAR RAPIDS IA 52404-2609

DOUGLAS F JONES
677 175TH ST
MECHANICSVILLE IA 52306-7619 43

DOUGLAS JONES
1764 34TH ST SE
CEDAR RAPIDS IA 52403

MICHELLE JORDAN
3212 7TH ST
NORWAY IA 52318

LARRY & MARSHA JUDD
308 TROY ST SW
CEDAR RAPIDS IA 52404

GEORGE KANZ
1612 TIMBERLAKE RUN
CEDAR RAPIDS IA 52403

KRISTINE A KEIPER
2819 BRYANT BLVD SW
CEDAR RAPIDS IA 52404-6191

JEFF KEISER
4034 DALEWOOD AVE SE
CEDAR RAPIDS IA 52403

LARRY KELLEY
1861 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

DENNIS KELLY
300 19TH ST NE
CEDAR RAPIDS IA 52402-5429

KEVEN C & JACQUELINE KEPROS
1732 ELLIS BLVD
CEDAR RAPIDS IA 52405

JOHN P & ELIE P KHAIRALLAH
1824 GRANDE AVE SE
CEDAR RAPIDS IA 52403

BRENDA K KING
416 18TH ST NW
CEDAR RAPIDS IA 52405

BEVERLY KINNEY
1433 C AVE NE
CEDAR RAPIDS IA 52402

ROBIN KLEPPE
511 10TH ST NW
CEDAR RAPIDS IA 52405

JAMES C KLEPPE JR
1732 WILSON AVE SW
CEDAR RAPIDS IA 52404-3347

JAMES C KLEPPE JR
729 F AVE NW
CEDAR RAPIDS IA 52405

ROBIN G KLEPPE SR
7100 MT VERNON RD SE TRLR 40
CEDAR RAPIDS IA 52403-7199

KENNETH W KNOEBEL
303 SAMUEL CT SW UNIT D
CEDAR RAPIDS IA 52404

THOMAS A & PEGGY J KNUTSON
525 H ST SW
CEDAR RAPIDS IA 52404 44

THOMAS A & PEGGY J KNUTSON
3960 DEER VALLEY DR B
MARION IA 52302

JENNIFER KONSTANS
1600 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

RANDY L & CYNTHIA A KOPP
1806 9TH ST SW
CEDAR RAPIDS IA 52404

JEFFERY M KRAMER
419 DRAKE ST SW
CEDAR RAPIDS IA 52404

JOSEPH R KRAPFL
74 GOLFVIEW CT
NORTH LIBERTY IA 52317-9713

JOHN KRUKOW
SCOTT MCDOWELL
404 J AVE NW
CEDAR RAPIDS IA 52401

MATTHEW H & DEBBIE K KULA
1319 18TH AVE SW
CEDAR RAPIDS IA 52404-2510

MARKELL KUPER
1517 HIDDEN HOLLOW LN NW
CEDAR RAPIDS IA 52405

LISA KUZELA
726 8TH ST NW
CEDAR RAPIDS IA 52405

LISA KUZLER
314 CARTER ST NW
CEDAR RAPIDS IA 52402

DOUG LAIRD
411 1ST AVE
CEDAR RAPIDS IA 52401

PATRICIA LANDT
5220 HERBERT AVE NW
CEDAR RAPIDS IA 52405

MICHAEL LANE
43 20TH AVE SW
CEDAR RAPIDS IA 52401

LARRY LANG
385 32ND ST SE
CEDAR RAPIDS IA 52403

DARRELL J & KAREN J LANGAN
514 32ND ST SE
CEDAR RAPIDS IA 52403

PORTIA D LANGHAM
ST LUKE'S HEALTH CARE FOUNDATI
1701 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

KEN LANGHAM REVOC TRUST
3646 RICHMOND RD NE
CEDAR RAPIDS IA 52402

EDWARD S LANGHURST III
1996 10TH AVE
MARION IA 52302

LINDA LANGSTON
4257 SUNLAND CT SE
CEDAR RAPIDS IA 52403

DIANE M LARIMORE
1815 D AVE NE
CEDAR RAPIDS IA 52401

DIANE M LARIMORE
123 14TH AVE SE
CEDAR RAPIDS IA 52401

JONATHAN LAWRENCE
PO BOX 191
ALBURNETT IA 52202

NORMA L LAWRENCE
6126 ROCKWELL DR NE
CEDAR RAPIDS IA 52402

BEATRICE LE CLERE
26 LEISURE BLVD NE
CEDAR RAPIDS IA 52402

BEATRICE LE CLERE
1314 SKYLARK DR
CEDAR RAPIDS IA 52403

MATTHEW LEHMKHUL
549 185TH ST
MECHANICSVILLE IA 52306

CADY LEIGHTON
1250 STARRY DR
MARION IA 52302

JONATHAN A & SHANOA L LEMKE
87 BIRCH DR
MARION IA 52302

JAMES LERCH
1811 J ST SW
CEDAR RAPIDS IA 52404

DAVID G & CONNIE L LEWIS
326 H AVE NW
CEDAR RAPIDS IA 52405

MICHAEL J & SANDRA K LINT
616 SISLEY GROVE RD NW
CEDAR RAPIDS IA 52405

MARK LONG
150 1ST AVE NE
CEDAR RAPIDS IA 52403

JEFF & TARA MACH
C/O MACHO & ASSOC INC
4640 BLARNEY DR
CEDAR RAPIDS IA 52411

CLAYTON R MACKIE
1623 HOLLYWOOD BLVD NE
CEDAR RAPIDS IA 52402-2912

LAURAL J MALLY
2600 FRUITLAND BLVD SW
CEDAR RAPIDS IA 52404

JANET MANATT
4404 EAST POST RD SE
CEDAR RAPIDS IA 52403

KYLE MARATHON
106 S ILLISSUS
MARATHON IA 50565

KENNETH E MARSH
5617 GORDON AVE NW
CEDAR RAPIDS IA 52405

KAY A MARTENSEN
1623 B AVE NW
CEDAR RAPIDS IA 52405-3715

DARRELL& BONITA MARTIN
3207 75TH ST
NORWAY IA 52318

ROBERT MAYS
1228 4TH ST NW
CEDAR RAPIDS IA 52401

HERMAN A MC CALLA
2327 CANYON ST SW
CEDAR RAPIDS IA 52404-6109

JEAN I MC CAULEY
2458 8TH AVE SW
CEDAR RAPIDS IA 52404

LESTER MC CORKLE
RNA ENTERPRISES LLC
1425 GEORGE DR
MARION IA 52302-7019

CRAIG MC CORMICK
3527 FIELDSTONE PL SW
CEDAR RAPIDS IA 52404

GALE L MC CULLOUGH
1536 GREENS WAY CT NE
CEDAR RAPIDS IA 52402

DAVID E MC DOWELL
1430 L ST SW
CEDAR RAPIDS IA 42405

ROBERT J & SANDRA J MC FATRIDGE
400 LINDALE DR #11
MARION IA 52302

LOU ANN MC GRAW
155 LENORA DR NW
CEDAR RAPIDS IA 52405

DONNA M MC GURK
3579 STONEY POINT RD SW
CEDAR RAPIDS IA 52404

PATRICIA MC INROY
14 CHAPELRIDGE CIR APT C
MARION IA 52302-7257

MIKE MC KENNA
2668 BECKY THACHER RD
MUSCATINE IA 52761

JAMES & BONNIE MC KIERNAN
3131 SCHAEFFER DR SW
CEDAR RAPIDS IA 52404

THEODORE J & LORI A MC MANN
2935 WOODLAND DR SW
CEDAR RAPIDS IA 52404

MICHELLE MC NAMARA
536 FOREST DR SE
CEDAR RAPIDS IA 52403-4235

EDWIN D JR & JUDY M MC PHAIL
4223 TOPAZA AVE NW
CEDAR RAPIDS IA 42405

DONALD F & OPAL E MC SPADDEN
1050 10TH AVE SE
CEDAR RAPIDS IA 52401-2575

RICHARD MCARTOR
1520 OAK RIDGE LN SE APT 4
CEDAR RAPIDS IA 52403-3664

BONNIE MCDONOUGH
1764 34TH ST SE
CEDAR RAPIDS IA 52403

DAVID MCDOWELL
1430 L ST SW
CEDAR RAPIDS IA 52404

JERRY MCGRANE
1105 8TH ST SE
CEDAR RAPIDS IA 52401

DONNA MCGURK
1320 EDGEWOOD RD NW APT #301
CEDAR RAPIDS IA 52405

LARRY T MCKINNON
1607 ELLIS BLVD NW
CEDAR RAPIDS IA 52401

LARRY & MARY MCKINNON
1601 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

JEFF MCLAUD
622 42ND ST NE
CEDAR RAPIDS IA 52402

TODD MCNALL
4336 FOX MEADOW DR SE
CEDAR RAPIDS IA 52403

PAMELA M MEIER
1831 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

WILLIAM & ANN-MARIE MERRITT
2311 SCOTTSDALE ST SW
CEDAR RAPIDS IA 52404

FLOYD H MEYER
1091 JUNIPER DR SW
CEDAR RAPIDS IA 52404

JOSEPH W & DOROTHY M MICHALEC
3731 DENNIS DR NW APT #5
CEDAR RAPIDS IA 52405

ROBERT K MIELL
1956 1ST AVE NE
CEDAR RAPIDS IA 52402

DAN MILLER
1603 HILLSDIE DR NW
CEDAR RAPIDS IA 52405

STACY R MILLER
1820 SHAWNEE CT NW
CEDAR RAPIDS IA 52405

JOEL MILLER
375 PHAETON DR
ROBINS IA 52328

JACK MINDER
GENE E MINDER REV TRUST
3858 KNOLLCREST CT NE
CEDAR RAPIDS IA 52402

DANIEL MITSCHELEN
DAVID MITSCHELEN ET AL
122 19TH ST NW
CEDAR RAPIDS IA 52405 50

BRYAN MOELLER
1637 5TH ST NW
CEDAR RAPIDS IA 52405

DAVID MONTAGUE
1841 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

JAMES V MONTAGUE
1713 8TH ST NW
CEDAR RAPIDS IA 52401

GENEVIEVE M MONTAGUE
C/O FLOYD PRATT
500 ASHTON P1 NE APT #102
CEDAR RAPIDS IA 52402

DAVID J MONTAGUE
1841 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

RYAN L MONTAGUE
630 66TH AVE SW
CEDAR RAPIDS IA 52404

JOYCE L MORSE
1525 5TH AVE SE
CEDAR RAPIDS IA 52403

IRMA J MRAZEK
451 18TH ST NW
CEDAR RAPIDS IA 52405

BRENT J & PATRICIA A MUENZENMEYER
3215 12TH AVE SW
CEDAR RAPIDS IA 52404

STEVEN J MULLIGAN
1630 PARK TOWNE LN NE APT 3
SHELLSBURG IA 52402-6477

ANNE B MUNSON
1922 B AVE NE
CEDAR RAPIDS IA 52402

AARON R & GINA M MUZINGO
6676 32ND AVE LOT 93
SHELLSBURG IA 52332

YAN MYERS
2802 JOHNSON AVE NW
CEDAR RAPIDS IA 52405

HENRY NATHANSON
PO BOX 74210
CEDAR RAPIDS IA 52407

GAIL NAUGHTON
2410 GRANDE AVE SE
CEDAR RAPIDS IA 52403

GEORGE W & PATRICIA NEAL
1618 E AVE NW
CEDAR RAPIDS IA 52401

HARVEY B & CLAIRBEL M NELSON
202 12TH ST NW #18
CEDAR RAPIDS IA 52405

EVERETT S NEMER
1425 7TH AVE SE
CEDAR RAPIDS IA 52403

CLARA NEWBERRY
1861 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

CHIEN V & THANH PHAM NGUYEN
3115 BRAMBLE RD SW
CEDAR RAPIDS IA 52404

TAMARA L O'BRINE
201 WESLEY DR NW
CEDAR RAPIDS IA 52405-4422

JOHN OESCHGER
1925 SISLEY GROVE RD
CEDAR RAPIDS IA 52404

CARL & CAROL OESCHGER
2230 DAVID CT NE
CEDAR RAPIDS IA 52402

ROBERT P & SANDRA L OHLHAUSER
204 TROY ST SW
CEDAR RAPIDS IA 52401

KENNETH L & JODI M OHLHAUSER
5550 VERMONT ST SW
CEDAR RAPIDS IA 52404-5127

SCOTT OLSON
411 1ST AVE STE 600
CEDAR RAPIDS IA 52401

KENNETH D ORMISTON
5910 28TH AVE LOT 63
VINTON IA 52349

MARY L OVERHULSER
342 26 ST NW
CEDAR RAPIDS IA 52405-3608

RONALD D & RITA M T PALMER
6702 COLORADO DR SW
CEDAR RAPIDS IA 52404

DON PALMER
1436 25TH ST SE
CEDAR RAPIDS IA 52403

JESSICA PALMER
6601 CREEKSIDE DR NE
CEDAR RAPIDS IA 52402

RICHARD PANKEY
342 WOODLAND DR SE
CEDAR RAPIDS IA 52403

PEGGY L PECHOTA
PO BOX 1144
CEDAR RAPIDS IA 52401

ERIC PENNE
3734 ROAY DR SW
CEDAR RAPIS IA 52402

DAVID PERKINS
4301 NORTHWOOD DR NE
CEDAR RAPIDS IA 52402

GERALD E PERKINS
113 BARBARA ST SW
CEDAR RAPIDS IA 52404

BRENDA PERRIN
1851 ELLIS BLVD NW
CEDAR RAPIDS IA 52401

ED PETTUS
2015 WERNER CT NE
CEDAR RAPIDS IA 52402

EDWARD & KATHY PETTUS III
2015 WERNER CT NE
CEDAR RAPIDS IA 52402

DENNIS PFAFF
3303 RIVERPOINTE CIR NE
CEDAR RAPIDS IA 52411

DENNIS W PFAFF
LEDERMAN BROS PROPERTY
106 3RD AVE SW
CEDAR RAPIDS IA 52401

DONALD PFEILER ET AL
3905 CENTERPOINT RD NE
CEDAR RAPIDS IA 52402

HAU & LOC PHAM
250 BRENTWOOD DR NE
CEDAR RAPIDS IA 52402

TERRENCE D & WANDA L PHARES
2820 Q AVE NW
CEDAR RAPIDS IA 52405

CODY F & RA PHILLIPS
320 14TH ST APT 9
MARION IA 52302-4455

RUSS & LOIS PIDIMA
722 G AVE NW
CEDAR RAPIDS IA 52405

CALVIN A PIERCE
1103 9TH ST NW
CEDAR RAPIDS IA 52405

ROBERT E & NANCY PIERSON
C/O AL PIERSON
PIERSON'S INC
331 23RD ST DR SE
CEDAR RAPIDS IA 52403

BRUCE A & SUZANNE M PIKE
33 DARTMOUTH ST SW
CEDAR RAPIDS IA 52404

LARRY & CATHERINE M POVLICK
PO BOX 358
NEWHALL IA 52315

STEPHEN POWER
817 19TH ST SE
CEDAR RAPIDS IA 52403-2737

BILL & RENA PRANGER
2422 26TH ST NW
CEDAR RAPIDS IA 52405

CHRISTOPHER J PUCKETT
2618 MEADOWBROOK DR SE
CEDAR RAPIDS IA 52403

MYRON & VICTORIA RAAS
1536 HWY 441 SE LOT 8
OKEECHOBEE FL 34974-7337

MYRON & VICTORIA RAAS
1536 HWY 441 SE LOT 8
OKEECHOBEE FL 34974

JOSEPH N RAILSBACK
2215 9TH AVE SW
CEDAR RAPIDS IA 52404-1508

SCOTT R RANSOM
1423 4TH ST NW
CEDAR RAPIDS IA 52401

DICK RANSOM
1860 BOYSEN RD
HIAWATHA IA 52233

KATHY L RASMUSSEN
PO BOX 123
NORWAY IA 52318-0123

DEBORA A RASMUSSEN
5718 MAYFARE ST SW
CEDAR RAPIDS IA 52404

LARRY A & SHARON M RAWSON
909 ELLIS LN NW
CEDAR RAPIDS IA 52405

CHAD T RAWSON
604 PENN AVE NW
CEDAR RAPIDS IA 52401

DOROTHY REGAN
1015 MOOSE DR NW
CEDAR RAPIDS IA 52405-7029

LU ANNE REIFSCHNEIDER
1005 KOUDSI BLVD NW
CEDAR RAPIDS IA 52405

WILLIAM & SUSAN REYHONS
1633 IVANHOE RD
ELY IA 52227

SHIRLEY REYNOLDS
1728 RICHMOND RD NE
CEDAR RAPIDS IA 57402

MARY A RICHARDSON ET AL
608 PENN AVE NW
CEDAR RAPIDS IA 52405

CLARK RIEKE
2904 SOUTTER AVE SE
CEDAR RAPIDS IA 52403

JENNIFER A & DARRYL L RISTING
1955 ZIKA AVE NW
CEDAR RAPIDS IA 52405-1232

MATTHEW W ROBINETTE
4720 HUBBELL AVE
DES MOINES IA 52317-4751

CORY ROBINSON
1298 33RD ST NE
CEDAR RAPIDS IA 52402

DONALD C & ALLEEN M RODMAN
500 4TH AVE SW
MT VERNON IA 52314-1735

MARCI RODMAN
1217 11TH ST NW
CEDAR RAPIDS IA 52405

BEN ROGERS
2503 B AVE NE
CEDAR RAPIDS IA 52402

CHRIS ROSELL
221 13TH ST NW
CEDAR RAPIDS IA 52405

BETTY A ROSELL
221 13TH ST NW
CEDAR RAPIDS IA 52405

MARK ROSKOPF
CAIN FORLAW COMPANY
1845 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

HARRY J ROSS
322 H AVE NW
CEDAR RAPIDS IA 52401

DONALD ROSS
ROSS INDUSTRIAL PARK
3015 WEN16 RD NEW
CEDAR RAPIDS IA 52402

THOMAS J ROTH
1213 SIOUX DR NW
CEDAR RAPIDS IA 52405-2342

JEFFREY J ROWRAY
431 LONGWOOD DR NE
CEDAR RAPIDS IA 52402

RALPH RUSSELL
8710 EARHART LN SW
CEDAR RAPIDS IA 52404

ANTHONY C TRUSTEE RUSSELL
4054 VIA CANGNEJO
SAN DIEGO CA 92130

KATIE SANDQUIST
1307 8TH ST NW
CEDAR RAPIDS IA 52405

BARRY SATTERFIELD
6210 EASTVIEW AVE SW
CEDAR RAPIDS IA 52404-1022

TOM SAXEN
6821 KIOWA TRCE NE
CEDAR RAPIDS IA 52411

CHRISTOPHER A SCHMIDT
2053 N TOWNE CT NE APT 7
CEDAR RAPIDS IA 52402-1948

MARION J & JEANNINE SCHMINKE
216 W 4TH
VINTON IA 52349

JOHN SCHNIPKOWEIT
900 2ND ST SE #209
CEDAR RAPIDS IA 52401

DAVE SCHOETTMER
PO BOX 363
PALO IA 52324

RANDY SCHOON
625 1ST ST SE
CEDAR RAPIDS IA 52403

GEORGE SCHORG
1233 9TH ST NW
CEDAR RAPIDS IA 52405

STEPHEN J SCHREIBER
1738 ELLIS BLVD NW
CEDAR RAPIDS IA 52405-1621

NOLA SCHROEDER
4520 1ST AVE NW UNIT E
CEDAR RAPIDS IA 52405

RONALD H SCHUSTER
IIAMS DUSTIN W
225 BERNITA DR NW
CEDAR RAPIDS IA 52405

CHARLES & EVELYN SCOTT
1108 STAUB CT NE
CEDAR RAPIDS IA 52402

MAURICE P & ARLIS M SEDLACEK
590 PENN AVE NW
CEDAR RAPIDS IA 52405

CRAIG E & MOLLY A SEELEY
3916 RICHLAND DR NW
CEDAR RAPIDS IA 52405-5273 57

GARY L & LINDA D SEGER
1629 8TH ST NW
CEDAR RAPIDS IA 52405-1606

KATHERINE L SEVERSON-MC NAMARA
304 MARGARITA LN NE
CEDAR RAPIDS IA 52402-1880

GARY J SHEA
425 2ND ST SE STE 1010
CEDAR RAPIDS IA 52401

ROBERT AND MARILYN SICHERT
716 WESTWOOD DR NW
CEDAR RAPIDS IA 52405

ANTOINETTE M & BRANT D SIMPSON
4510 MIDWAY DR NW
CEDAR RAPIDS IA 52405

BOBBY J SR & BETTY A SLATON
2401 KENWAY BLVD SW
CEDAR RAPIDS IA 52404

PATRICIA A SMITH
343 26TH ST NW
CEDAR RAPIDS IA 52405

MARTIN SMITH
PO BOX 2326
CEDAR RAPIDS IA 52406-2326

VANESSA SOLESBEE
312 2ND AVE SE
CEDAR RAPIDS IA 5201

GARY STANSBERY
1501 8TH ST NW
CEDAR RAPIDS IA 52405

LEONARD J & CAROL A STEINER
2145 C ST SW
CEDAR RAPIDS IA 52404

LISA M & MARK A STILWELL
3232 HUXLEY LN SW
CEDAR RAPIDS IA 52404-3318

WAYNE A & JOSIE L SELCK
640 22ND AVE SW
CEDAR RAPIDS IA 52404-5538

LARRY SHARP
3614 SUE LN NW
CEDAR RAPIDS IA 52405

CHET & SHIRLEY SHEETZ
148 21ST AVE SW
CEDAR RAPIDS IA 52404

ROBERT & MARILYN SIECHERT
716 WESTWOOD DR NW
CEDAR RAPIDS IA 52405

MAJOR JEN SJORGEN
SALVATION ARMY
PO BOX 1656
DAVENPORT IA 52809

BRANDON L SMITH
1240 CENTER ST NE
CEDAR RAPIDS IA 52402-3538

ADAM M SMITH
1206 1ST ST SW
CEDAR RAPIDS IA 52404

DALE A SNYDER
1867 ELLIS BLVD NW
CEDAR RAPIDS IA 52405-1247

DANA D SPORE
PO BOX 8515
CEDAR RAPIDS IA 52408-8515

LARRY & CHERYLE STEGGALL
FUTIO LLC
2550 OXFORD LN NW APT 6
CEDAR RAPIDS IA 52405-1196

MARLENE STERN
5220 ELY RD SW
CEDAR RAPIDS IA 52404

GREGORY STOKESBERRY
2416 29TH AVE SW
CEDAR RAPIDS IA 52404

LINDA K STOLL
3309 WAVELAND DR NW
CEDAR RAPIDS IA 52405

JIMMY STOMPFF
1611 WOLF DR NW
CEDAR RAPIDS IA 52405

PAMELA M STOWELL
1831 ELLIS BLVD NW
CEDAR RAPIDS IA 52401

JOSHUA STRANG
1305 GRANDE AVE
CENTER POINT IA 52213

DAN STRELLNER
7429 BERKSHIRE DR NW
CEDAR RAPIDS IA 52402

MATTHEW S & SARA E STUEFEN
1649 27TH ST NW
CEDAR RAPIDS IA 52405

DEAN J STULL
1308 4TH ST NW
CEDAR RAPIDS IA 52401

JEFFREY C STULL
231 W SOVERS STT
SOLON IA 52333

LAVINIA SULLIVAN
C/O TERRY SULLIVAN
2922 SCHAFFER DR SW
CEDAR RAPIDS IA 52404

KEITH SUTHERLAND
2729 SENECA CT NE
CEDAR RAPIDS IA 52402

ALBERT L & RITA R SWEARINGEN
1327 4TH ST NW
CEDAR RAPIDS IA 52401

SCOTT SWENSON
424 1ST AVE
CEDAR RAPIDS IA 52403

JESSIE TAKEN
116 14 AVE SE
CEDAR RAPIDS IA 52402

JESSIE TAKEN
LOCAL P-3 RETIREE INC
2813 MURIEL DR NW
CEDAR RAPIDS IA 52405

GARY R & CHERI R TALLMAN
6215 WAYSIDE CIRCLE
CEDAR RAPIDS IA 52411

MIKE TERTINGER
3RD PARK TERRACE SE
CEDAR RAPID IA 52403

DAVID & DIANE THOMAS
3496 FORSYTHE TERRACE
THE VILLAGES FL 32162

ALLAN & MARY THOMS
3935 SALLY DR NE
CEDAR RAPIDS IA 52402

DEREK J & SONYA R THORNTON
1842 ELLIS BLVD NW
CEDAR RAPIDS IA 52401

RON TIETGE
2758 IOWA AVE
CEDAR RAPIDS IA 52403

JOHN C TILTON
51 18TH AVE SW
CEDAR RAPIDS IA 52401

MARGIE TINSTMAN
175 KOHAWK ST SW
CEDAR RAPIDS IA 52404-5205

DALE TODD
1821 GRANDE AVE SE
CEDAR RAPIDS IA 52402

ROBERT & ANN TOW
1624 3RD AVE SE
CEDAR RAPIDS IA 52402

LARRY E & AMY J TUBBS
309 MAPLE ST
CENTER POINT IA 52213-9248

GERALD E & MELODY A TURNER
1945 B AVE NE
CEDAR RAPIDS IA 52402

ALLEN L ULFERTS
1212 29TH ST NE
CEDAR RAPIDS IA 52402

SHANE & DEIDRA USHER
171 36TH AVE SW
CEDAR RAPIDS IA 52404-4639

LARRY E & RUTH A VAN DUESEN
1408 ELLIS BLVD NW
CEDAR RAPIDS IA 52405

JUSTIN VAN FLEET
79 SUMMER CIRCLE NE
CEDAR RAPIDS IA 52401

LEONARD F & MARY A VERDECK
600 ROCKHURST DR SW
CEDAR RAPIDS IA 52401

SANDRA VOSMEK
2552 OXFORD LN NW APT 5
CEDAR RAPIDS IA 52405-1192

LARRY A WADDELL
1623 A ST SW
CEDAR RAPIDS IA 52401

VIRGINIA L WALKER
5327 HOLLY AVE NW
CEDAR RAPIDS IA 52405

CHARLES WALSH
2510 CARLSBAD ST SW
CEDAR RAPIDS IA 52404-6153

CHARLES R & JOSEPHINE S WALTERS
1233 4TH ST NW
CEDAR RAPIDS IA 52401

JOHN WASTA
PO BOX 1383
CEDAR RAPIDS IA 52406

ROBERT D & JOYCE E TURNBULL
1115 9TH ST SE
CEDAR RAPIDS IA 52401-2047

ZAY TURNERFORD
110 2ND ST SE
CEDAR RAPIDS IA 52401

ALLEN ULFERTS
3731 12TH AVE SW
CEDAR RAPIDS IA 52404

CATHERINE W VALANDINGHAM
210 AUSTIN ST SW
CEDAR RAPIDS IA 52404

HOMER F VAN DYKE
965 2ND AVE
MARION IA 52302

HANNAH VARNER
1501 6TH AVE SE
CEDAR RAPIDS IA 52401

DAVID E & RUTH A VIFIAN
1432 4TH ST NW
CEDAR RAPIDS IA 52401

MARTY L VOZENILEK
1604 27TH ST NW
CEDAR RAPIDS IA 52405

DALE G WADE
126 29TH ST DR SE
CEDAR RAPIDS IA 52403-1407

MICHAEL C WALSH
307 PRAIRIE AVE
FAIRFAX IA 52228-9528

DWIGHT D & WENDY A WALTERS
1108 80TH ST NW
CEDAR RAPIDS IA 52405-9005

DOUG & LOIS WARD
5435 DECATUR ST SW
CEDAR RAPIDS IA 52404

MAMIE WATERBURY
3713 FOXBOROUGH TER NE
CEDAR RAPIDS IA 52402

LEROY C WATSON
52 SAMOA DR
HIAWATHA IA 52233

THOMAS J & PAMELA K WECKER
1215 26TH ST
MARION IA 52302-5077

RAYMOND F & LILLIAN L WELLS
2047 N TOWNE CT NE APT 2
CEDAR RAPIDS IA 52402-1978

DUSTIN M WHITE
1319 18TH AVE SW
CEDAR RAPIDS IA 52404-2510

HARRY J WILFORD
1303 18TH ST SW
CEDAR RAPIDS IA 52404

ELDON WOHLLEBEN
3051 28H AVE
MARION IA 52302

ADAM WRIGHT
2510 K AVE NW
CEDAR RAPIDS IA 52405

SCOTT E & ERIN A ZAPUTIL
3401 WENIG RD NE
CEDAR RAPIDS IA 52402

LOWELL L & NANCY R WAYBILL
1805 ELLIS BLVD NW
CEDAR RAPIDS IA 52401

FRANK E WEINSTEIN
3525 RAVEN LN NE
CEDAR RAPIDS IA 52402

ARTHUR L & VIRGINIA C WENTZEL
1127 SUMMIT AVE SW
CEDAR RAPIDS IA 52404-4852

BETTY F WIESE
2520 LAFAYETTE ST SW
CEDAR RAPIDS IA 52404-6169

ROBERT WINGEN
1302 K ST SW
CEDAR RAPIDS IA 52404

RICHARD WOODWARD
3041 CIRCLE HILL CT NE
CEDAR RAPIDS IA 52402-3420

KIMBERLY K & SCOTT D YEATER
6269 33RD AVE DR
SHELLSBURG IA 52332

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX L
PERTINENT CORRESPONDENCE

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX L
PERTINENT CORRESPONDENCE

July 8, 2005 Memorandum from Commander, CEMVD to Commander, CEMVR, Approval of Section 205, Initial Assessment L-1

January 11, 2008, Letter from Ken DeKeyser, P.E., City of Cedar Rapids, Iowa Storm Water Utility Engineer to CEMVR L-2

June 23, 2009, Letter from CEMVR to Various Organizations L-3

July 1, 2009, Response Letter from John F. Doershuk, Ph.D. RPA, State Archaeologist to CEMVR L-67

July 29, 2009, Response Letter from Jennifer Sandy, Program Officer, National Trust for Historic Preservation to CEMVR L-69

July 30, 2009, Letter from CEMVR to Various Organizations L-72

August 17, 2009, Response Letter from the Sierra Club to CEMVR L-75

August 24, 2009, Response Letter from the Iowa Department of Natural Resources to CEMVR L-78

August 31, 2009, Letter from CEMVR to Various Organizations L-80

September 8, 2009, Response Letter from the U.S. Fish and Wildlife Service to CEMVR L-85

October 4, 2009, Response Letter from Daniel K. Higginbottom, Archaeologist, Iowa State Historic Preservation Office to CEMVR L-87

October 15, 2009, Letter from CEMVR to Various Organizations L-90

October 20, 2009, Letter from CEMVR to Various Organizations L-93

October 28, 2009, Agenda for Consulting Parties Meeting held at Cedar Rapids Crowne Plaza Hotel L-102

November 5, 2009, Response Letter from the Iowa Department of Natural Resources to CEMVR L-103

November 6, 2009, Response Letter from the Iowa Department of Natural Resources to CEMVR L-104

February 16, 2010, Letter from CEMVR to Various Organizations L-106

March 17, 2010, Response Letter from Daniel K. Higginbottom, Archaeologist Iowa State L-150
Historic Preservation Office to CEMVR

June 14, 2010, Letter from City of Cedar Rapids in Support of Alternative 4C L-151

June 22, 2010, Letter from City of Cedar Rapids for Request for Selection of Alternative 1A-C.....L-152

July 20, 2010, Response Letter from Daniel K. Higginbottom, Archaeologist Iowa SHPO to CEMVR ..L-154

August 13, 2010, ASA(CW) Response Letter to City of Cedar Rapids Letter of June 22, 2010.....L-156

DEPARTMENT OF THE ARMY
MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
P.O. BOX 80
VICKSBURG, MISSISSIPPI 39181-0080
http://www.mvd.usace.army.mil/

REPLY TO
ATTENTION OF:

CEMVP-PD-SP

8 July 2005

MEMORANDUM FOR Commander, Rock Island District, ATTN: CEMVP-PM-A

SUBJECT: Approval of Section 205 Initial Assessment Report, Cedar Rapids, Linn County, Iowa, Cedar River, Indian Creek, and Dry Creek Watersheds and Time Check Levee, CWIS No. 181244

1. Reference:

a. Memorandum, CEMVP-PM-A, 30 July 2004, subject: Initial Assessment, Flood Damage Reduction Alternatives, Indian Creek, Cedar Rapids, Iowa, (CWIS No. 181244) Section 205 Flood Damage Reduction (encl 1).

b. Memorandum, CEMVR-PM-F, 20 May 2005, subject: CEMVR Response to Consolidated CEMVD Staff Comments Initial Assessment, Flood Damage Reduction Alternatives, Indian Creek, Cedar Rapids, IA, (CWIS No. 181244) (encl 2).

c. Electronic mail message, *Michael Zukowski*, CEMVR-PM-F, 7 July 2005 (encl 3).

2. The initial appraisal is approved as a basis to continue feasibility studies. If, however, during the feasibility studies, it appears that the recommended project(s) will exceed the per project Federal cost limitation under Section 205 of the Continuing Authority Program, then CEMVR must to take steps to either seek a waiver from ASA(CW) for additional Non-Federal cost-sharing above 35%, or convert the study to a specifically authorized General Investigation study.

4. The CEMVD point of contact for this project is Jim Garner, CEMVD-PD-SP; telephone 601-634-7970.

Charles B. Barton

Encl

Charles Barton
Chief, District Support Team
For MVS, MVR, and MVP

Printed on Recycled Paper

CEDAR RAPIDS
City of Five Seasons

January 11, 2008

Michael Zukowski, Study Manager
US Army Corps of Engineers
Clock Tower Building
PO Box 2004
Rock Island IL 61204

RE: Time Check Area Flood Study
CIP No. 304290

Dear Mr. Zukowski:

This letter acknowledges that the City of Cedar Rapids, Iowa intends to proceed with the Time Check Area Flood Study. The City has obtained State grant and local funding to meet the City's share of the project cost. Please find attached a signed Self-Certification of Financial Capability for Agreements.

If you have any questions regarding this project, please feel free to contact our office.

Sincerely,

THE CITY OF CEDAR RAPIDS PUBLIC WORKS DEPARTMENT

Ken DeKeyser, P.E.
Storm Water Utility Engineer

KWD/tls

Encl.

cc: David J. Elgin, P.E., L.S., Public Works Director/City Engineer (w/out encl.)
Robert A. Davis, P.E., Engineering Manager (w/out encl.)

304290\CORRES\ LTR KWD US ARMY CORPS OF ENG 01

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING - P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF:

June 23, 2009

Planning, Programs, and
Project Management Division

Ms. Lavonne Grimes
Iowa Historic Preservation Agency
ATTN: Review and Compliance
Program
State Historical Society of Iowa
Capitol Complex
Des Moines, Iowa 50319 (w/enclosures)

Dear Ms. Grimes;

The United States Army Corps of Engineers Rock Island District (Corps) and the City of Cedar Rapids, Linn County, Iowa is planning to conduct the Cedar River, Cedar Rapids, Iowa – Flood Risk Management Feasibility Study (FRMFS)- Linn County, Cedar Rapids, Iowa, and flood protection management measures are proposed at various location (Enclosure 1). The FRMFS is authorized, as promulgated under GI - General Investigations - House Resolution Docket 2749 adopted April 5, 2006, and Committee on Environment and Public Works, United States Senate, dated May 23, 2006. This correspondence is promulgated under the National Historic Preservation Act as amended (NHPA), and its implementing regulations 36CFR Part 800: "Protection of Historic Properties."

The FRMFS encompasses the reach of the Cedar River and its floodplain/ watershed located in, or adjacent to the City of Cedar Rapids in Linn County. The Corps and the City of Cedar Rapids will manage the FRMFS throughout all stages of flood analysis and protection, project development, construction, and management. Several other Federal agencies, as well as non-government entities and individual citizens, will also regularly participate in the development of projects within the FRMFS (Enclosure 2: Fact Sheet). Plates of the flood protection measure under study for the FRMFS are show on Enclosure 3 (Plates 1-13). Lands being considered for soil borrows are located on Enclosure 4 (City Owned Properties SW Quadrant).

The Corps and the City of Cedar Rapids have determined that the implementation of the FRMFS may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and will consult with the Advisory Council on Historic Preservation (Council) and the Iowa State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]) (NHPA), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]).

The Corps and the City of Cedar Rapids invite your agency, the SHPO, Council, interested Tribal Historic Preservation Officers, Tribal members, and any other interested and consulting parties to review and comment on the enclosed draft Programmatic Agreement (PA). All comments will be considered for inclusion within the final PA to participate in the consultation process and in the development of a *Programmatic Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, Cedar Rapids Historic Preservation Commission, and Advisory Council on Historic Preservation for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study – Linn County, Cedar Rapids, Iowa* (PA, Draft Enclosure 5).

The Corps, the Council, and the City of Cedar Rapids propose to execute the PA, as stipulated by 36 CFR Part 800.14(b) (ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA. Other agencies and parties can request concurring or participatory status. The appropriate and/or pertinent comments of all parties will be addressed in the final PA and will be provided for execution by the lead participatory and concurring parties to this PA. The executed PA will be in the National Environmental Policy Act (NEPA) document resulting from the FRMFS, as evidence of Corps and City of Cedar Rapids compliance promulgated by the NHPA and the consulting process.

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the NEPA of 1969, the Corps and the DNR have developed a preliminary **Interested and Consulting Parties List** comprised of 26 individuals from government organizations or agencies, 14 Tribes or tribal members, and 4 other interested parties (Enclosure 6). The Corps will comply with any requests to be removed from, or added to, the Consulting Parties List. The development and maintenance of the **Interested and Consulting Parties List** allows agencies, tribes, individuals, organizations, and other interested parties an opportunity to provide views on any effects of this undertaking on historic properties resulting from the FRMFS and to participate in the review of the Draft PA. Response will allow the Corps and the City of Cedar Falls to provide those on the **Interested and Consulting Parties List** access to all environmental reports.

Those on the enclosed final **Interested and Consulting Parties List** will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Comments received by the Corps and the City of Cedar Falls will be taken into account when finalizing plans for the FRMFS, as promulgated by the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the FRMFS. Although the FRMFS presently lies entirely within the State of Iowa, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Cedar River watershed, the Corps requests any information concerning our Federal trust responsibilities.

The NHPA recognizes that properties of traditional religious and cultural importance to a tribe may be determined eligible for inclusion on the NRHP. In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Illinois watershed, the FRMFS will be implemented in compliance with Executive Order No. 13007, specifically:

> **Section 1.** *Accommodation of Sacred Sites.* (a) In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.

The Secretary of the Interior's **Standards and Guidelines for Federal Agency Historic Preservation Programs** pursuant to the NHPA states that a:

> Traditional Cultural Property is defined as a property that is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community.

Allowing for tribal review and comment contributes to fulfilling our obligations as set forth in the NHPA (Public Law [PL] 89-665), as amended; the NEPA of 1969 (PL 91-190); Executive Order (EO) 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeological and Historical Preservation Act of 1974 (PL 93-291); the Advisory Council on Historic Preservation "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800); and the applicable National Park Service and Corps regulations and guidance.

The Corps is concerned about impacts to those traditional cultural properties and sacred sites recognized by Native Americans, tribes, ethnic and religious organizations, communities, and other groups as potentially affected by the FRMFS. Presently, the Corps is unaware of any traditional cultural properties or sacred sites within the Illinois River watershed. If there are concerns or potential effects known or identified, please complete the enclosed "**Traditional Cultural Property and Sacred Site Form**" (Enclosure 7). To facilitate tribal coordination, the Corps asks those on the Consulting Parties Lists to refer to the National Park Service, NRHP Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties, available for internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm). Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request

Enclosure 1: Flood Risk Management Feasibility Study Locational Map.



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACREAGE
FRESH WATER INTAKE WELLS	FWIW	8	N/A

US Army Corps of Engineers ®
Rock Island District

Revisions

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed By: Date:
Drawn By: Scale:
Checked By: Project Engr:
Reviewed By: Submitted/Approved:

CEDAR RIVER
CEDAR RAPIDS, IOWA
GENERAL INVESTIGATION
FEASIBILITY STUDY

FWIW
DAMAGED REACH 8

Sheet Reference Number:
PLATE 1
Sheet of XX

35% REVIEW



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS WEST SIDE	DTCE-W RIVER EDGE ALIGNMENT A	2A-2D	92.07 AC

US Army Corps of Engineers ®
Rock Island

No.	Description	Date	Approved
1	Revisions		

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

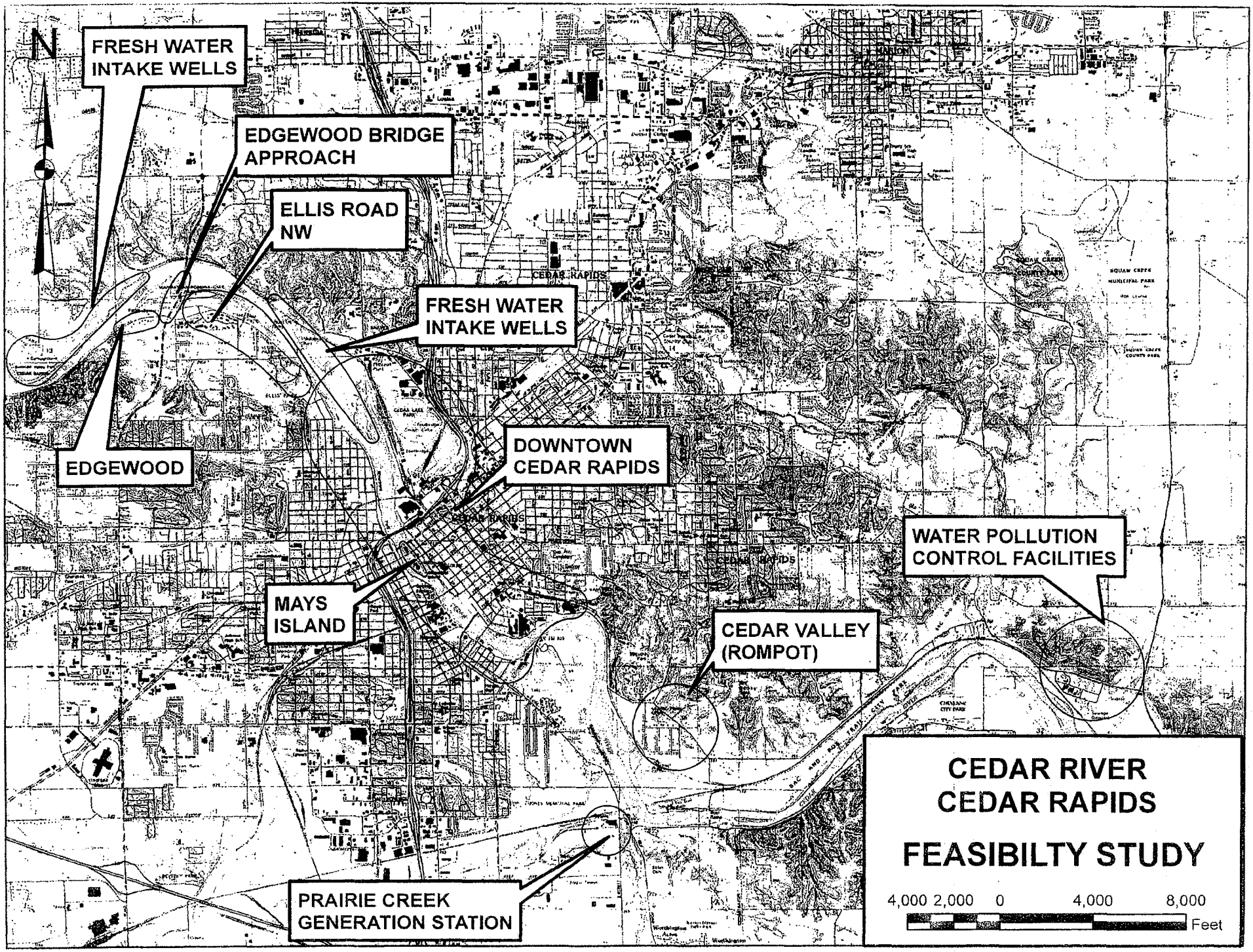
Designed By: | Date:
Drawn By: | Scale:
Checked By: | Project Chief:
Reviewed By: | Submitted By:

CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

DTCR-W RIVERS EDGE ALIGNMENT A REACH 2A-2D

Sheet Reference Number:
PLATE 2
Sheet of XX

35% REVIEW


N
FRESH WATER INTAKE WELLS
EDGEWOOD BRIDGE APPROACH
ELLIS ROAD NW
FRESH WATER INTAKE WELLS
EDGEWOOD
DOWNTOWN CEDAR RAPIDS
WATER POLLUTION CONTROL FACILITIES
MAYS ISLAND
CEDAR VALLEY (ROMPOT)
PRAIRIE CREEK GENERATION STATION
CEDAR RIVER
CEDAR RAPIDS
FEASIBILTY STUDY
4,000 2,000 0 4,000 8,000
Feet

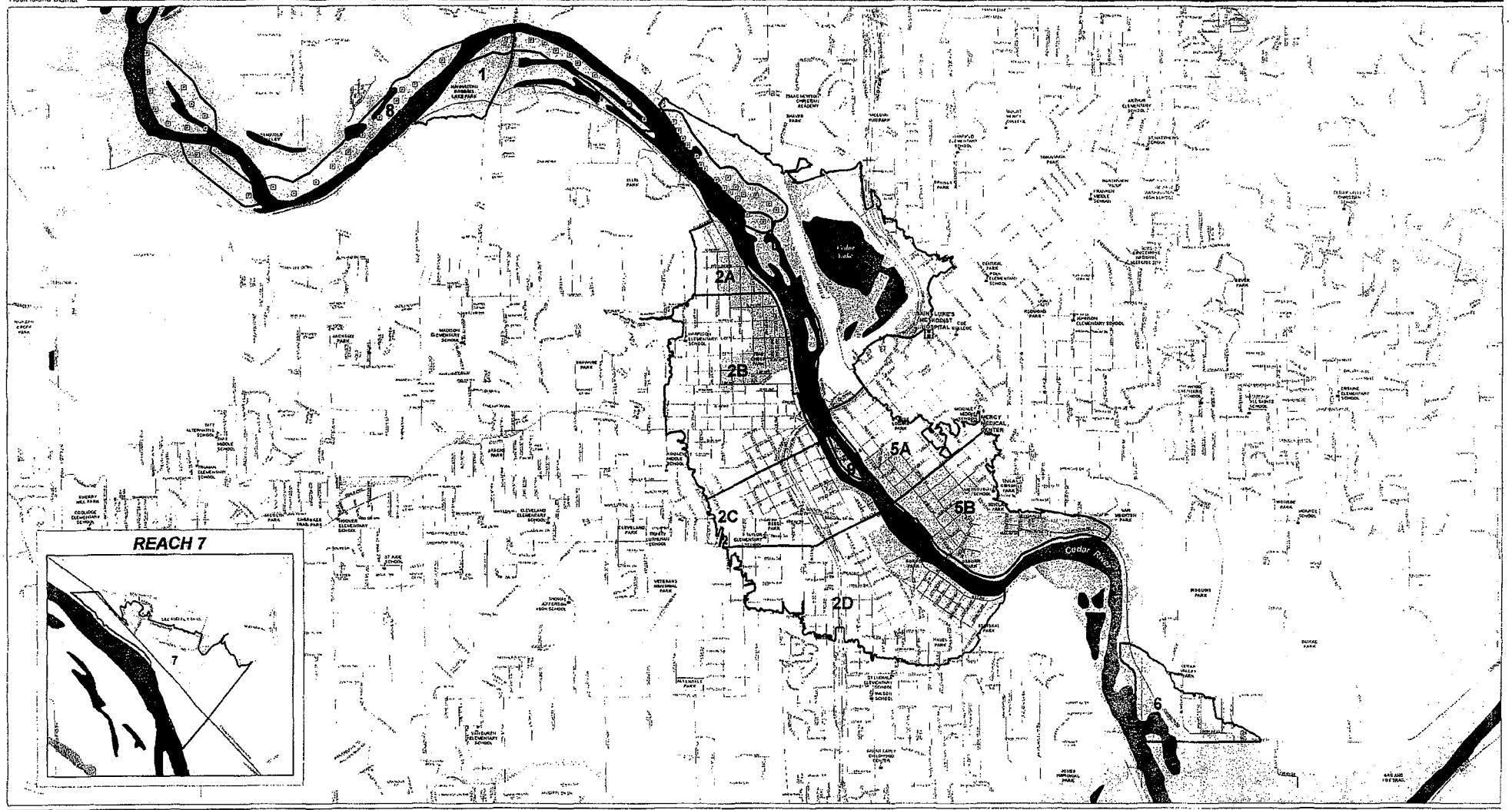
Enclosure 2: Fact Sheet Cedar River Flooding at Cedar Rapids.

Enclosure 3: Flood Risk Management Feasibility Study Linn County, Cedar Rapids, Iowa Flood Protection Measures Under Study (Plates 1-13)

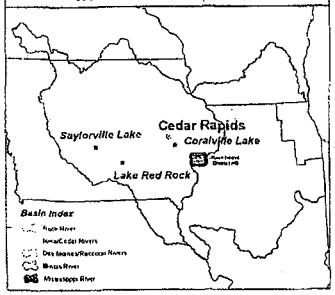
Plate	Area	Alternative Description	Acres of Impact
1	Fresh Water Intake Wells	FWIW	0.00
2	Downtown Cedar Rapids - West Side	DTCR-W River Edge Alignment A	92.07
3	Downtown Cedar Rapids - West Side	DTCR-W River Edge Alignment B	88.06
4	Downtown Cedar Rapids - West Side	DTCR-W Corridor Redevelopment Alignment A	188.30
5	Downtown Cedar Rapids - West Side	DTCR-W Corridor Redevelopment Alignment B	172.30
6	Downtown Cedar Rapids - East Side	DTCR-E Rivers Edge Alignment A	97.29
7	Downtown Cedar Rapids - East Side	DTCR-E Rivers Edge Alignment B	48.69
8	Downtown Cedar Rapids - East Side	DTCR-E Rivers Edge Alignment C	78.59
9	Downtown Cedar Rapids - East Side	DTCR-E Set Back Alignment	23.70
10	Downtown Cedar Rapids	DTCR Mays Island - Floodproofing	8.08
11	Prairie Creek Generation Station	PCGS Alignment Around Entire Station	17.95
12	Prairie Creek Generation Station	PCGS Water Intake Tunnels Closure	0.00
13	Water Pollution Control Facilities	WPCF Alignment Around Entire Facility	22.40

US Army Corps of Engineers
Rock Island District

Damage Reach Extents
- City of Cedar Rapids -



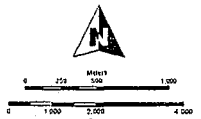
MVR BASIN MAP



LEGEND

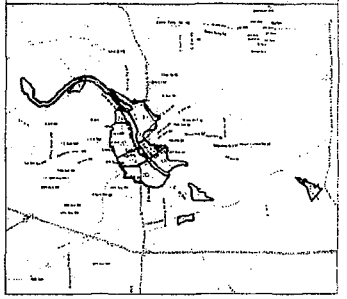
- City Well Fields
- Hospitals
- Schools
- Streets
- Water
- * 100-Yr. Flood Zone
- * 500-Yr. Flood Zone
- Damage Reach
- Parks

* *Flood Limits Taken From 3/18/1991 FEMA Flood Insurance Study*



DISCLAIMER - While the United States Army Corps of Engineers, hereinafter referred to USACE) has made a reasonable effort to ensure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation or guaranty, either express or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein.

OVERVIEW MAP



Fact Sheet
Cedar River Flooding at Cedar Rapids

The flood of 2008 was a hydrological event involving most of the rivers in eastern Iowa beginning around June 8, 2008 and ending about July 1, 2008. Several factors contributed to the severe flooding in 2008. First, the state was already saturated with moisture from the previous year. The year 2007 was Iowa's fourth wettest year in 135 years of state recordkeeping. Second, January, February, and March 2008 were unusually cold and wet. Record or near-record snowfall was reported from parts of eastern Iowa while overall Iowa recorded its 21st coldest and 8th wettest winter in 135 years of data. Finally, Spring 2008 was also unusually cool and wet, ranking 29th coldest and 12th wettest spring in 136 years of data. The lower temperatures are significant in that they result in lower evaporation rates, thus slowing the rate of drying. The magnitude of the rains in the May 29, 2008 to June 12, 2008 period were such that very severe flooding would have resulted anyway, but these antecedent conditions definitely made things worse.

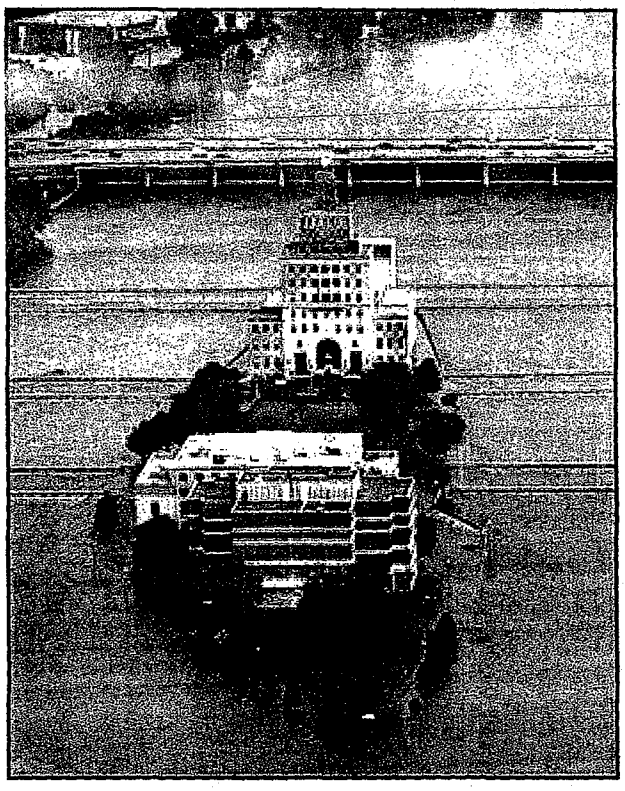
Iowa endured an exceptionally wet period from May 29, 2008 through June 12, 2008 when a statewide average of 8.99 inches of rain fell (normal for the period is 2.45 inches). Record stages and discharges occurred at 29 gage sites in Iowa. Record flooding occurred along the entire length of the Cedar River; the Iowa River below Marshalltown; the Mississippi River along Louisa and Des Moines counties; and a portion of the Des Moines River between Fort Dodge and Des Moines. Many other smaller rivers and streams also recorded major or record flooding. The most exceptional flooding occurred at the City of Cedar Rapids (City) where the Cedar River crested on June 13, 2008 at 19.12 feet above flood stage and 11.12 feet higher than the previous record crests recorded in 1929 and 1851.

The City documents that on June 13, 2008, more than 10 square miles (14%) of downtown Cedar Rapids and surrounding neighborhoods were devastated by record floods. The recurrence interval for the 2008 flood is greater than a 500-year flood, being 3.5 feet above that elevation. In addition to hundreds of businesses and thousands of residential properties, 310 City facilities suffered severe water damage from the flood. As a result, the estimated financial public assistance needs for the State of Iowa exceeds $1.1 billion, making the floods of 2008 the fifth largest state disaster based on the amount of damage to public facilities determined by FEMA in U.S. history behind Hurricane Katrina (Louisiana); Terrorist Attack (9/11); Hurricane Katrina (Mississippi); and Hurricane Wilma (Florida). Approximately 25,000 people, or 1/5 of the total population, were evacuated. Approximately 5,900 homes, businesses, and public and nonprofit structures were affected, with an estimated $2.4 billion dollars of city-wide damage. When Governor Chet Culver declared 85 of Iowa's 99 counties disaster areas during the 2008 floods, he called it "the worst natural disaster in the state's history." The June 2008 flood caused five times the damage in the State of Iowa than the 1993 flood.

The City continues to recover from the 2008 flood, and many state and Federal agencies are participating in that recovery. The United States Army Corps of Engineers Rock Island District (Corps) and the City of Cedar Rapids, Linn County, Iowa is conducting the *Cedar River, Cedar Rapids, Iowa - Flood Risk Management Feasibility Study - Linn County, Cedar Rapids, Iowa*, in which flood protection measures will be identified and evaluated to determined if they meet the Corps selection criteria. This Feasibility Study is under General Investigations House Resolution Docket 2749 adopted April 5, 2006, and the Committee on Environment and Public Works, United States Senate, dated May 23, 2006.

The photographic images from the June 2008 flood document some affected areas in the City, and the "Damage Reach Extents" map delineates the flooded area(s) under study.

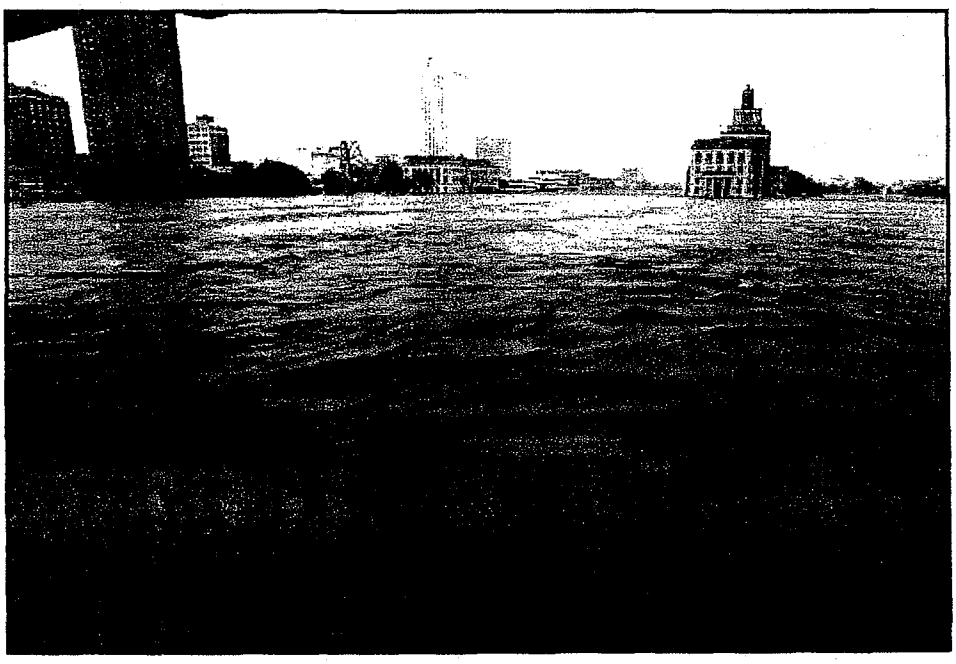
THURSDAY JUNE 12, 2008



Part of Mays Island, site of the Linn County Jail, foreground, and the Linn County Courthouse, is underwater as floodwaters continue to rise. Heavy rains continue to pound large portions of Iowa, and as flooding continues, officials are scrambling as rivers are expected to crest at record levels in many portions of the state.
(AP Photo/Steve Pope)

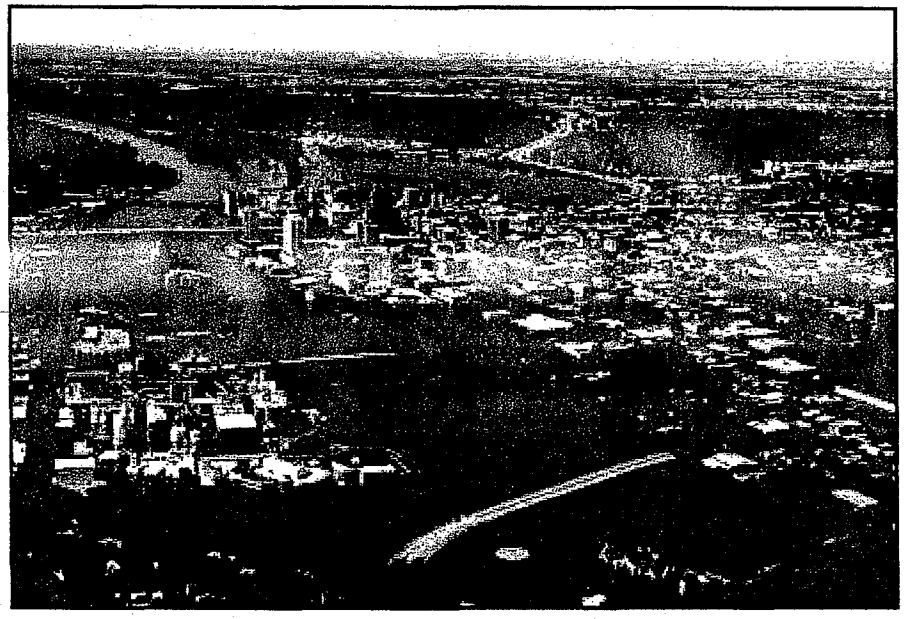


Cedar Rapids Fire Department personnel and Army reservists use a boat to rescue residents from flooded areas of the city . The city is reportedly calling for the evacuation of 10,000 of its residents as flood waters from the rain-soaked Cedar River continue to rise.
(AFP/Getty Images/Scott Olson)

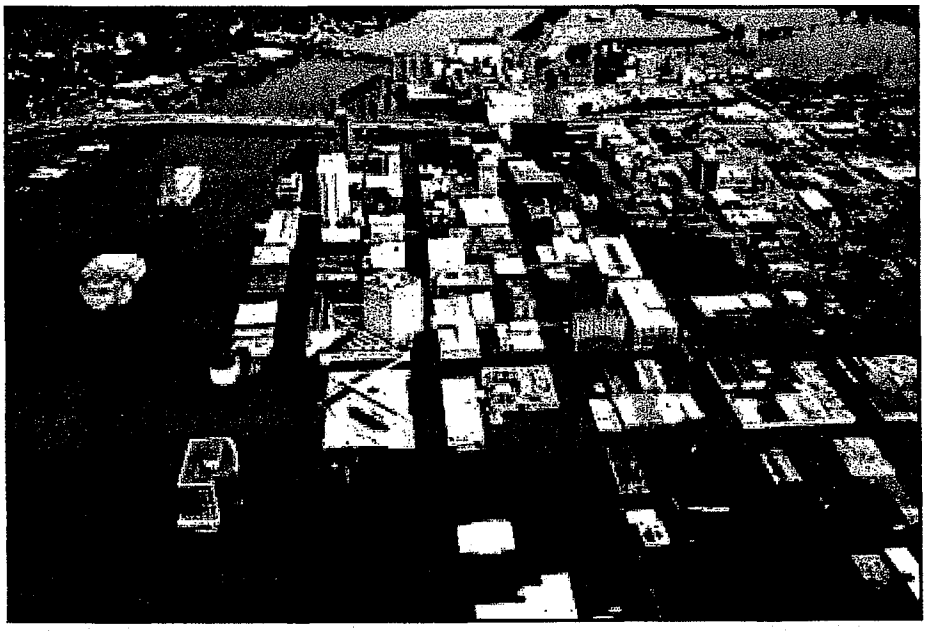


Water from the swollen Cedar River rushes past downtown buildings. Officials estimated that 100 blocks were under water , forcing the evacuation of nearly 4,000 homes and leaving cars under water.
(AP Photo/Jeff Roberson)

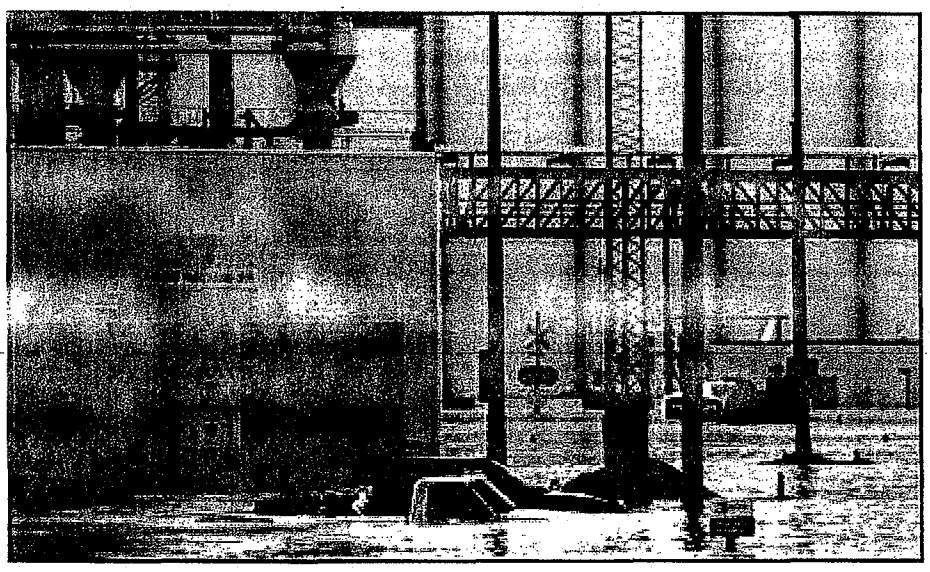
FRIDAY JUNE 13, 2008



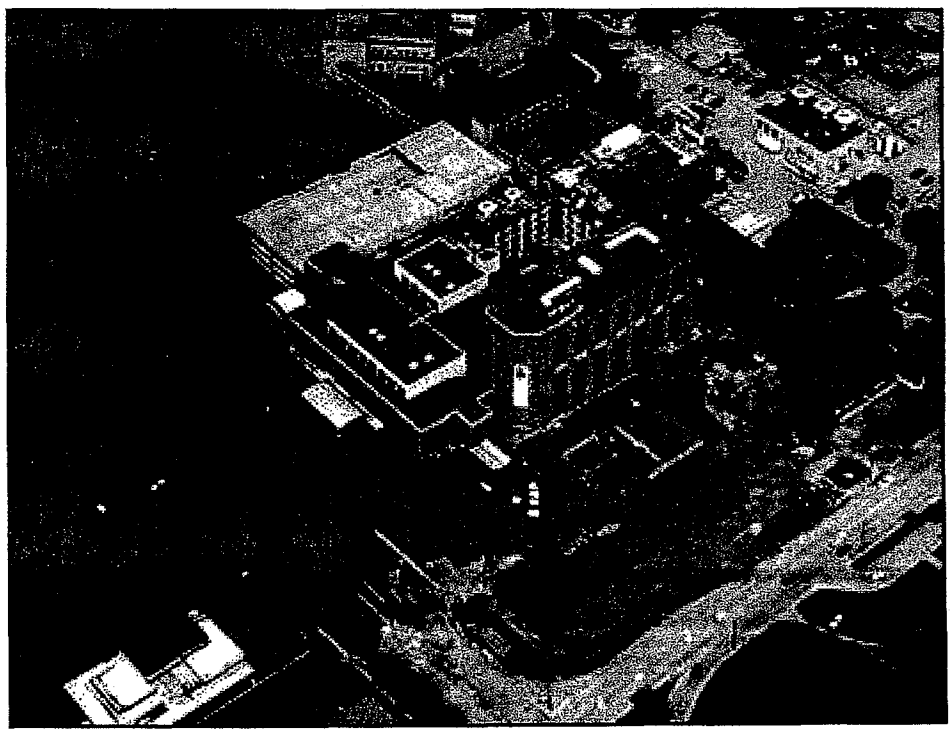
An aerial image of downtown shows flood-affected areas. The flooding of numerous bridges and approaches in the river dramatically affected traffic, delayed emergency responses, and reduced evacuation routes.
(David Greedy / Getty Images)



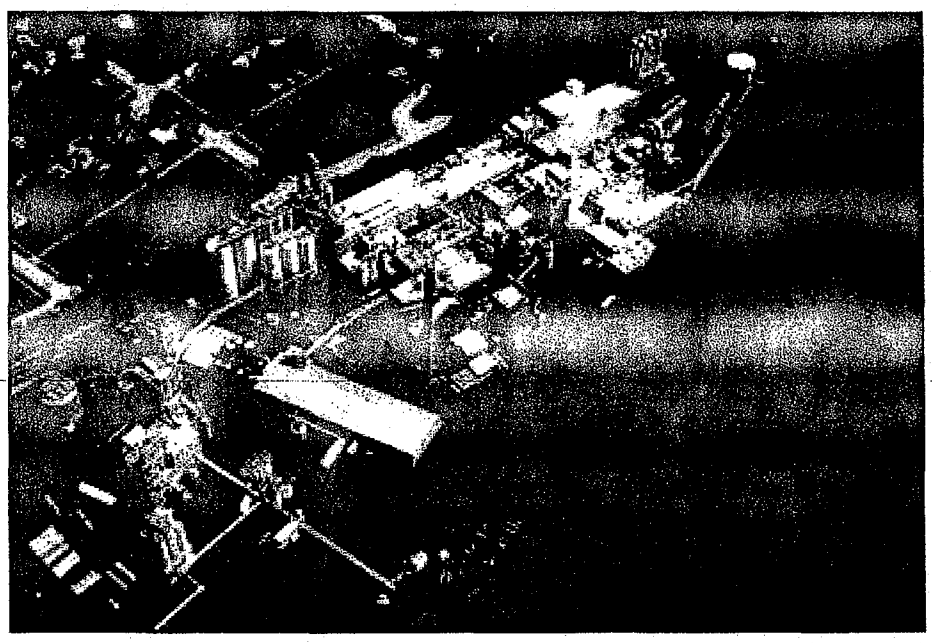
An aerial photo shows a flooded area of downtown looking north. Interstate I-380 can be seen in the background while Mays Island, with Cedar Rapids City Hall, is seen on the left with its bridges under water. Floodwaters have inundated about 100 city blocks of Cedar Rapids, Iowa's second-largest city with 120,758 residents (2000 US Census)
(Ron Mayland/Reuters)



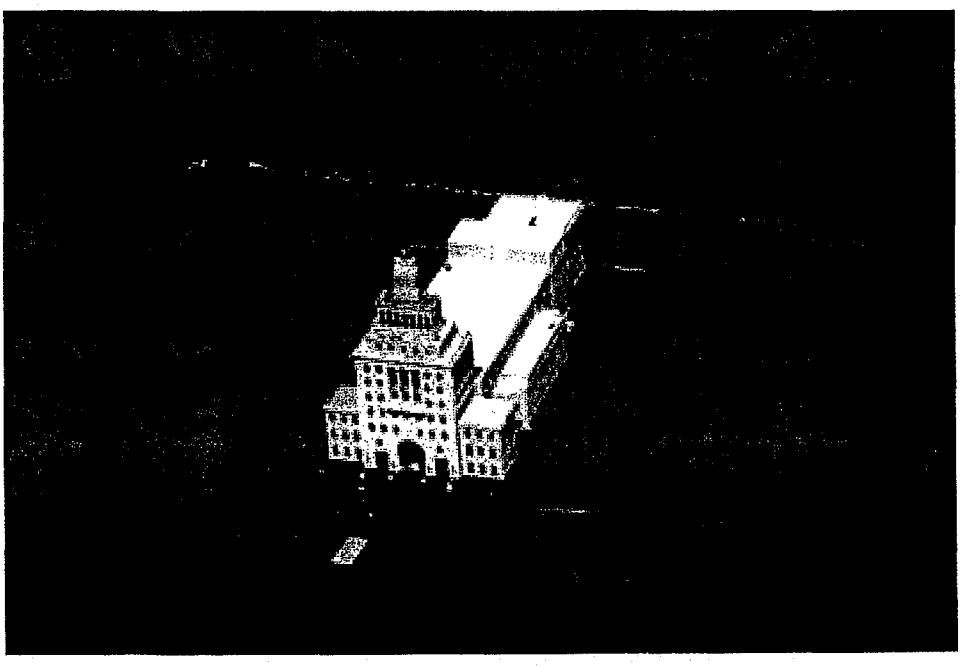
Abandoned cars sit in floodwaters in the parking lot of the Quaker Oats plant in downtown.
(Frank Polich/Reuters)



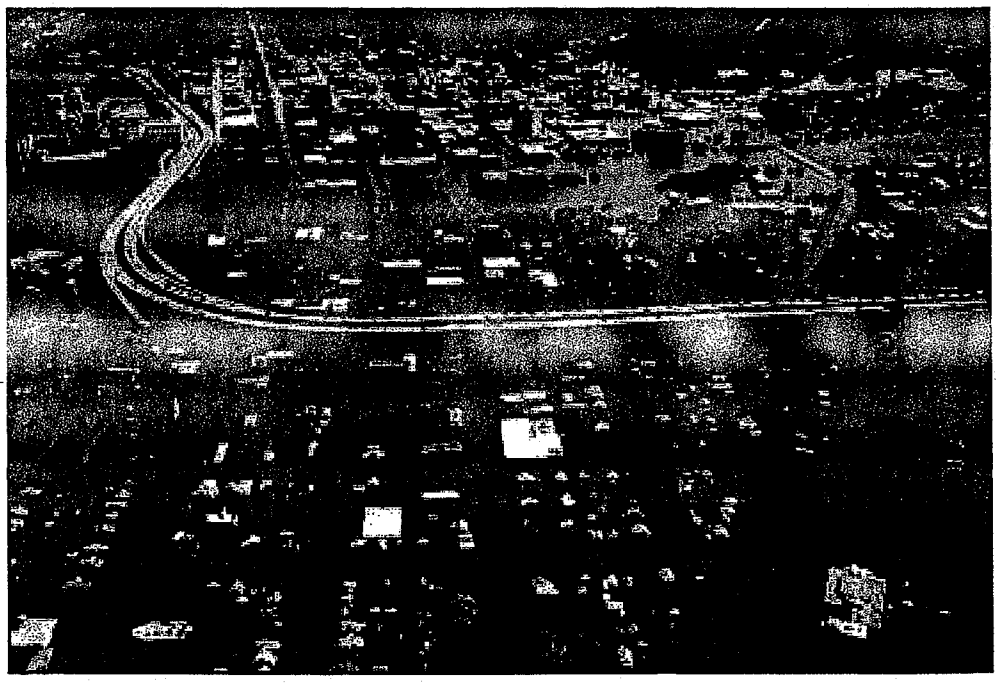
An aerial photo shows Mercy Hospital as it takes on water. The hospital eventually flooded and evacuated its patients after a levee break on the Cedar River turned the downtown area into a shallow lake.
(REUTERS/Ron Mayland)



An aerial photograph shows the Cargill corn plant on the banks of the Cedar River inundated with flood waters south of downtown. Overflowing rivers in Iowa forced evacuations and disrupted the region's economy on Friday with fears of worse to come from fragile levees and more rain. Thousands were forced to leave their homes in the worst Midwest flooding in 15 years. (REUTERS/Ron Mayland)



This aerial view shows Mays Island, the location of the City of Cedar Rapids City Hall, with nearby bridges completely underwater. The Veterans Memorial building was damaged, including an underground parking garage, Linn County Courthouse, and Linn County Jail. (REUTERS/Ron Mayland).



An aerial photograph shows flooded area of downtown looking north over the city. Interstate I-380 can be seen in the center. Floodwaters inundated about 100 city blocks of Cedar Rapids, Iowa's second-largest city with 200,000 residents.
(REUTERS/Ron Mayland)



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS WEST SIDE	DTCR-W RIVER EDGE ALIGNMENT B	2A-2D	88.06 AC

DTCR-W RIVER EDGE ALIGNMENT B

1000 0 1000 2000
SCALE IN FEET

US Army Corps of Engineers
Rock Island District

Symbol	Description	Date	Approved

Revisions

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND ILLINOIS

Designed By: | Date:
Drawn By: | Scale:
Checked By: | Project Code:
Reviewed By: | Edition Number:

CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

DTCR-W RIVERS EDGE
ALIGNMENT B
REACH 2A-2D

Sheet Reference Number
PLATE 3
Sheet of XX

35% REVIEW



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS WEST SIDE	DTCR-W CORRIDOR REDEVELOPMENT ALIGNMENT A	2A-2D	188.29 AC

DTCR-W CORRIDOR REDEVELOPMENT ALIGNMENT A

1000 0 1000 2000
SCALE IN FEET

US Army Corps of Engineers
Rock Island District

Revisions

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed By
Drawn By
Checked By
Reviewed By
Date
Scale
Project Code
Selection Number

CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

DTCR-W COORIDOR REDEVELOPMENT ALIGNMENT A

Sheet Reference Number:
PLATE 4
Sheet of XX

35% REVIEW



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS WEST SIDE	DTCR-W CORRIDOR REDEVELOPMENT ALIGNMENT B	2A-2D	172.34 AC

DTCR-W CORRIDOR REDEVELOPMENT ALIGNMENT B

1000 0 1000 2000
SCALE IN FEET

US Army Corps of Engineers®
Rock Island District

DEPARTMENT OF THE ARMY
CEDAR RAPIDS, IOWA
GENERAL INVESTIGATION
FEASIBILITY STUDY

DTCR-W CORRIDOR REDEVELOPMENT ALIGNMENT B

Sheet Reference Number
PLATE 50

35% REVIEW


CEDAR RIVER



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS EAST SIDE	DTCR-E RIVERS EDGE ALIGNMENT B	4	48.69 AC

US Army Corps of Engineers ®
Rock Island District

Revisions

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND ILLINOIS

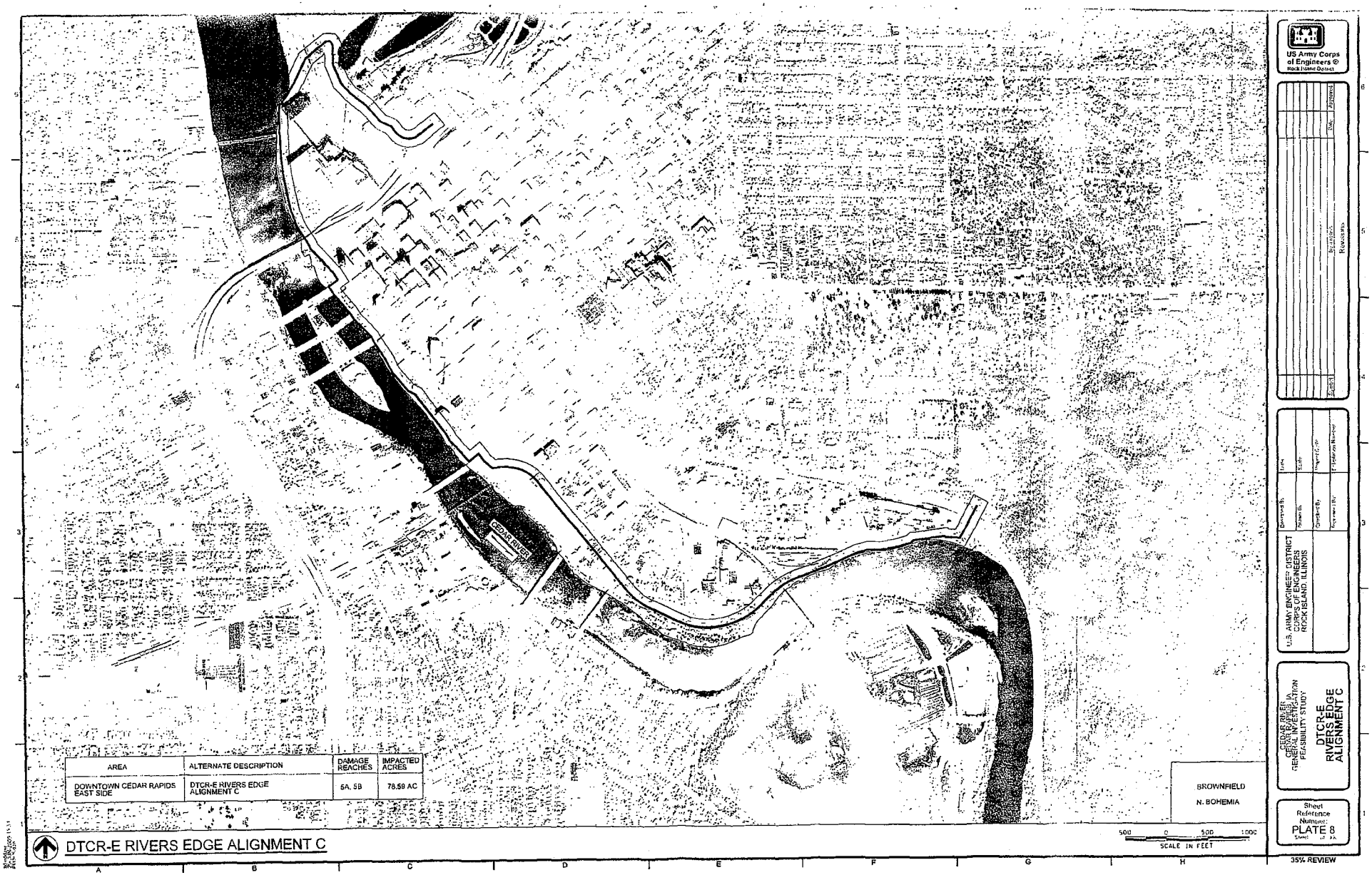
CEDAR RIVER
CEDAR RAPIDS, IOWA
GENERAL INVESTIGATION
FEASIBILITY STUDY

DTCR-E
RIVERS EDGE
ALIGNMENT B

Sheet Reference Number:
PLATE 7
Sheet of XX

35% REVIEW

L-24



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS EAST SIDE	DTCR-E RIVERS EDGE ALIGNMENT C	5A, 5B	78.59 AC

DTCR-E RIVERS EDGE ALIGNMENT C

US Army Corps of Engineers ® Rock Island District

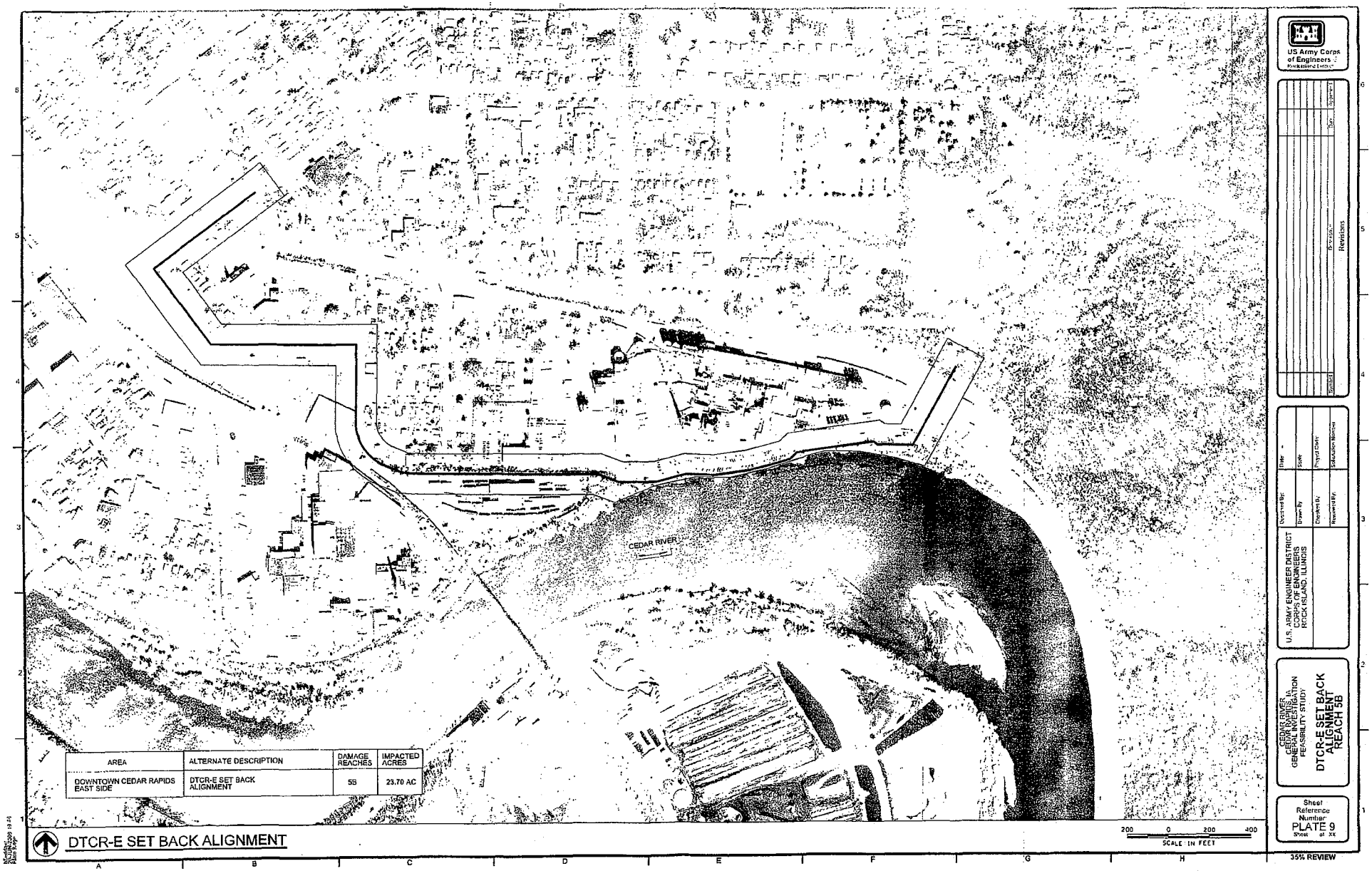
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS

CEDAR RIVER DOWNTOWN FLOOD RISK REDUCTION FEASIBILITY STUDY

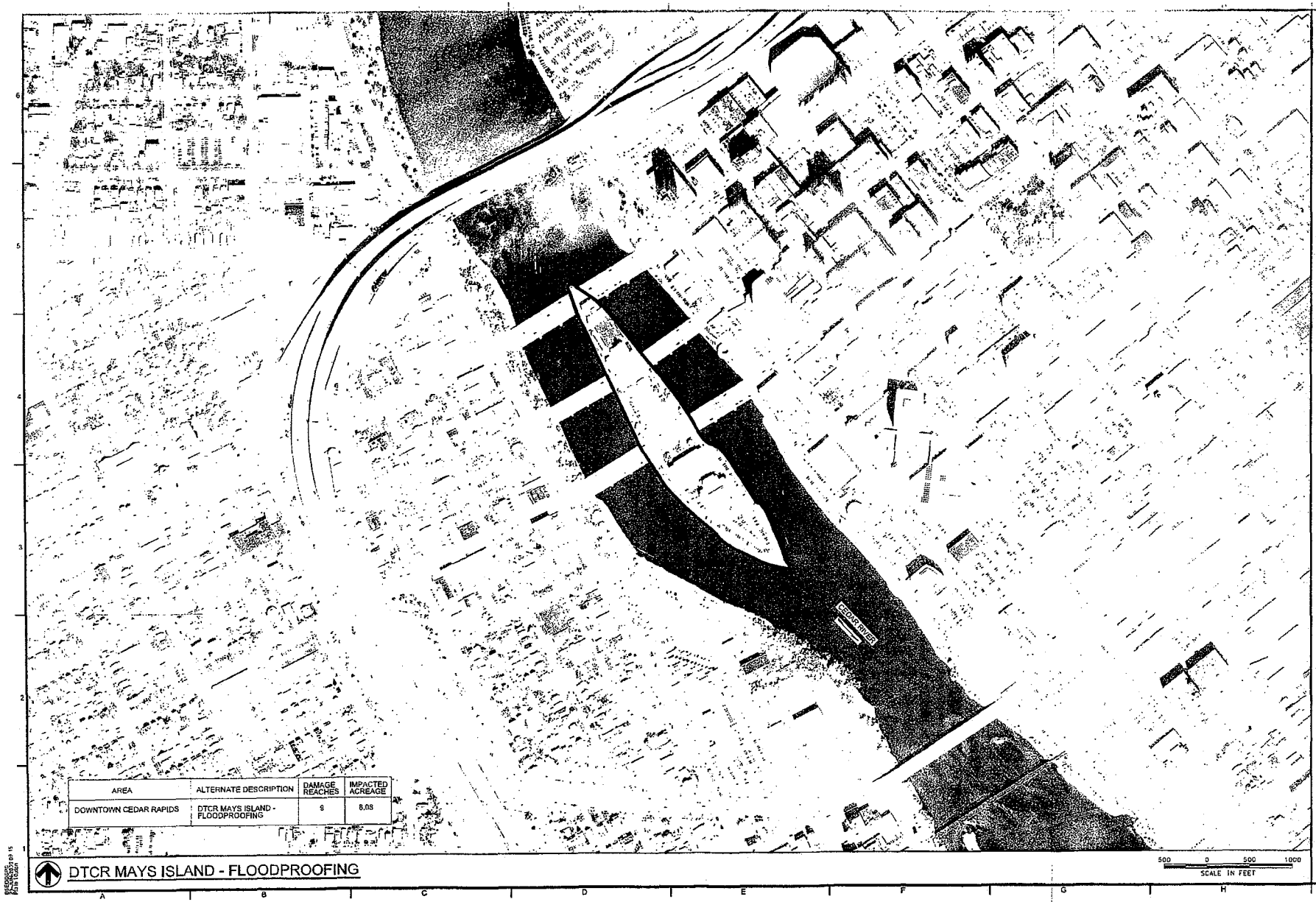
DTCR-E RIVERS EDGE ALIGNMENT C

Sheet Reference Number: PLATE 8

35% REVIEW



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACRES
DOWNTOWN CEDAR RAPIDS EAST SIDE	DTCR-E SET BACK ALIGNMENT	5B	23.70 AC



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACREAGE
DOWNTOWN CEDAR RAPIDS	DTCR MAYS ISLAND - FLOODPROOFING	9	8.08

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

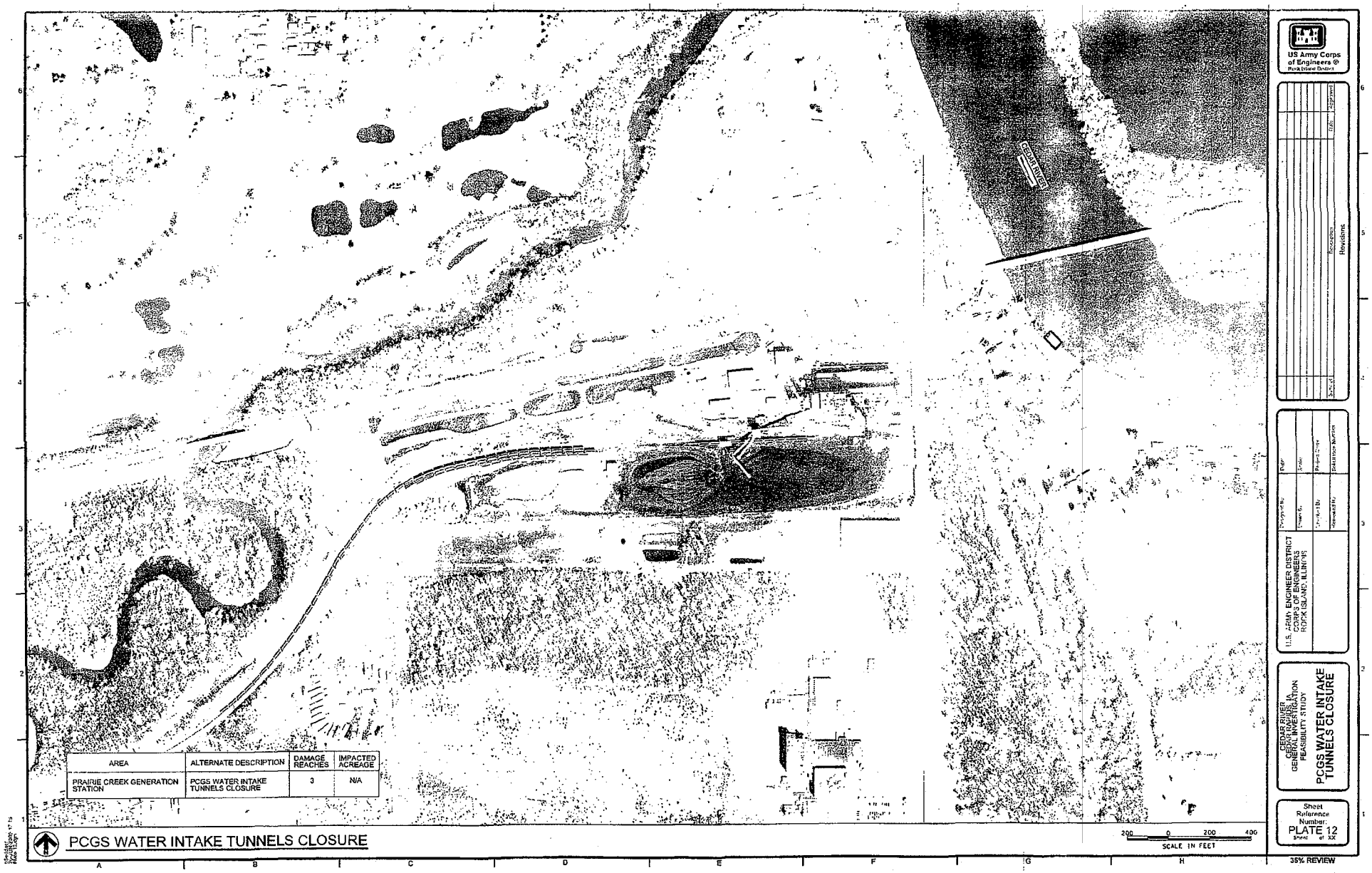
CEDAR RIVER
CEDAR RAPIDS, IA
GREENBELT PROTECTION
RE-ASSESSMENT STUDY

DTCR MAYS ISLAND - FLOODPROOFING

Sheet Reference Number:
PLATE 10
Sheet of XX

35% REVIEW

CEDAR RIVER



AREA	ALTERNATE DESCRIPTION	DAMAGE REACHES	IMPACTED ACREAGE
PRAIRIE CREEK GENERATION STATION	PCGS WATER INTAKE TUNNELS CLOSURE	3	N/A

PCGS WATER INTAKE TUNNELS CLOSURE

US Army Corps of Engineers
Rock Island District

Revisions

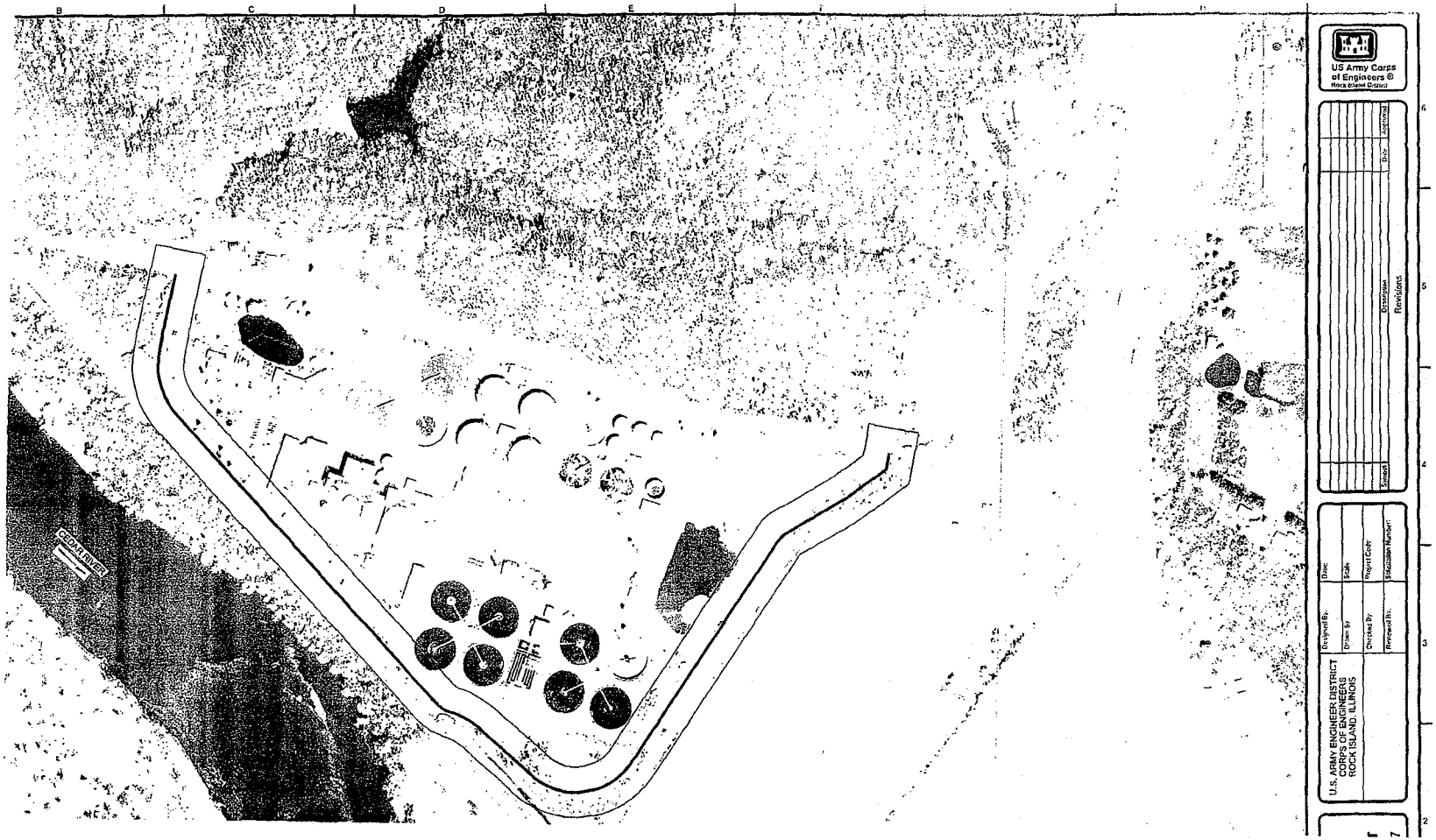
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

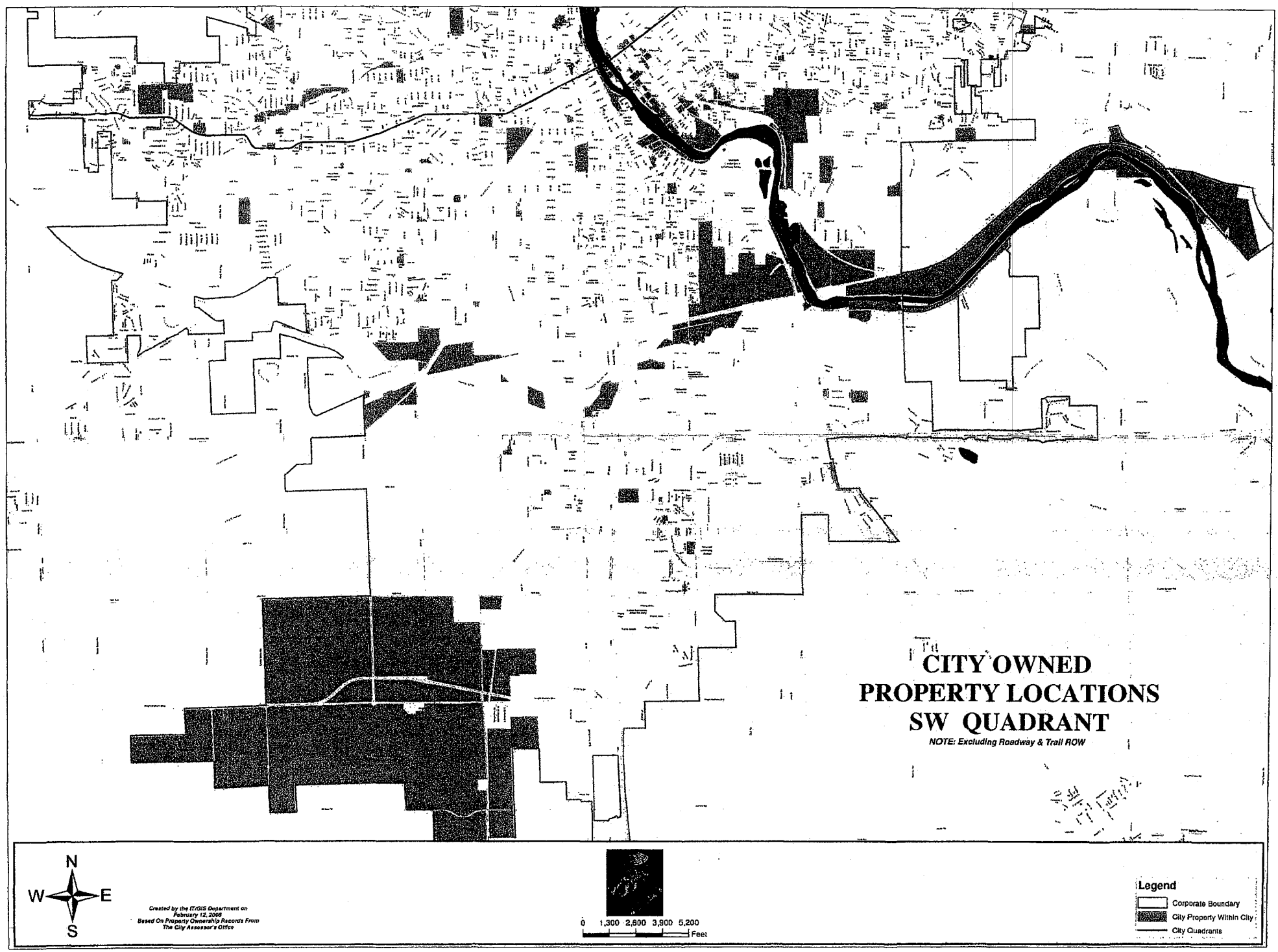
PCGS WATER INTAKE TUNNELS CLOSURE

Sheet Reference Number:
PLATE 12
Sheet of XX

35% REVIEW


US Army Corps of Engineers
Rock Island District
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed By:
Drawn By:
Checked By:
Reviewed By:
Date:
Scale:
Project Code:
Stabilization Number:
Symbol
Description
Date
Approved
Revisions
CEDAR RIVER

Enclosure 4: City Owned Properties SW Quadrant.


CITY OWNED
PROPERTY LOCATIONS
SW QUADRANT
NOTE: Excluding Roadway & Trail ROW
N
W
E
S
Created by the IT/GIS Department on
February 12, 2008
Based On Property Owner(s) Records From
The City Assessor's Office
0 1,300 2,600 3,900 5,200
Feet
Legend
Corporate Boundary
City Property Within City
City Quadrants

Enclosure 5: Draft *Programmatic Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, Cedar Rapids Historic Preservation Commission, and Advisory Council on Historic Preservation for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study – Linn County, Cedar Rapids, Iowa*

PROGRAMMATIC AGREEMENT AMONG THE UNITED STATES ARMY CORPS OF ENGINEERS ROCK ISLAND DISTRICT, IOWA STATE HISTORIC PRESERVATION OFFICER, CITY OF CEDAR RAPIDS, CEDAR RAPIDS HISTORIC PRESERVATION COMMISSION, AND ADVISORY COUNCIL ON HISTORIC PRESERVATION FOR THE CEDAR RIVER, CEDAR RAPIDS, IOWA FLOOD RISK MANAGEMENT FEASIBILITY STUDY, LINN COUNTY, CEDAR RAPIDS, IOWA

WHEREAS, the United States Army Corps of Engineers Rock Island District (Corps) and the City of Cedar Rapids, Iowa (City) is undertaking the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study (FRMFS), Linn County, Cedar Rapids, Iowa that flood protection management measures are proposed, as promulgated General Investigations of the City, of House Resolution Docket 2749 adopted April 5, 2006, and Committee on Environment and Public Works U.S. Senate dated May 23, 2006; and

WHEREAS, the Corps has determined that implementation of the FRMFS flood protection management measures will result in undertakings that may affect properties listed or eligible for listing on the National Register of Historic Places (NRHP), and has consulted with the Advisory Council on Historic Preservation (Council), the Iowa State Historic Preservation Officer, Native American Indian Tribes (Tribes), Tribal Historic Preservation Officers (THPOs), and Interested Parties (Parties) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f), [and Section 110(f) of the same Act (16 U.S.C. 470h-2(f)]; and,

WHEREAS, historic properties acquired or affected by the City's Voluntary Acquisition Program using Federal Emergency Management Association (FEMA) funds have been covered under a draft (unsigned) Programmatic Agreement (PA) (*Programmatic Agreement Among the Federal Emergency Management Agency of the Department of Homeland Security, the State Historic Preservation Office of Iowa, and the Iowa Homeland Security and Emergency Management Division, and the Advisory Council on Historic Preservation*); which was negotiated to comply with FEMA and City's Section 106 responsibilities; and

WHEREAS, historic properties acquired or affected by the City's' Voluntary Acquisition Program using Community Development Block Grants funds from the Housing and Urban Development (HUD) are covered under a PA dated January 2009 (*Programmatic Agreement Between the U.S. Department of Housing and Urban Development, the City of Cedar Rapids, the Advisory Council on Historic Preservation, and the Iowa Historic Preservation Officer of Iowa*), complies with the HUD's and the City's Section 106 responsibilities; and

WHEREAS, the Corps has determined that the FRMFS flood protection management measures of any one of, or a combination of all alternative plan(s) have not been fully finalized and may change or be modified since economical, operational, engineering, and environmental studies are ongoing, the Corps will determine effects promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties," as stipulated:

A. that, the Corps has provided scholarly evidence of stewardship in the recordation, protection, and management of historic properties within the City through systemic research and studies which have been finalized and approved, then placed in the Corps and permanent files of the State Historic Preservation Officer (SHPO) as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties." This study is titled: Background Historic Research and Geomorphological Investigation along the City Riverfront,

B. that, the Corps will consider the FMRFS Area of Potential Effect (APE) as including the construction zones of footprints of the proposed levees, floodwalls, and/or any other flood protection measures, plus road raises, tieback levees, drainage diversions, reservoirs, municipality modifications, borrow areas and any other project related features proposed and identified in the FMRFS,

C. that, other undertakings or actions associated with the implementation of the flood protection management measures, including any ancillary mitigation actions, will be coordinated with any determination of effects within FMRFS and any other reports promulgated under the National Environmental Policy Act of 1969 (42 U.S.C. 470a, et seq.).

D. that, areas with the potential for containing submerged historic properties will be taken into consideration and coordinated with the SHPO, and

E. that, if the City selects flood protection measures or betterments to the Corp proposed flood protection measures (National Economic Development Plan), and if those alternatives or betterments become part of the project and therefore, are included under this PA; and

WHEREAS, because the City is a Certified Local Government pursuant to 36 CFR Part 61, the Cedar Rapids Historic Preservation Commission participated in the consultation and has been invited to participate in this PA as a Concurring Party, and

NOW, THEREFORE, the Corps, the City, the SHPO and the Council agree that the undertakings shall be implemented in accordance with the following stipulations to satisfy the Corps' Section 106 responsibilities for all individual actions.

I. HISTORIC PROPERTY SURVEYS AND TESTING

A. The Corps will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for inclusion in the NRHP, burials, cemeteries, or sites likely to contain human skeletal remains/ artifacts and objects associated with interments or religious activities, and provide this information, studies, and/or reports to the SHPO through the implementation of historic property surveys and testing, and the treatments of historic properties. The Corps will ensure that the following measures are implemented:

1. Unless recent and modern ground surface disturbances and/or historic use can be documented, the Corps will conduct a historic property visual (reconnaissance) survey with subsurface testing on all areas indirectly and directly affected by construction, use, maintenance, and operation of all flood protection measures during the implementation of the FRMFS preferred alternative along with the project related activities and projects. The Corps will evaluate historic properties identified through the reconnaissance survey in accordance with 36 CFR Part 800.4(c) and reports of the findings shall be submitted to the appropriate SHPO(s) for review and comment. If the reconnaissance survey results in the identification of historic properties that are eligible for the NRHP, the Corps, in consultation with the SHPO, Tribe(s), THPO(s), and/or Parties, shall develop and implement plans for the appropriate

treatment of historic properties. Treatment will include, but not be limited to, avoidance of the historic property, avoidance of a portion of the historic property, data recovery of the portion of the historic property to be affected, or data recovery of the entire historic property.

2. The reconnaissance surveys and subsurface testing will be conducted in a manner consistent with the Secretary of the Interior's Standards and Guidelines for Identification and Evaluation (48 FR 44720-23) and take into account the National Park Service publication The Archaeological Survey: Methods and Uses (1978) and any extant or most recent version of appropriate SHPO(s) guidelines for historic properties reconnaissance surveys/reports, related guidance, and etc. The reconnaissance surveys and subsurface testing will be implemented by the Corps and monitored by the SHPO.

3. In consultation with the SHPO, the Corps shall evaluate for eligibility all significant historic properties by applying the National Register criteria (36 CFR Part 60.4).

a. For those properties that the Corps and the SHPO agree are not eligible for nomination to or inclusion in the National Register, no further historic properties investigations will be required, and the project may proceed in those areas.

b. If the survey results in the identification of properties that the Corps and the SHPO agree are eligible for inclusion on the National Register, such properties shall be treated in accordance with Stipulation II, TREATMENT OF HISTORIC PROPERTIES.

c. If the Corps and the SHPO do not agree on National Register eligibility, or if the Council or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the National Register, National Park Service, whose determination shall be final.

II. TREATMENT OF HISTORIC PROPERTIES

The Corps will adhere to the following guidelines when dealing with historic properties in the Project's area of potential effect.

A. Avoidance. The preferred treatment for all archeological, historical, and architectural historic properties is avoidance of effects by the Project. The Corps shall, to the extent feasible, avoid historic properties either through Project design changes, use of temporary fences or barricades during construction, realignments, landscaping, or other measures that will protect historic properties.

B. Reduction of Effects on Properties Preserved In Place. When the Corps determines that complete avoidance of historic properties is not feasible, the Corps shall explore ways to reduce the extent of the adverse effects on the properties. Exploration of ways to reduce adverse effects will include the consideration of preservation in place of historic properties through partial avoidance of the property or the protection of historic properties against impacts by Project-related activities in close proximity to the property.

C. Alteration/Floodproofing. The Corps shall ensure that alterations to historic buildings or structures required for floodproofing adhere to the recommended approaches in the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Properties*. The floodproofing shall also meet the applicable City ordinances and regulations. The Corps shall coordinate proposed floodproofing plans with the appropriate SHPO, City, and Parties and take their comments and recommendations into consideration when deciding on the treatment plan.

D. When the Corps, in consultation with the appropriate SHPO, determines that Project activities will have an adverse effect on buildings, structures, sites, districts, or objects, and that avoidance or in-place preservation is not feasible, the Corps shall ensure that a mitigation plan is developed for these properties in accordance with Stipulation IV, *Mitigation f Adverse Effects to Historic Properties.*

E. The Corps shall ensure that qualified professionals meeting the *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44738-39) are used to develop and implement all treatment plans.

F. Unless the SHPO objects within 30 days of receipt of any plan, the Corps shall ensure that the treatment plans are implemented by the Corps or its representative(s). The Corps shall revise treatment plans to address comments and recommendations provided by the SHPO so long as the Corps and SHPO can agree that they are technically feasible and economically prudent. Should the Corps and SHPO not agree, the Corps will request the Council's comments in accordance with Stipulation IX, *Dispute Resolution.*

G. Buildings and Structures. When avoidance or in-place preservation is not feasible, treatment plans for National Register listed or eligible buildings and structures shall adhere to the following guidelines:

1. Acquisition

a. The buildings located within the proposed levee and floodwall construction corridors shall be acquired by the City as part of their obligations under this flood protection project's Project Cooperation Agreement.

b. Once an historic building or structure has been acquired by the City and prior to any further actions on the building, the Corps will document the building or structure in accordance with Stipulation IV, *Mitigation of Adverse Effects to Historic Properties*, Section C.1.

2. Relocation.

The Corps shall determine, in consultation with the SHPO, the City, Cedar Rapids Historic Preservation Commission, and Parties, whether it is feasible and prudent to move the historic building or structure to a new location where it can be preserved.

3. Property Transfer/Marketing

a. During negotiations, property owners will have the opportunity to reserve historic buildings and structures for offsite removal. Compensation will be adjusted accordingly to reflect salvage value of any reserved improvements. Purchase agreements and conveyance documents will specify which improvements are reserved to the owner and the timeframe during which they must be removed. If not removed within the time specified, the improvements will become property of the City.

b. Historic buildings and structures which are acquired by the City as part of the Project will be offered for sale in conformance with City code. Prior to advertising historic properties for offsite removal, the Corps and City agree to consult with the SHPO and develop a strategy for advertising these properties to include, at a minimum, a distribution plan and advertising schedule.

DRAFT

c. If no offer is received for a historic building or structure, that improvement will become a construction clearing item and will be dealt with in accordance with Stipulation III, CURATED ITEMS, Section G.4.

4. Demolition.

If relocation is not feasible or if there are no offers for the historic building or structure, the Corps shall document the building or structure in accordance with Stipulation IV, *Mitigation of Adverse Effects to Historic Properties*, Section C.1 after notifying the appropriate SHPO.

5. New Construction.

The Corps shall ensure that the design and specifications for new construction at an historic property or district are developed in consultation with the SHPO and are submitted to the SHPO for review and comment. The Corps shall ensure that the Project design for new construction is technically feasible and economically prudent; is compatible with the historic and architectural qualities of the historic property or district in question in terms of scale, massing, color, and materials; and is responsive to the recommended approaches to new construction set forth in the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* (National Park Service 1983).

H. Archeological Sites. When avoidance or preservation in place of archeological properties is not feasible, a data recovery plan shall be prepared by the Corps in consultation with the appropriate SHPO and concerned tribes. Mitigation plans for archeological sites eligible to the National Register under criteria other than or in addition to criterion D shall be developed in accordance with Stipulation IV, *Mitigation of Adverse Effects to Historic Properties*, Section C.3. Data recovery plans for archeological sites that are eligible to the National Register solely under criterion D shall be developed using the following guidelines.

1. Archeological Data Recovery.

The Corps shall ensure that any historic property whose preservation in place is not feasible and that is eligible to the National Register solely under criterion D, is subjected to data recovery, based on a data recovery plan developed in consultation with the respective SHPO, concerned tribes, and Parties. All data recovery plans shall be consistent with the *Secretary of the Interior's Standards and Guidelines for Archeological Documentation* (48 FR 44734-37) and take into account the Council's publication: *Treatment of Archeological Properties*. Each data recovery plan shall specify, at a minimum:

a. The property, properties, or portions of properties where data recovery is to be carried out;

b. The research questions to be addressed through the data recovery, with an explanation of their relevance and importance;

c. The methods to be used, with an explanation of their relevance to the research questions;

d. The methods to be used in analysis, data management, and dissemination of data, including a schedule;

e. The proposed disposition of recovered materials and records;

f. Proposed methods for involving the interested public in the data recovery; and

g. A proposed schedule for the submission of progress reports to the Iowa SHPO, the Council, and where applicable, concerned tribes and Parties.

2. The Corps shall ensure that each data recovery plan is submitted to the respective SHPO, the Council, and any tribes and Parties whose interests pertain to the property involved for 30 days review and comment.

I. Burial Sites. If human remains and/or associated grave goods are encountered in the Project area during either the historic properties identification, evaluation or mitigation activities or during Project construction, the Corps shall follow the appropriate State burial laws Iowa State Code Chapter 523I.316 (6) regarding the discovery of human remains. If human remains are discovered during the course of project implementation, the Corps or City will notify the County Coroner and the SHPO immediately and the Office of the State Archeologist if the human remains are suspected to be more than 150 years in age in accordance with Code of Iowa Chapters 263B and 716.5; and will require the sub-grantee to stop project activities in the vicinity of the discovery and take all reasonable measures to avoid or minimize harm until the Corps concludes consultation with the signatories of this PA. Procedures outlined in Stipulation VII, *Provision for Post-Review Discoveries*, Section B, will follow thereafter if human remains are determined to be under the purview of the Office of the State Archaeologist.

J. Traditional Cultural Properties.

1. If a Traditional Cultural Property (TCP) is identified within the Project's APE, the Corps shall develop a treatment plan for the TCP in consultation with the tribe or ethnic group that could be affected by Corps proposed Project activity at the specific historic site or property involved. The plan will cover analysis of treatment options and selection of a recommended treatment for the TCP and the measures which will be undertaken by the Corps to ensure that the plan is implemented.

2. Access to TCPs within the proposed levee and floodwall construction zone (levee or floodwall footprint plus 20 feet either side) will not be allowed during construction for safety reasons. TCPs located within the Project's APE but outside of the project construction zone will be accessible during construction.

3. The Corps shall submit the final plan to the SHPO and to the affected tribe or ethnic group and shall implement the plan in accordance with the procedures outlined in the plan, if formal objections are not received within 30 days following its distribution.

4. Should a formal objection to the final plan be submitted within 30 days following its distribution, the Corps, the SHPO, and the affected tribe or ethnic group shall attempt to resolve the objection. If the Corps, the SHPO, and the affected tribe or ethnic group have not resolved the objection within 90 days, the Corps shall request the comments of the Council in accordance with Stipulation IX, *Dispute Resolution.*

III. CURATED ITEMS

In consultation with the appropriate SHPO(s), the Corps will ensure that all materials and records resulting from the compliance with this PA and Section 106, shall be curated in Iowa in accordance with 36 CFR Part 79, unless recovered from non-federally owned or privately owned lands. Materials recovered from non-federally owned or privately owned

lands or properties shall be maintained in accordance with 36 CFR Part 79 until analysis is complete and, if necessary, are returned to their owner(s).

IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES

A. The Corps shall provide the appropriate SHPO with a report summarizing the alternatives considered to avoid adverse effects to historic properties. In the report, the Corps will propose measures that will avoid, minimize, or mitigate adverse effects to those properties. The SHPO may request that the District consider other alternatives to avoid, minimize or mitigate adverse effects.

B. After the Corps and SHPO agree on a proposed alternative to mitigate adverse effects, the Corps, in consultation with the SHPO, will develop a Standard Mitigation Agreement to be used to mitigate the adverse effects to specific historic properties or property types resulting from Project implementation. Once the Corps and SHPO have finalized the Standard Mitigation Agreement, a copy will be filed with the Council. The Corps is responsible for implementing all provisions set forth in each signed Standard Mitigation Agreement.

C. Standard mitigation measures to be considered include, but are not limited to, the following:

1. Documentation

a. The Corps shall consult with the SHPO regarding the appropriate level of documentation prior to the substantial alteration, relocation, or demolition of any historic building or structure. Documentation shall be consistent with the *Secretary of the Interior's Standards for Architectural and Engineering Documentation* and the *Secretary of the Interior's Standards for Historical Documentation.*

b. Unless otherwise agreed to by the SHPO, the Corps shall ensure that all documentation is completed and accepted by the SHPO prior to the demolition, alteration, or relocation of the historic building or structure.

c. The Corps will provide copies of the documentation to the SHPO and other local, county, or state organizations which they designate.

2. Transfer or Conveyance without Preservation Covenants

In instances where the historic properties will not be conveyed or transferred with preservation covenants, the Corps shall record these properties to Historic American Building Survey standards or to a level agreed upon with the SHPO. The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the NRHP, sources of funding for historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation or substantial alteration of historic properties, the Corps and the City, in consultation with the SHPO, shall develop a plan to transfer and convey the historic property without covenants. The Corps shall submit the plans to the SHPO for review and comment.

3. Data Recovery for Archeological Sites Eligible Other Than Criterion D

If preservation in place is not feasible, the Corps shall consult with the appropriate SHPO, tribes, and Parties to develop a mitigation plan for any archeological site that is eligible to the

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National Register under criteria other than or in addition to criterion D. The Corps shall submit the plan to the SHPO for review and comment.

4. Salvage and Donation of Significant Architectural Elements

Prior to demolition, partial demolition, or substantial alteration of historic buildings or structures, the Corps and the City, in consultation with the SHPO, shall develop a salvage and donation plan to identify appropriate Parties willing and capable of receiving and preserving the salvaged significant architectural elements. Any salvage and donation plan agreed upon shall be in accordance with the applicable City Code(s). The Corps shall submit the plans to the SHPO and City for review and comment. The City agrees to comply with the conditions of the salvage and donation plan as part of the demolition, partial demolition, or alteration process.

5. Off-Site Mitigation for the Loss of a Historic Property

The Corps may preserve similar property types or sites outside the Project's APE as mitigation for properties that cannot be preserved in place due to flood protection requirements of the Project. The Corps and the SHPO will consult to determine if off-site preservation is suitable mitigation and to develop appropriate easements, covenants and other legal instruments for the protection of such off-site properties, if off-site preservation is undertaken. Prior to the demolition of historic properties within the Project area, the Corps, in consultation with the SHPO and Parties, shall consider the appropriateness of developing an off-site mitigation plan to compensate for the loss of historic properties. The Corps shall submit the plans to the SHPO for review and comment.

6. Alteration and Floodproofing Activities Not Adhering to the Standards

The Corps shall consult with the SHPO to develop alternate treatment or mitigation plans for those features which cannot meet the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Properties*. The Corps shall submit the plans to the SHPO for review and comment.

V. TREATMENT OF HUMAN REMAINS AND ITEMS OF RELIGIOUS AND CULTURAL SIGNIFICANCE

A. If human remains are encountered either during the data recovery or during any project construction activities, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made under consultation with the SHPO. If finds of human remains are encountered or collected from Federal lands or Federally-Recognized Tribal lands, the Corps will coordinate with the appropriate Federally-recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*), under consultation with the appropriate SHPO.

B. If items of religious and cultural importance to tribes are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made under consultation with the SHPO, Tribe(s), THPO(s), and/or other Parties. When finds of religious or cultural importance to tribes are encountered or collected from Federal lands or Federally-Recognized Tribal lands, the Corps will coordinate with the appropriate Federally-recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*), under consultation with the SHPO.

VI. REPORTS

The Corps will ensure that all final historic properties reports resulting from the actions pursuant to this PA will be provided in a format acceptable to the SHPO. The Corps will ensure that all such reports are responsive to contemporary standards utilizing any state guidance, recommendations, forms, and format, and to the Department of the Interior's Format Standards for Final Reports of Data Recovery (42 FR 5377-79). Precise locational data may be provided only in a separate appendix if it appears that the release of this locational data could jeopardize historic properties. Precise locational data of traditional cultural properties or sacred sites, consisting of architectural, landscapes, objects, or surface or archeology sites, identified in coordination with Tribes, THPO(s), and/or Parties, may be determined sensitive information and not be made available for public disclosure. The reports and associated data, minus precise aforementioned locational data and sensitive information, will be made available for publication and public dissemination.

VII. PROVISION FOR POST-REVIEW DISCOVERIES

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps will cease, or cause to stop, any activity having an effect and consult with the SHPO to determine if additional investigation is required. If further investigations are warranted or required, any treatment plan will be performed in accordance with Stipulation II, *Treatment of Historic Properties;* Stipulation III, *Curated Item:* Stipulation V, *Treatment of Human Remains and Items of Religious And Cultural Significance*, Stipulation VI, *Report,* and Stipulation VII, *Provision for Post-Review Discoveries.* If both the Corps and the SHPO, under consultation with the appropriate with Tribe(s), THPO(s), and/or Parties, determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps and the appropriate SHPO(s) concerning the need for further investigations will be handled pursuant to Stipulation IX, *Dispute Resolution.*

VIII. EMERGENCY ACTIVITIES

A. The Corps shall consider an emergency to exist when a structure, building, or site poses an imminent threat to life, safety, or property. Such situations should require an immediate response (30 days or less) based upon the findings of an engineer, architect, emergency response professional, or project manager, representing the Corps or the City.

B. The Corps shall immediately notify the SHPO of any emergency action and request a written response within 7 days, unless the nature of the emergency does not allow for such a delay. The Corps shall submit relevant background information, including photographs, engineering or structural reports, local citations, etc. If the nature of the emergency does not permit action to be delayed, the Corps shall undertake the action and subsequently provide the SHPO with documentation. If the SHPO fails to respond within 7 days, the Corps may assume concurrence with its proposed response and proceed. If the Corps and the SHPO disagree over the Corps' proposed response, the Corps will request that the Council provide its recommendation regarding treatment within seven days of notification.

IX. DISPUTE RESOLUTION

Should the SHPO or the Council object within 30 days to any plans or actions provided for review pursuant to this agreement, the Corps will consult with the objecting party for resolution. If the Corps determines that the disagreement cannot be resolved, the Corps will request further comment from the Council in accordance with the applicable provisions of 36

CFR Part 800.7. The Corps in accordance with 36 CFR Part 800.7(c) (4) will take any Council comment provided in response into account, with reference only to the subject of the dispute. The signatories to the PA will continue to comply with the uncontested provisions until dispute resolution or termination.

X. TERMINATION

Any of the signatories to this PA may request a reconsideration of its terms or revoke the agreement upon written notification to the other signatories, by providing 30 days notice to the other Parties, provided that the Parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR Parts 800.3 through 800.7 with regard to individual undertakings covered by this PA.

XI. AMENDMENTS

Any party to this PA may request that it be amended, whereupon the Parties will consult in accordance with 36 CFR Section 800.13, to consider such amendment.

XII. PERIODIC REVIEW

The Corps will provide the SHPO with evidence of compliance with this PA by letter on January 30, 2010, and once every 5 years thereafter said date. This letter shall contain the name of the Project, title of the documents which contained the PA, historic properties identified, determinations of effect, avoidance procedures, and level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed.

XIII. EXECUTION AND IMPLEMENTATION

A. Nothing in this PA is intended to prevent the Corps from consulting more frequently with the SHPO or the Council concerning any questions that may arise or on the progress of any actions falling under or executed by this PA. Any resulting modifications to this PA will be coordinated in accordance with 36 CFR Section 800.6(c) (7).

B. The undersigned concur that the Corps has satisfied its Section 106 responsibilities for all individual undertakings through this PA regarding the implementation of the alternative plans for reducing delays to commercial navigation implemented as a result of the FRMFS.

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XV. SIGNATORIES TO THIS AGREEMENT

PRINCIPAL SIGNATORIES

A. ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS

BY: _____ Date: _____

Michael F. Clarke
Lieutenant Colonel
District Engineer

B. IOWA STATE HISTORIC PRESERVATION OFFICER

BY: _____ Date: _____

Ms. Patricia Ohlerking
Iowa State Historic Preservation Officer
State Historical Society of Iowa

C. CITY OF CEDAR RAPIDS

BY: _____ Date: _____

Ms. Kay Halloran
Mayor
City of Cedar Rapids and City Council

As attested by:

_____ Date: _____

Mr. Casey Drew
Finance Director

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D. ADVISORY COUNCIL ON HISTORIC PRESERVATION

BY: _____ Date: _____

Mr. John M. Fowler
Executive Director
Advisory Council on Historic Preservation

CONCURRING SIGNATORIES

E. City of Cedar Rapids Historic Preservation Commission

BY: _____ Date: _____

Ms. Maura Pilcher
Chair
Department of Community Development

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Enclosure 6: Cedar Rapids, Cedar Rapids, Iowa – Flood Risk Management Feasibility Study, Cedar Rapids, Black Hawk County, Iowa Interested and Consulting Parties List.

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PROGRAMMATIC AGREEMENT AMONG THE UNITED STATES ARMY CORPS OF ENGINEERS ROCK ISLAND DISTRICT, IOWA STATE HISTORIC PRESERVATION OFFICER, CITY OF CEDAR RAPIDS, AND ADVISORY COUNCIL ON HISTORIC PRESERVATION FOR UNDERTAKINGS IMPLEMENTED UNDER THE CEDAR RIVER, CEDAR RAPIDS, IOWA FLOOD RISK MANAGEMENT FEASIBILITY STUDY, LINN COUNTY, CEDAR RAPIDS, IOWA

WHEREAS, the United States Army Corps of Engineers Rock Island District (hereinafter Corps) and the City of Cedar Rapids, Iowa (hereinafter City) is undertaking the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study (FRMFS), Linn County, Cedar Rapids, Iowa, and that proposes flood protection management measures in accordance with House Resolution Docket 2749 (General Investigations) adopted April 5, 2006, and Committee on Environment and Public Works U.S. Senate dated May 23, 2006; and

WHEREAS, the Corps has determined that implementation of the FRMFS flood protection management measures will result in undertakings that may affect properties listed or eligible for listing on the National Register of Historic Places (hereinafter NRHP), and has consulted with the Advisory Council on Historic Preservation (hereinafter Council), the Iowa State Historic Preservation Officer (hereinafter SHPO), Native American Indian Tribes (hereinafter Tribes), Tribal Historic Preservation Officers (hereinafter THPOs), and Interested Parties (hereinafter Parties) pursuant to 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act [16 U.S.C. 470(f) and Section 110(f) of the same Act (16 U.S.C. 470h-2(f)]; and,

WHEREAS, the FRMFS program is complex in its scope and the Corps, in consultation with the SHPO, proposes a phased approach to identify historic properties and to evaluate the level of the undertaking's effects upon them as allowed by 36 CFR 800.4(b)(2); and

WHEREAS, the Corps has not fully determined the Areas of Potential Effects (hereinafter APE) for all of the undertakings envisioned under the FRMFS program but will consult with the SHPO in a timely manner prior to implementation in order to determine the APE for each of the projects subject to the terms of this agreement; and

WHEREAS, because the City is a Certified Local Government pursuant to 36 CFR § 61, the Cedar Rapids Historic Preservation Commission (hereinafter CRHPC) participated in the consultation and has been invited to participate as a Concurring Party (**XVI. SIGNATORIES TO THIS AGREEMENT**); and

WHEREAS, the Office of the State Archaeologist (hereinafter OSA) participated in the consultation and requested to be included as a concurring signatory in the Programmatic Agreement (PA), the OSA has been invited to participate as a Concurring Party (**XVI. SIGNATORIES TO THIS AGREEMENT**); and

NOW, THEREFORE, the Corps, the SHPO, the City, and the Council agree that the undertakings shall be implemented in accordance with the following stipulations of this *Programmatic Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, City of Cedar Rapids, and Advisory Council on Historic Preservation for Undertakings Implemented Under the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa* (PA) to satisfy the Corps' Section 106 responsibilities for all individual actions (**XVI. SIGNATORIES TO THIS AGREEMENT**).

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STIPULATIONS

I. HISTORIC PROPERTY SURVEYS AND TESTING

The Corps will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for inclusion in the NRHP, burials, cemeteries, or sites likely to contain human skeletal remains/ artifacts and objects associated with interments or religious activities, and provide this information, studies, and/or reports to the OSA and SHPO through the implementation of historic property surveys and testing, and the treatments of historic properties. The Corps will ensure that the following measures are implemented:

A. that, the Corps will provide scholarly evidence of stewardship in the recordation, protection, and management of historic properties within the City through systemic research and studies which have been finalized and approved, then placed in the permanent files of the SHPO as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 CFR § 800: "Protection of Historic Properties." Furthermore, the Corps will make a reasonable and good faith effort to carry out appropriate identification efforts level of effort under § 800.4(b)(1) which will include a study titled: *Background Historic Research and Geomorphological Investigation of Measures Under Study for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study Linn County, Cedar Rapids, Iowa* (Corps Contract Number W912EK-08-D-0002, Delivery Order Number 16),

B. Unless recent and modern ground surface disturbances and/or historic use can be documented, the Corps will conduct necessary surveys on all areas indirectly and directly affected by construction, use, maintenance, and operation of all flood protection measures during the implementation of the FRMFS preferred alternative along with the project related activities and projects. The Corps will evaluate historic properties relative to past surveys and reports and properties deemed ineligible within the last 5 years will not be reevaluated. If a survey results in the identification of properties that are eligible to the NRHP, the Corps, in consultation with the SHPO, Tribe(s), THPO(s), and/or Parties, shall develop and implement plans for the appropriate treatment of historic properties. In order of preference, treatment will include, but not be limited to preservation of all or part of the historic property, avoidance of the historic property, data recovery of the portion of the historic property to be affected, or data recovery of the entire historic property.

C. All surveys will be conducted in a manner consistent with the Secretary of the Interior's *Standards and Guidelines for Identification and Evaluation* (48 FR 44720-23) and take into account the National Park Service publication *The Archaeological Survey: Methods and Uses* (1978) and any extant or most recent version of the *Guidelines for Archaeological Investigations in Iowa* (1999). The reconnaissance surveys and subsurface testing will be implemented by the Corps, reported, and the reports will be provided to the SHPO for review and comment.

D. In consultation with the SHPO, the Corps shall evaluate for eligibility all properties by applying the NRHP criteria (36 CFR § 60.4).

1. For those properties that the Corps and the SHPO agree are not eligible for nomination to or inclusion in the NRHP, no further historic properties investigations will be required, and the project may proceed in those areas.

2. If the survey results in the identification of properties that the Corps and the SHPO agree are eligible for inclusion on the NRHP, such properties shall be treated in accordance with Stipulation **II. TREATMENT OF HISTORIC PROPERTIES**.

3. If the Corps and the SHPO do not agree on NRHP eligibility, or if the Council or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the NRHP, National Park Service, whose determination shall be final.

II. TREATMENT OF HISTORIC PROPERTIES

The Corps will adhere to the following guidelines when dealing with historic properties in the Project's area of potential effect.

A. Avoidance. The preferred treatment for all archeological, historical, and architectural historic properties is avoidance of direct and indirect effects implemented by the Project. The Corps shall, to the extent feasible, avoid historic properties either through Project design changes, use of temporary fences or barricades during construction, realignments, landscaping, or other measures that will protect historic properties.

B. Reduction of Effects on Properties Preserved in Place. When the Corps determines that complete avoidance of historic properties is not feasible, the Corps shall explore ways to reduce the extent of the adverse effects on the properties. Exploration of ways to reduce adverse effects will include the consideration of preservation of historic properties or the protection of historic properties against impacts by Project-related activities in close proximity to the property.

C. Alteration/Floodproofing. The Corps shall ensure that alterations to historic buildings or structures required for floodproofing adhere to the recommended approaches in the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitation*. The floodproofing shall also meet the applicable City ordinances, standards, and regulations. The Corps shall coordinate proposed floodproofing plans with the appropriate SHPO, City, CRHPC, and Parties and take their comments and recommendations into consideration when deciding on the treatment plan.

D. Mitigation Plans. When the Corps, in consultation with the appropriate SHPO, determines that Project activities will have an adverse effect on buildings, structures, sites, districts, or objects, and that avoidance or in-place preservation is not feasible, the Corps shall ensure that a mitigation plan is developed for these properties in accordance with Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES**.

E. Qualified Professions. The Corps shall ensure that qualified professionals meeting the *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44738-39) are used to develop and implement all treatment plans.

F. Treatment Plans. Unless the SHPO objects within 30 days of receipt of any plan, the Corps shall ensure that the treatment plans are implemented by the Corps or its representative(s). The Corps shall revise treatment plans to address comments and recommendations provided by the SHPO so long as the Corps and SHPO can agree that they are technically feasible and economically prudent. Should the Corps and SHPO not agree, the Corps will request the Council's comments in accordance with Stipulation **X. DISPUTE RESOLUTION**.

G. Buildings and Structures. When avoidance or in-place preservation is not feasible, treatment plans for NRHP listed or eligible buildings and structures shall adhere to the following guidelines:

1. Acquisition.

a. The buildings located within the proposed levee and floodwall construction corridors shall be acquired by the City as part of their obligations under this flood protection Project Partnership Agreement.

b. Once an historic building or structure has been acquired by the City and prior to any further actions on the building, the Corps will document the building or structure in accordance with Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES**, Section C.1.

2. Relocation.

a. The Corps shall determine, in consultation with the SHPO, the City, CRHPC, and Parties, whether it is feasible and prudent to move the historic building or structure to a new location where it can be preserved. Adverse effects upon a structure or building contributing to Historic District, will consider effects to the structure or building, as well as to the entire Historic District.

3. Property Transfer/Marketing.

a. During negotiations, property owners will have the opportunity to reserve historic buildings and structures for offsite removal. Purchase agreements and conveyance documents will specify which improvements are reserved to the owner and the timeframe during which they must be removed. If not removed within the time specified, the improvements will become property of the City.

b. The Corps and City agree to consult with the SHPO and CRHPC when significant historic buildings and structures which are acquired by the City as part of the Project and offered for sale in conformance with City code, or demolished, or designated for offsite removal, and.

c. If no offer is received for a historic building or structure, that improvement will become a construction clearing item and will be dealt with in accordance with Stipulation **III. CURATED ITEMS**, Section G.4.

4. Demolition.

If relocation is not feasible or if there are no offers for the historic building or structure and no other prudent and feasible creative alternatives present themselves, the Corps will notify the SHPO and shall document the building or structure in accordance with Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES**, Section C.1.

5. New Construction.

For new construction on or adjacent to a significant historic property or historic district (include those properties deemed eligible to be, or listed on the NRHP), the Corps shall ensure that the design and specifications for new construction are developed in consultation with the SHPO and CRHPC and are submitted to the SHPO for final approval. The Corps shall ensure that the Project design for new construction is technically feasible and economically prudent; is compatible with the historic and architectural qualities of the historic property or district in question in terms of scale, massing, color, and materials; and is responsive to the recommended approaches to new construction set forth in the *Secretary of the Interior's Standards for Rehabilitation* (National Park Service 1983). The Corps has determined that the FRMFS flood

protection management measures of any one of, or a combination of all alternative plan(s) have not been fully finalized and may change or be modified since economical, operational, engineering, and environmental studies are ongoing, the Corps will determine effects promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 CFR § 800: "Protection of Historic Properties." Also the Corps

a. will consider the FMRFS visual and physical effects within the APE, such as all construction area, as including the construction zones of footprints of the proposed levees, floodwalls, and/or any other flood protection measures, plus road raises, tieback levees, drainage diversions, reservoirs, municipality modifications, borrow areas and any other project related features and ancillary features proposed,

b. will consider areas with the potential for containing submerged historic properties will be taken into consideration and coordinated with the SHPO, and

c. will consider areas where the City selects flood protection measures or betterments to the Corps proposed flood protection measures (National Economic Development Plan), and if those alternatives or betterments become part of the project that they will be included under this PA.

H. Archeological Data Recovery. The Corps shall ensure that any historic property whose preservation in place is not feasible and that is eligible to the NRHP is subjected to data recovery, based on a data recovery plan developed in consultation with the Council, SHPO, THPOs, and Parties for 30 days review and comment. All data recovery plans shall be consistent with the *Secretary of the Interior's Standards and Guidelines for Archeological Documentation* (48 FR 44734-37), the *Guidelines for Archaeological Investigations in Iowa* (1999), and take into account the Council's publication: *Treatment of Archeological Properties*. Each data recovery plan shall specify, at a minimum

a. the property, properties, or portions of properties where data recovery is to be carried out;

b. the research questions to be addressed through the data recovery, with an explanation of their relevance and importance;

c. the methods to be used, with an explanation of their relevance to the research questions;

d. the methods to be used in analysis, data management, and dissemination of data, including a schedule;

e. the proposed disposition of recovered materials and records;

f. proposed methods for involving the interested public in the data recovery; and

g. a proposed schedule for the submission of progress reports to the Iowa SHPO, the Council, and where applicable, concerned Tribes and Parties.

I. Traditional Cultural Properties.

1. If a Traditional Cultural Property (TCP) is identified within the Project's APE, the Corps shall develop a treatment plan for the TCP in consultation with the Tribe or Parties that could be affected by Corps proposed Project activity at the specific historic site or property involved. The plan will cover analysis of treatment options and selection of a recommended

treatment for the TCP and the measures which will be undertaken by the Corps to ensure that the plan is implemented.

2. The Corps shall submit the final plan to the SHPO and to the affected Tribe or Parties and shall implement the plan in accordance with the procedures outlined in the plan, if formal objections are not received within 30 days following its distribution.

3. Should a formal objection to the final plan be submitted within 30 days following its distribution, the Corps, the SHPO, and the affected Tribe or Parties shall attempt to resolve the objection. If the Corps, the SHPO, and the affected Tribe or Parties have not resolved the objection within 90 days, the Corps shall request the comments of the Council in accordance with Stipulation X. Dispute Resolution.

III. CURATED ITEMS

Artifacts, samples, and materials (artifacts) recovered from federal lands collected and designated for curation and any associated records, will be curated in Iowa in accordance with 36 CFR Part 79. When artifacts are collected from non-federal lands, the Corps and SHPO shall make the landowners aware of any tax advantages to be gained by donating the artifacts to the state, city, or local museum. The Corps shall ensure that materials recovered from non-federally owned lands which are donated to, or owned by the state or City, will be maintained within the state in accordance with 36 CFR § 79. The Corps will ensure that all recovered artifacts are identified as to landowner and be given the opportunity to have their artifacts curated within the state in accordance with 36 CFR § 79.

IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES

A. The Corps shall provide the SHPO and Parties with letter reports summarizing the alternatives considered to avoid adverse effects to historic properties. In the report, the Corps will propose measures that will avoid, minimize, or mitigate adverse effects to those properties. The SHPO may request that the Corps consider other alternatives to avoid, minimize or mitigate adverse effects.

B. After the Corps and SHPO agree on a proposed alternative to mitigate adverse effects, the Corps, in consultation with the SHPO, will develop a Mitigation Agreement to be used to mitigate the adverse effects to specific historic properties or property types resulting from Project implementation. Once the Corps and SHPO have finalized the Mitigation Agreement in letter format and received concurrence from the SHPO, a copy will be filed with the Council and CRHPC. The Corps is responsible for implementing all provisions set forth in each Mitigation Agreement.

C. Standard mitigation measures to be considered include, but are not limited to, the following:

1 Documentation.

a. The Corps shall consult with the SHPO regarding the appropriate level of documentation prior to the substantial alteration, relocation, or demolition of any historic building or structure. Documentation shall be consistent with the *Secretary of the Interior's Standards for Architectural and Engineering Documentation* and the *Secretary of the Interior's Standards for Historical Documentation.*

b. Unless otherwise agreed to by the SHPO, the Corps shall ensure that all documentation is completed and accepted by the SHPO prior to the demolition, alteration, or relocation of the historic building or structure.

c. The Corps will provide copies of the documentation to the SHPO and CRHPC, and other local, county, or state organizations in which the SHPO and CRHPC designate.

2. Transfer or Conveyance without Preservation Covenants.

In instances where the historic properties will not be conveyed or transferred with preservation covenants, the Corps shall record these properties to Historic American Building Survey standards or to a level agreed upon with the SHPO. The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the NRHP, sources of funding for significant historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation of historic properties, the Corps and the City, in consultation with the SHPO and CRHPC, shall develop a plan to transfer and convey significant historic property without covenants.

3. Transfer or Conveyance with Preservation Covenants.

In instances where the historic properties will be conveyed or transferred with preservation covenants, the Corps shall record these properties to Historic American Building Survey standards or to a level agreed upon with the SHPO. The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the NRHP, sources of funding for historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation of historic properties, the Corps and the City, in consultation with the SHPO and the CRHPC shall develop a plan to transfer and convey the historic property with a covenant. The Corps shall submit the covenant to the SHPO and CRHPC for review, comment, and execution.

4. Mitigation for Archeological Sites Eligible Other Than Criterion D.

If preservation in place is not feasible, the Corps shall consult with the SHPO, Tribes, and Parties to develop a mitigation plan for any archeological site that is eligible to the NRHP under criteria other than or in addition to criterion D. The Corps shall submit the plan to the SHPO for review and comment.

5. Off-Site Mitigation for the Loss of a Historic Property.

The Corps may preserve similar property types or sites outside the Project's APE as mitigation for properties that cannot be preserved in place due to flood protection requirements of the Project. The Corps and the SHPO will consult to determine if off-site preservation is suitable mitigation and to develop appropriate easements, covenants and other legal instruments for the protection of such off-site properties, if off-site preservation is undertaken. Prior to the

demolition of historic properties within the Project area, the Corps, in consultation with the SHPO and Parties, shall consider the appropriateness of developing an off-site mitigation plan to compensate for the loss of historic properties. The Corps shall submit the plans to the SHPO for review and comment.

6. Alteration and Flood Proofing Activities Not Adhering to the Standards.

The Corps shall consult with the SHPO to develop alternate treatment or mitigation plans for those features which cannot meet the *Secretary of the Interior's Standards for Rehabilitation.* The Corps shall submit these plans to the SHPO for review and comment.

7. Other Mitigation Strategies.

The Corps, SHPO, City, CRHPC, and Parties shall consult to devise other mitigation strategies in instances where those listed do not satisfactorily mitigate adverse effects to historic properties. It may be necessary to develop separate Mitigation Agreements of effects on specific historic properties.

V. TREATMENT OF HUMAN REMAINS AND ITEMS OF RELIGIOUS AND CULTURAL SIGNIFICANCE

A. If human remains are encountered either during the data recovery or during any project construction activities, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made under consultation with the OSA, SHPO, and other appropriate State agencies. If finds of human remains are encountered or collected from Federal lands or Federally-Recognized Tribal lands, the Corps will coordinate with the appropriate Federally-recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*), under consultation with the SHPO.

B. If items of religious and cultural importance to tribes are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made under consultation with the SHPO, OSA, Tribe(s), THPO(s), and/or other Parties. When finds of religious or cultural importance to tribes are encountered or collected from Federal lands or Federally-Recognized Tribal lands, the Corps will coordinate with the appropriate Federally-recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*), under consultation with the OSA and SHPO.

VI. REPORTS

The Corps will ensure that all final historic properties reports resulting from the actions pursuant to this PA will be provided in a format that conforms to currently acceptable professional standards including the Secretary of the Interior's Professional Standards for Archeological Investigations and Guidelines for Archaeological Investigations in Iowa (1999). The Corps will ensure that all such reports are responsive to contemporary standards utilizing any state guidance, recommendations, forms, and format, and to the Department of the Interior's *Format Standards for Final Reports of Data Recovery* (42 FR 5377-79). Precise locational data may be provided only in a separate appendix if it appears that the release of this locational data could jeopardize historic properties. Precise locational data of traditional

cultural properties or sacred sites, consisting of architectural, landscapes, objects, or archeology sites, identified in coordination with Tribes, THPO(s), and/or Parties, may be determined sensitive information and not be made available for public disclosure (see Stipulation **VII. CONFIDENTIALITY**). The reports and associated data, minus precise aforementioned locational data and sensitive information, may be made available for publication and public dissemination.

VII. CONFIDENTIALITY

The specific locations of historic and archaeological properties are subject to protection through nondisclosure under Section 304 of the National Historic Preservation Act (156 U.S.C. 470w-3) and Section 22.7 of the State of Iowa Code. All maps subject to public review/access shall not contain any information on archeological sites. This information is not to be released in order to protect the resources at the sites. All final site reports will be provided to the State Historical Society of Iowa (hereinafter SHSI) for their permanent files.

VIII. PROVISION FOR POST-REVIEW DISCOVEREIES

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps will cease, or cause to stop, any activity having an effect and consult with the OSA and SHPO to determine if additional investigation is required. If further investigations are warranted or required, any treatment plan will be performed in accordance with Stipulation **II. TREATMENT OF HISTORIC PROPERTIES**; Stipulation **III. CURATED ITEMS;** Stipulation **V. TREATMENT OF HUMAN REMAINS AND ITEMS OF RELIGIOUS AND CULTURAL SIGNIFICANCE**, Stipulation **VI. REPORTS;** and Stipulation **VIII. PROVISION FOR POST-REVIEW DISCOVERIES**. If the Corps, OSA, and the SHPO, under consultation with the appropriate with Tribe(s), THPO(s), and/or Parties, determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps, OSA, and SHPO concerning the need for further investigations will be handled pursuant to Stipulation **X. DISPUTE RESOLUTION**.

IX. EMERGENCY ACTIVITIES AND POST-REVIEW DISCOVERIES

For any emergency action, the Corps intends to follow the procedures outlined in 36 CFR § 800.12.

X. DISPUTE RESOLUTION

Should the SHPO or the Council object within 30 days to any plans or actions provided for review pursuant to this agreement, the Corps will consult with the objecting party for resolution. If the Corps determines that the disagreement cannot be resolved, the Corps will request further comment from the Council in accordance with the applicable provisions of 36 CFR § 800.7. The Corps in accordance with 36 CFR § 800.7(c) (4) will take any Council comment provided in response into account, with reference only to the subject of the dispute. The signatories to the PA will continue to comply with the uncontested provisions until dispute resolution or termination.

XI. TERMINATION

Any of the signatories to this PA may request a reconsideration of its terms or revoke the agreement upon written notification to the other signatories, by providing 30 days notice to the other Parties, provided that the Parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR § 800.3 through § 800.7 with regard to individual undertakings covered by this PA.

XII. AMENDMENTS

Any party to this PA may request that it be amended, whereupon the Parties will consult in accordance with 36 CFR § 800.6(c)(7) to consider such amendment.

XIII. INTERESTED AND CONSULTING PARTIES

A. Consultation.

1. Pursuant to 36 CFR § 800.2(d), § 800.3, § 800.5(c), and § 800.6(a)(2), § 800.8(c)(1)(iv) of the National Historic Preservation Act (NHPA) and to meet the responsibilities under the National Environmental Policy Act of 1969 Act (NEPA) (42 U.S.C. 4321-4327) , the Corps and the City have developed an Interested and Consulting Parties List comprised of 28 individuals from government organizations or agencies, 14 THPOS or Tribes, and 4 other interested parties (number count of addresses as of 5 August 2009). The Corps will comply with any requests to be removed from, or added to, the Consulting and Interested Parties List. The development and maintenance of the Interested and Consulting Parties List:

a. allows agencies, tribes, individuals, organizations, and other interested parties an opportunity to provide views on any effects of this undertaking on historic properties resulting from the FRMFS and to participate in the review of the Draft PA. Response will allow the Corps and the City to provide those on the Interested and Consulting Parties List access to all environmental reports,

b. provides an opportunity to comment and consult as accorded by NHPA (36 C.F.R. § 800.2(d). Being a living document, this distribution list is expected to change and grow as the FRMFS identifies a preferred plan,

c. is integral to the development of the Public Development Plan, as follows: In consort with the Project Delivery Team (PDT), a Public Involvement Plan has been finalized and will be implemented to meet NEPA (42 U.S.C. 4321-4327) scoping requirements and the requirements of Corps of Engineers (Engineering Regulations) ER 1105-2-100. The plan will inform and involve the public throughout the study. Public input will be solicited on problems, issues, and potential solutions for flood damage reduction, environmental effects, and related purposes in Cedar Rapids, Iowa. Public involvement tasks throughout the FRMFS will include developing and maintaining a mailing list of interested publics consists of 856 names (number count of addresses as of 5 August 2009) which includes those on the Interested and Consulting Parties List), designing/holding public meetings (or open houses) to inform the public of and gather public input on the study's progress, writing after-action reports summarizing the public meetings, and including the Public Involvement Appendix for the Study,

d. is integral to the requirements of NEPA and will be provided study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s),

including all draft agreement documentation, as stipulated by 36 CFR § 800.14(b)(ii) of the NHPA. Comments received by the Corps and the City will be taken into account when finalizing plans for the FRMFS, as promulgated by the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the FRMFS. Although the FRMFS presently lies entirely within the State of Iowa, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Cedar River watershed, the Corps requests any information concerning our Federal trust responsibilities. The Corps NEPA document will be included within the FRMFS, contain a draft of this PA, and be made available to all on the Corps mailing list generated during the implementation of the Public Involvement Plan. This draft PA will be provided for review and comment as accorded by 36 CFR § 800.8(c) for the use of the NEPA process for consultation and public involvement outlined in,

e. is stipulated by 36 CFR § 800.6(a) and § 800(a)(4) for continued consultation with the public during resolution of adverse effects and to garner the views and comments of the affected public. Within the FRMFS, the public will be invited to be included on the Corps Interested and Consulting Parties List. Those on the Interested and Consulting Parties List will be provided access to Corps environmental reports and other documentation concerning undertakings specified in 36 CFR § 800.11(e) subject to the confidentially provisions of § 800.11(c), also stipulations **VI. REPORTS** and **VII. CONFIDENTIALITY**.

2. Although THPOS, Tribes and Parties are included within the Interested and Consulting Parties Distribution List, the NHPA recognizes that properties of traditional religious and cultural importance to a Tribe and Parties may be determined eligible for inclusion on the NRHP. In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Cedar River watershed, the FRMFS will be implemented in compliance with Executive Order No. 13007. The *Secretary of the Interior's Standards and Guidelines for Federal Agency Historic Preservation Programs* pursuant to the NHPA states that a:

> Traditional Cultural Property is defined as a property that is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community.

Allowing for tribal review and comment contributes to fulfilling our obligations as set forth in the NHPA (Public Law [PL] 89-665), as amended; the NEPA of 1969 (PL 91-190); Executive Order (EO) 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeological and Historical Preservation Act of 1974 (PL 93-291); the Council's "Regulations for the Protection of Historic and Cultural Properties" (36 CFR § 800); and the applicable National Park Service and Corps regulations and guidance. To facilitate tribal coordination, the Corps asked those on the Consulting Parties Lists to refer to the National Park Service, NRHP Bulletin 38: *Guidelines for Evaluating and Documenting Traditional Cultural Properties*. Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request any on the Interested and Consulting Parties List can choose not to disclose locations of traditional cultural properties or sacred sites and the Corps and City can secure this information from the general public.

XIV. PERIODIC REVIEW

A. The Corps will provide the SHPO, City, CRHPC, and Council with evidence of compliance with this PA by letter on January 30, 2010, and once every year thereafter said date. This letter shall contain the name of the Project, title of the documents which contained the PA, historic properties identified, determinations of effect, avoidance procedures, and level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed.

XV. EXECUTION AND IMPLEMENTATION

Nothing in this PA is intended to prevent the Corps from consulting more frequently with the SHPO or the Council concerning any questions that may arise or on the progress of any actions falling under or executed by this PA. Any resulting modifications to this PA will be coordinated in accordance with 36 CFR § 800.6(c)(7).

XVI. SIGNATORIES TO THIS AGREEMENT

PRINCIPAL SIGNATORIES

A. ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS

BY: _____ Date: _____

Shawn P. McGinley
Colonel, US Army
Commander and District Engineer

B. IOWA STATE HISTORIC PRESERVATION OFFICER

BY: _____ Date: _____

Ms. Barbara A. Mitchell
Deputy Iowa State Historic Preservation Officer
State Historical Society of Iowa

C. CITY OF CEDAR RAPIDS

BY: _____ Date: _____

Ms. Kay Halloran
Mayor
City of Cedar Rapids and City Council

As attested by:

_____ Date: _____

Mr. Casey Drew
Finance Director

D. ADVISORY COUNCIL ON HISTORIC PRESERVATION

BY: _____ Date: _____

Mr. John M. Fowler
Executive Director
Advisory Council on Historic Preservation

CONCURRING SIGNATORIES

E. CITY OF CEDAR RAPIDS HISTORIC PRESERVATION COMMISSION

BY: _____ Date: _____

Ms. Maura Pilcher
Chair
Department of Community Development

F. THE UNIVERSITY OF IOWA

BY: _____ Date: _____

Mr. John F. Doershuk, Ph.D, RPA
State Archaeologist
Office of the State Archaeologist

END

Enclosure 7: Traditional Cultural Property and Sacred Site Form.

TRADITIONAL CULTURAL PROPERTY AND SACRED SITE FORM*

The purpose of this form is to document a traditional cultural property and/or sacred site of your tribe, which will be affected by a project currently proposed. Provided below is information on our proposed project.

PROJECT DESCRIPTION:

_____

_____

_____

_____

2. GENERAL INFORMATION:

2.1. Site or Property Name (if applicable): _____

2.2. Address: _____

2.3. County: _____ City: _____ Zip: _____

2.4. Federal Agency(s) Responsible: United States Army Corps of Engineers.

2.5. Contact Person on Project: Mr. Ron Deiss, CEMVR-PM-A, telephone: 1-309-794-5185.

2.6. Return Address: Clock Tower Building, PO Box 2004, Rock Island, Illinois, 61204-2004.

3. TRADITIONAL CULTURAL PROPERTY OR SACRED SITE:

3.1. Check box(es) as appropriate:

☐ **ARCHITECTURE,** ☐ **LANDSCAPE,** ☐ **OBJECT, and/or** ☐ **SURFACE OR ARCHEOLOGY SITE**

3.2 ☐ Yes ☐ No In my opinion the project will directly or visually affect an area, building, structure, landscape, object, element, feature, or object 50 years of age or older.

If Yes, please submit this completed form on each such property/site and check below the kinds of project activities which would affect cultural property and/or sacred site :

☐ Rehabilitation ☐ New Construction (e. g., addition); ☐ Yard, sidewalks, plantings;

☐ Demolition; ☐ Vacate/Abandon/Sell;

☐ Other: _____

3.3. ☐ Yes ☐ No In my opinion the project will be affected by excavation and/or ground disturbance.

If yes, please submit all of the following information with this form:

☐ Precise project location map (preferably USGS 7.5 min Quad with name, date, & location);

☐ Site plan showing property or site shape with map legend;

☐ Number of acres or dimensions_____;

☐ Legal location: Section(s)_____, Township(s)_____ Range(s)_____

☐ Description of historical, architectural, archeological, or cultural significance _____

_____

4. DISCLOSURE INFORMATION: The undersigned maintains that the completed information on this form is true and

accurate and ☐ can or ☐ cannot be provided as public information; write name _____

date _____, affiliation_____, and address_____

*We are seeking your comments to fulfill cultural resources obligations as set forth in the National Historic Preservation Act of 1966 (Public Law [PL] 89-665) as amended: the National Environmental Policy Act of 1969 (PL 91-190); Executive Order (EO) 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971); the Archaeological and Historical Preservation Act of 1974 (PL 93-291); the Advisory Council on Historic Preservation "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800); and the applicable National Park Service and Corps of Engineers regulations.

THE UNIVERSITY OF IOWA

OFFICE OF THE STATE ARCHAEOLOGIST
700 Clinton Street Building
Iowa City, Iowa 52242
319-384-0732 Fax 319-384-0768
osa@uiowa.edu
www.uiowa.edu/~osa

July 1, 2009

Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building – P.O. Box 2004
Rock Island, Illinois 61204-2004
ATTN: Planning, Programs, and Project Management Division (Ron Deiss)

Re: Cedar River, Cedar Rapids, Iowa—Flood Risk Management Feasibility Study (FRMFS)-Linn County

Dear Ron:

I am in receipt of the June 23, 2009 mailing for the above referenced project. Thank you for including the Office of the State Archaeologist (OSA) on the distribution list for this important undertaking. I have reviewed the draft PA with Shirley Schermer, Director of the OSA Burials Program, and we recommend several modifications (see below) to better reflect compliance with the Code of Iowa regarding ancient remains. Please let me know if there are any questions regarding these recommended changes (phone: 319-384-0751; e-mail: john-doershuk@uiowa.edu). Lastly, I also respectfully request that OSA be included as a concurring signatory on the PA.

Sincerely,

John F. Doershuk, Ph.D., RPA
State Archaeologist

cc: Doug Jones, Review Archaeologist, State Historical Society of Iowa (Review and Compliance Program, State Historic Preservation Office)

Recommended modifications to the draft PA (continued on following page):

I. HISTORIC PROPERTY SURVEYS AND TESTING

Part A. identifies that the Corps will "take all measures necessary" and provide all relevant information to SHPO; please add "and the Office of the State Archaeologist (OSA)" to this paragraph, especially since it includes explicit reference to potential information concerning human remains and associated objects.

II. TREATMENT OF HISTORIC PROPERTIES

Part I. includes the phrase "the Corps will follow appropriate State burial laws Iowa State Code" we recommend this be simplified to "the Corps will follow Code of Iowa". Retain the Chapter citation as currently presented as it is correct.

V. TREATMENT OF HUMAN REMAINS…

Parts A. and B. are substantially correct but both portions require explicit inclusion of OSA in the consultation. Note that on non-federal land in Iowa the State Archaeologist has authority regarding whether disinterment of ancient remains may occur, not just a consulting role. The reference in this section "the Corps will comply with all provisions outlined in the appropriate state acts, statutes…" implicitly acknowledges this authority but it might prove useful to the PA consulting parties to make this more explicit. At a minimum, I recommend inserting "and OSA" immediately following "SHPO" in both occurrences in both paragraphs. Note that in Part A. the identifier "appropriate" appearing immediately before "SHPO" in the last line can be deleted as this PA refers only to Iowa.

VII. PROVISION FOR POST-REVIEW DISCOVERIES

Following from the comments above, for Section V., as State Archaeologist I have authority to deny disinterment of ancient remains from non-federal lands in Iowa, therefore "and OSA" should be inserted following all three occurrences of "SHPO." Also, as per the above, the phrase "appropriate SHPO(s)" should be modified in this paragraph to read "the SHPO" in the second to the last line.

July 29, 2009

NATIONAL TRUST FOR HISTORIC PRESERVATION®

Midwest OFFICE

Kenneth A. Barr
Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004

Re: Cedar River, Cedar Rapids, Iowa - Flood Risk Management Feasibility Study (FRMFS) - Linn County, Cedar Rapids, Iowa

Dear Mr. Barr,

The National Trust for Historic Preservation ("National Trust") appreciates the opportunity to participate as a consulting party to the *Programmatic Agreement among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, City of Cedar Rapids, Cedar Rapids Historic Preservation Commission, and Advisory Council on Historic Preservation for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa*. This letter summarizes the National Trust's comments on the Draft Programmatic Agreement.

The Midwest Office of the National Trust has been closely engaged with Iowa's preservation community in helping to respond to the flood of 2008. Specifically, our office has provided recovery assistance in the form of technical advice, financial assistance, and outreach and education. Our experiences in Iowa, as well as the National Trust's knowledge about historic properties at the national level, can provide a valuable perspective as a consulting party in the Section 106 process for this project.

1. **Participation of Interested and Consulting Parties**

The National Trust is concerned that the Draft Programmatic Agreement does not consistently reflect a process that includes specific opportunities for consulting and interested parties and the public to participate in future decisions associated with the FRMFS. The Section 106 regulations not only reflect the need to generally involve consulting parties and the public, 36 C.F.R. § 800.2(d), but indicate specific entry points of the Section 106 process where involvement of consulting parties and public is required, e.g., 36 C.F.R. § 800.5(c), 800.6(a)(2), (4). Indeed, providing for opportunities for the public to engage in the Section 106 process, especially as a consulting party, is the cornerstone of Section 106 of the NHPA. The Draft Programmatic Agreement does not provide for clear entry points for consulting parties and the public to participate. For example, there is no opportunity for members of the public, and interested and consulting

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parties, to be involved under Stipulation IV, Section B, which deals with creating agreements to address the mitigation of adverse effects to historic properties. The Corps should revise the Draft Programmatic Agreement to provide for a consistent approach for participation of interested and consulting parties, and members of the public. In fact, the Corps should consider adding a new Stipulation that deals specifically with public participation, outlining exactly how and when the Corps will address its responsibilities to involve the public throughout the implementation of the Programmatic Agreement.

2. Area of Potential Effect and Scope of Undertaking

The Draft Programmatic Agreement's defined Area of Potential Effect (APE) neglects to take into account the visual and indirect effects of project-related features. In accordance with 36 C.F.R. § 800.5(a)(1), the Corps must consider the indirect effects of the Federal undertaking. The Draft Programmatic Agreement defines the APE as including "the construction zones of footprints of the proposed levees, floodwalls, and/or any other flood protection measures, plus road raises, tieback levees, drainage diversions, reservoirs, municipality modifications, borrow areas and any other project related features proposed and identified in the FMRFS" (Fifth "Whereas" clause, stipulation B, page 2). As defined, the APE would exclude many potential affected historic properties.

The Draft Programmatic Agreement also does not include a description of the scope of the undertaking. An Appendix outlining the types of activities being considered in the undertaking should also be included. Additionally, as the APE is likely to change throughout the execution of this Programmatic Agreement, the document should incorporate an Appendix outlining the boundaries of the current APE, which can be updated as the project area changes.

3. Background Historic Research and Geomorphological Investigation along the City Riverfront

The fifth "Whereas" clause, Stipulation A, references a study called "Background Historic Research and Geomorphological Investigation along the City Riverfront." The clause is written as if this study has already been completed, but it is our understanding that this is not the case. In addition, this clause does not contain any provision for review of the study by SHPO and other interested and consulting parties prior to finalization of the study. This should be re-written and moved to Section I. Historic Property Surveys and Testing.

4. The Role of the Historic Preservation Commission

Because Cedar Rapids is a Certified Local Government, and the Cedar Rapids Historic Preservation Commission (HPC) is a Concurring Signatory to this Programmatic Agreement, the HPC should be given the opportunity to expand their role. We have

inserted redline suggestions in the Draft Programmatic Agreement (attached) where we feel the HPC could play a valuable role in the execution of this agreement and suggest that the Corps consult with the HPC directly to determine where they could appropriately increase their involvement.

5. National Environmental Policy Act compliance

The National Trust understands that the executed Programmatic Agreement will become part of the National Environmental Policy Act (NEPA) document resulting from the FRMFS. The National Trust requests the opportunity to review draft versions of the FRMFS and provide comments on the various alternatives prior to the finalization of the NEPA document.

Please include both Jennifer Sandy and Mike Smith of the National Trust for Historic Preservation in your distribution list for public notices of any meetings, and for the circulation of any documents for comment. All correspondence should be sent to:

Jennifer Sandy
Program Officer
Midwest Office
53 West Jackson Blvd. Ste. 350
Chicago, IL 60604
jennifer_sandy@nthp.org

Mike Smith
Assistant General Counsel
National Trust for Historic Preservation
1785 Massachusetts Ave., NW
Washington, D.C. 20036-2117
mike_smith@nthp.org

We look forward to participating actively in both the Section 106 and NEPA processes.

Sincerely,

Jennifer Sandy
Program Officer

Cc: Mike Smith, Assistant General Counsel, National Trust for Historic Preservation
Ron Deiss, U.S. Army Corps of Engineers
Barbara Mitchell, Deputy State Historic Preservation Officer, State Historic Preservation Office
Dan Higginbottom, Archeologist, State Historic Preservation Office
Ralph Christian, Historian, State Historic Preservation Office
John Eddins, Advisory Council on Historic Preservation
Rod Scott, President, Iowa Historic Preservation Alliance
Maura Pilcher, Chair, Cedar Rapids Historic Preservation Commission

DuPrey/McGuire/jmb/5709

July 30, 2009

Planning, Programs, and
Project Management Division

SEE DISTRIBUTION LIST

The U.S. Army Corps of Engineers, Rock Island District is preparing an Environmental Assessment (EA) entitled *Environmental Assessment, Cedar River, Cedar Rapids, Iowa, Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa*. This EA will assess the potential impacts resulting from the construction of a levee system on both sides of the Cedar River, in addition to other structural and non-structural flood risk management alternatives. The first plate attached is a generalized map of areas in Cedar Rapids that may receive some flood risk damage reduction measure, while enclosed Plates 2, 4, 6, 11, and 13 give a more detailed view. The proposed sites to acquire borrow material for levee construction can be found in the enclosed map entitled "Eastern Iowa Airport Properties". This levee system is comprised of permanent earthen levees, floodwalls, and removable floodwall segments; and would be designed to mitigate impacts/damages from severe floods as were experienced in 2008. Numerous potential levee alignments are illustrated in the enclosed plates. A preferred levee alignment, if one is found to be justified, will be decided upon in the near future, during the planning process for the EA.

At this time, we are requesting your comments regarding any significant resources that might be impacted by the proposed action. Federal and/or state-listed threatened or endangered species are of particular concern. We also request your assistance in identifying any additional existing significant resources that may be impacted, such as wetlands, prime farmlands, eagle nests, conflicts with known land-use plans, floodplain issues, etc.

Please provide your comments/concerns regarding this proposal within 30 days of the date of this letter. A timely review of this information and a written response will be greatly appreciated. Should you have any questions regarding this proposal, please contact Mr. Lonn McGuire of our Economic and Environmental Analysis Branch, telephone 309/794-5709. Written responses may be sent to our address above, ATTN: Planning, Programs, and Project Management Division (Lonn McGuire).

Sincerely,
ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Economic and
Environmental Analysis Branch

DISTRIBUTION LIST

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Feasibility Study

Linn County
Cedar Rapids, Iowa

Mr. Richard Nelson
Ecological Services Field Office
U.S. Fish and Wildlife Service
1511 47th Avenue
Moline, IL 61265

Mr. Tom Cox
US Fish and Wildlife Service
10728 County Road X61
Wapello, IA 52653-9477

Mr. Mike Griffin
Iowa Department of Natural Resources
206 Rose Street
Bellevue, IA 52031

Mr. John Askew, Regional Administrator
U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, KS 66101

Ms. Kathy Mulder
Water Resources Protection Branch
U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, KS 66101

Mr. Richard Leopold, Director
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand
Des Moines, IA 50319-0034

Ms. Diane Ford-Shivvers
Conservation & Recreation
Coordination & Policy
Iowa Department of Natural Resources
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Des Moines, IA 50319-0034

Ms. Christine M. Schwake
Water Quality Bureau
Iowa Department of Natural Resources
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Des Moines, IA 50319-0034

Linn County Conservation
1890 County Home Road
Marion, IA 52302-9753

Mr. Gerald Neff
Iowa Chapter Sierra Club
3839 Merle Hay Road
Suite 280
Des Moines, IA 50310

Mr. Ken DeKeyser
Stormwater Utility Engineer
1201 6th Street SW
Cedar Rapids, IA 52404

Mr. Bob Godlove, President
Linn County Chapter Izaak Walton League
5401 42nd Street
Cedar Rapids, IA 52411

Mr. Bill Northey
Iowa Dept of Ag and Land Stewardship
Wallace State Office Bldg
502 E. 9th Street
Des Moines, IA 50319

The Nature Conservancy, Iowa Field Office
303 Locust Street
Suite 402
Des Moines, IA 50309

Mr. Doug Harr
Iowa Chapter Audubon Society
P.O. Box 65
Larchwood, IA 51241

Mr. Jim Durbin
Cedar Rapids Audubon Society
1764 Sherbrook Dr. NE
Cedar Rapids, IA 52411

Mike Wyrick
Cedar Rapids Sierra Club
4823 Black Ivy Court NE
Cedar Rapids, IA 52411

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Cedar-Wapsie Group
of the Iowa Chapter

1700 C Ave NW
Cedar Rapids, Iowa 52405

August 17, 2009

Department of the Army
Rock Island District Corps of Engineers
Attn: Planning, Programs, and Project Management Division
(Lonn McGuire)
PO Box 2004
Rock Island, Illinois 61204-2004

Re: Cedar River, Cedar Rapids, Iowa, Flood Risk Management Feasibility Study

Dear Sir or Ms:

The Cedar Wapsie Group of the Sierra Club has reviewed the materials related to the significant resources request concerning the Flood Risk Management Feasibility Study of the Cedar River in Cedar Rapids, Iowa and offers the following comments.

1. There are a number of significant cultural areas or historical areas that need to be protected from flooding. They include:
   - The Wells Fargo Bank on 3rd Avenue.
   - Czech School at 2nd Street SW.
   - Salvation Army Building
   - Old Globe Grocery Store
   - Czech Village
   - Little Bohemia
   - Indian Creek Nature Center, visitors center
2. We support making the Wilson's packing plant green space.
3. With respect to threatened, endangered, and significant species of plants and animals, we are concerned about the following:
   - There are mussels in the Cedar River. There have been efforts in restoring the Higgins Eye Clam.
   - The Cedar River is a wintering area for a number of eagles. The trees near the river on Eighth Avenue in

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Cedar-Wapsie Group
of the Iowa Chapter

1700 C Ave NW
Cedar Rapids, Iowa 52405

downtown Cedar Rapids are a popular roosting area. The area near the roller dam is also a popular area for wintering eagles.

- McLoud Run provides habitat for trout. Any work with levees should insure that the trout habitat is not destroyed.
- The Sac and Fox Trail is a popular bike and nature trail in the metropolitan area. Part of the trail was destroyed by the 2008 flood. Efforts need to be made to protect this trail.

4. In general, as we reviewed the materials, we became concerned that this is strictly a plan of creating flood walls and levees. We believe that the solution to the flooding in Cedar Rapids needs a much more comprehensive set of solutions.
5. We are concerned that there is no plan for a series of retention or detention basins in the Cedar River watershed above Cedar Rapids.
6. Nor is there any effort at restoring wetlands in the watershed above Cedar Rapids. We support wetland restoration throughout the Cedar River Basin, including Dry Creek, Indian Creek, and Squaw Creek in the Cedar Rapids metro area. Likewise major tributaries need to be reviewed for major wetland restoration.
7. We would suggest reviewing the area upstream from Cedar Rapids for fill dirt, instead of the airport properties. Removing fill from areas upstream would solve two problems - creating fill and creating a retention/detention area to abate downstream flooding.
8. We support raising the Edgewood Road bridge approach, particularly the south side. This approach is low-lying and easily subjected to higher water conditions, which would restrict travel over the bridge. Edgewood Road is a major north-south transportation corridor.
9. We support the use of rain gardens on individual properties to slow the flow of water into the Cedar River and its tributaries.
10. We support modifying the storm sewers in the metropolitan area so that water is more slowly released, and is instead stored in regional detention basins.
11. We support a permanent moratorium on adding fill to the 100-year floodplain of the Cedar River. Furthermore, we believe that moratorium should extend to all tributaries in the Cedar Rapids metropolitan area.

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1700 C Ave NW
Cedar Rapids, Iowa 52405

12. By focusing the building of flood walls and levees in the Cedar Rapids metropolitan area, it is obvious that the flood waters will be held further upstream. We are concerned about the effect that will have on upstream properties. One of the areas of special concern is the Rock Island County and State Preserves.

The Army Corps of Engineers issued a report after the 1993 flood, commonly known as the Galloway Report. Its official name is "A Blueprint for Change -- Sharing the Challenge: Floodplain Management into the 21st Century". This document is "The Report of the Interagency Floodplain Management Review Committee to the Administration Floodplain Management Task Force" which was issued in June, 1994. Among the things mentioned in that report was the need for more comprehensive strategies in solving flooding issues, including restoration of wetlands. We have been deeply concerned that the lessons learned from the 1993 did not result in significant changes in philosophy and actual restoration of those wetlands. And we are likewise concerned that the plans we are being shown are not strategically implementing flood prevention by restoring wetlands upstream.

Thank you for considering these comments.

Very truly yours,

Elwood Garlock

Elwood Garlock

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

August 24, 2009

Lonn McGuire
US Army Corps of Engineers, Rock Island District
PO Box 2004
Rock Island, IL 61204-2004

RE: Environmental Review for Natural Resources
Environmental Assessment, Cedar River, Cedar Rapids, Iowa
Flood Risk Management Feasibility Study
Linn County
DTCE-W River Edge Alignment A
DTCR-W Corridor Redevelopment Alignment A
Section 17, 20, 21, 27, 28, Township 83N, Range 7W

DTCR-E Rivers Edge Alignment A
Section 16, 21, 27, 28, Township 83N, Range 7W

Prairie Creek Generation Station
PCGS Alignment Around Entire Station
Section 3, Township 82N, Range 7W

Water Pollution Control Facilities
WPCF Alignment Around Entire Facility
Section 32, 33, Township 83N, Range 6W

Eastern Iowa Airport, Potential Borrow Areas
Section 24-27, Township 82N, Range 8W
Section 19, 20, 29-32, Township 82N, Range 7W

Dear Mr. McGuire:

Thank you for inviting Department comment on the impact of this project. Please note that the proposed DTCE-W, DTCR-W, and DTCR-E alignments may require a Sovereign Lands Construction Permit from the Department as the alignments appear to directly abut the Cedar River. More information about the Sovereign Lands program is available from the Department website at http://www.iowadnr.gov/other/slands.html.

The Department has searched for records of rare species and significant natural communities in the project area and found no site-specific records that would be impacted by this project. However, these records and data are not the result of thorough field surveys. If listed species or rare communities are found during the planning or construction phases, additional studies and/or mitigation may be required.

This letter is a record of review for protected species, rare natural communities, state lands and waters in the project area, including review by personnel representing state parks, preserves, recreation areas, fisheries and wildlife but does not include comment from the Environmental Services Division of this Department. This letter does not

502 EAST 9th STREET / DES MOINES, IOWA 50319-0034
PHONE 515-281-5918 FAX 515-281-6794 www.iowadnr.gov

constitute a permit. Other permits may be required from the Department or other state or federal agencies before work begins on this project.

Any construction activity that bares the soil of an area greater than or equal to one acre including clearing, grading or excavation may require a storm water discharge permit from the Department. Construction activities may include the temporary or permanent storage of dredge material. For more information regarding this matter, please contact Ruth Rosdail at (515) 281-6782.

The Department administers regulations that pertain to fugitive dust IAW Iowa Administrative Code 567-23.3(2)"c." All persons shall take reasonable precautions to prevent the discharge of visible emissions of fugitive dusts beyond the lot line of property during construction, alteration, repairing or demolishing of buildings, bridges or other vertical structures or haul roads. All questions regarding fugitive dust regulations should be directed to Jim McGraw at (515) 242-5167.

If you have questions about this letter or require further information, please contact me at (515) 281-8967.

Sincerely,

Inga Foster
Environmental Specialist
Conservation and Recreation Division

FILE COPY: Inga Foster
Tracking Number: 3879

CC: Bob Clevenstine, U.S. Fish and Wildlife Service, Rock Island Field Office, 1511 47th Ave., Moline, IL 61265-7022
Christine Schwake, Iowa DNR

DEISS/vdc/5185

August 31, 2009

COYLE PM-A VC 21 aug 09
DEISS PM-A 21 Aug 2009
HARING PM-M CH Aug 21, 2009
BARR PM-A Aug 27 09

Planning, Programs, and
Project Management Division 310-2d)

Ms. June Strand
Iowa Historic Preservation Agency
ATTN: Review and Compliance Program
State Historical Society of Iowa
600 East Locust - Capitol Complex
Des Moines, Iowa 50319

Dear Ms. Strand:

The United States Army Corps of Engineers Rock Island District (Corps) and the City of Cedar Rapids (City), Linn County, Iowa has been consulting with the State Historical Society of Iowa (SHSI) concerning the Cedar River, Cedar Rapids, Iowa –Flood Risk Management Feasibility Study (FRMFS) - Linn County, Cedar Rapids, Iowa, and flood protection management measures are proposed at various locations. The FRMFS is authorized under GI - General Investigations - House Resolution Docket 2749 adopted April 5, 2006, and Committee on Environment and Public Works, United States Senate, dated May 23, 2006. This correspondence is promulgated under the National Historic Preservation Act as amended (NHPA), and its implementing regulations 36CFR Part 800: "Protection of Historic Properties."

The Corps and City have determined that the implementation of the FRMFS may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and have initiated consultation with the Advisory Council on Historic Preservation (Council) and the Iowa State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]) (NHPA), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]). An Interested and Consulting Parties List has been (enclosure 1) developed and those on the list will be provided with public meeting announcements, special releases, and notifications of the availability of report(s), including all draft and final agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA.

By letter dated June 23, 2009, the Corps and the City provided a preliminary description of the FRMFS, maps of alternatives studied, a draft *Programmatic Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, Cedar Rapids Historic Preservation Commission, and Advisory Council on Historic Preservation for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study – Linn County, Cedar Rapids, Iowa*, and invited the participation and consultation of those listed

on enclosure 1. Tribal Historic Preservation Officers, Tribes, and other parties were asked to provide any known information concerning sacred sites or traditional cultural properties. Comments concerning the draft PA were received from the Office of the State Archaeologist (OSA letter dated 1 July 2009), SHSI (email dated 29 July 2009), Council (email dated 14 August 2009), and the National Trust on Historic Preservation (NTHP letter dated 29 July 2009). All comments received were considered (the majority of the comments were incorporated for inclusion) in the enclosed (enclosure 2) revised draft PA. Comments are indispensible in the development of a final PA and the Corps appreciated all efforts and contributions.

The Corps and the City of Cedar Rapids invites the SHSI, Council, OSA, NTHP, Tribal Historic Preservation Officers, Tribal members, and any other interested and consulting parties to review and comment on the enclosed revised draft Programmatic Agreement (PA, enclosure 2). All comments will be considered for inclusion within the final PA. To allow for the full extent of Public comment on the PA, the Corps proposes to include an unexecuted (unsigned) draft PA in the National Environmental Policy Act (NEPA) document when it is released for Public Review.

The Corps is also producing a report documenting archival and historic background research and geomorphological investigations focused on those areas where the FRMFS measures are under study and any city-owned properties considered for potential borrow. These investigations are conducted to compliment the City of Cedar Rapids and Federal Emergency Management Agency (Department of Homeland Security), extensive architectural documentation of the area. A major component of the report will focus on delineating areas/landforms/reaches of no, low, medium, and high potential for containing NRHP potentially eligible, eligible, or listed archeological properties.

Please provide any information, requests, views, or comments within 30 days, or the Corps will assume that you agree with our proposal of drafting and executing the PA and the proposed archival and geomorphological investigations report. If you have questions concerning the revised draft PA, please call Mr. Ron Deiss of our Economic and Environmental Analysis Branch, telephone 309/794-5185, or write to our address, ATTN: Planning, Programs, and Project Management Division (Ron Deiss).

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosures

Kansas City, MO 64108-2654
Mr. Adrian Stroupe
Long Term Community Recovery
FEMA, ESF #14
500 C Street SW
Washington, DC 20472

Ms. Kristen O'Connell
National Park Service
Historic American Engineering Record
1201 Eye Street, NW. 2270
Washington, DC 20005

Mr. Dana Lockett
Architectural Project Manager
National Park Service
Historic American Engineering Record
1201 Eye Street NW. 2270
Washington, DC 20005

Justine Christianson
Historian
Historic American Engineering Record
1201 Eye Street NW. 2270
Washington, DC 20005

Mr. David J. Grignon
Tribal Historic Preservation Officer
Menominee Indian Tribe of Wisconsin
P.O. Box 910
Keshena, WI 54135-0910

National Trust on Historic Preservation
1785 Massachusetts Avenue NW.
Washington, DC 20036-2117

Ms. Jennifer Sandy
Midwest Office
National Trust for Historic Preservation
53 West Jackson Boulevard, Suite 350
Chicago, IL 60604

Ms. Barbara Mitchell
Deputy (SHPO), Architectural Historian
600 East Locust Street
Des Moines, IA 50319-0290

Mr. Ralph Christian
Historian
600 East Locust Street
Des Moines, IA 50319-0290

Ms. Paula Mohr
Local Government Coordinator (SHPO)
600 East Locust Street
Des Moines, IA 50319-0290

Mr. Douglas Jones
Archeologist, Review & Compliance
Program Manager
600 East Locust Street
Des Moines, IA 50319-0290

Mr. Daniel Higginbottam
Archeologist, Review & Compliance
Program Manager
600 East Locust Street
Des Moines, IA 50319-0290

TRIBES

Mr. Johnathan Buffalo
Historic Preservation Coordinator
Sac and Fox Tribe of the Mississippi
in Iowa
349 Meskwaki Road
Tama, IA 52339-9629

Mr. Donald L. Robidoux
NAGPRA Coordinator
Iowa Tribe of Nebraska and Kansas
Rt. 1, Box 210
Hiawatha, KS 66434

Suzette McCord-Rogers
Iowa Tribe of Kansas and Nebraska
Native American Heritage Museum
RR1 Box 152 C
Highland, KS 66035

Cedar Rapids, Cedar Rapids, Iowa – Flood Risk Management Feasibility Study, Cedar Rapids, Black Hawk County, Iowa Interested and Consulting Parties List

AGENCIES

ATTN: Mr. Thomas McCullouch
c/o Mr. Don L. Klima
Director
Eastern Office of Project Review
Old Post Office Building
1100 Pennsylvania Avenue, NW. Suite 809
Washington, DC 20004

Mr. Tom Morain,
Administrator and SHPO
State Historical Society of Iowa
600 East Locust Street
Des Moines, IA 50319-0290

Charles A. Bello, M.A., RPA,
Historic Preservation Specialist - Archaeologist
IA Homeland Security and Emergency Management
4459 Northwest 121st Street
Urbandale, IA 50323

Mr. Tim Weitzel
Historic Preservation Specialist
Iowa Department of Economic Development
200 East Grand Avenue
Des Moines, IA 50309

Mr. John Doershuk
State Archaeologist
Office of the State Archaeologist
700 South Clinton Street
University of Iowa
Iowa City, IA 52242-1030319

Ms. Maura Pilcher
Chair
Cedar Rapids Historic Preservation Commission
Department of Community Development
3851 River Ridge DR NE
Cedar Rapids, IA 52402-3851

Mr. Rod Scott
President
Iowa Historic Preservation Alliance
P.O. Box 814
Mt. Pleasant, IA 52641

Mr. Ken DeKeyser
PE CPESC
Cedar Rapids Public Works Dept.
1201 6th Street SW.
Cedar Rapid, IA 52404

Ms. Rita Rasmussen
Real Estate
1201 6th Street SW.
Cedar Rapid, IA 52404

Mr. Dave Smith
Parks and Recreation
3601 42nd Street NE.
Cedar Rapids, IA 52402

Mr. Adam Lindenlaub
Economics
3851 River Ridge Drive NE.
Cedar Falls, IA 52402

Mr. Ken Sessa
US Department of Homeland Security
FEMA Region VII
2323 Grand Boulevard, Suite 900

MFR: Standard coordination letter promulgated under Section 106 of the NHPA to IA SHPO and other consulting parties concerning the Flood Risk Management Feasibility Study, review of the revised a draft PA, and proposed archival background and geomorphological report.

(all w/encls):
Dist File (PM-M)
PM-A (Deiss, McGuire, Coyle)
PM-M (Haring)
PM-M (Zukowski)
EC-DM (Sunderman

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
1511 47th Avenue
Moline, Illinois 61265
Phone: (309) 757-5800 Fax: (309) 757-5807

IN REPLY REFER TO: FWS/RIFO

September 8, 2009

Mr. Kenneth Barr
Chief, Economic and Environmental Analysis Branch
U.S. Army Corps of Engineers
Rock Island District
Clock Tower Building, PO Box 2004
Rock Island, Illinois 61201-2004

Dear Mr. Barr:

This letter responds to your coordination letter dated July 30, 2009, regarding proposed flood risk reduction at Cedar Rapids, Iowa. Your letter indicates that the planning process will include consideration of non-structural alternatives along with the structural alternatives portrayed in the plates provided. We recognize that functional flood risk reduction involves examination of the suite of alternatives ranging from improved flood forecasting/warning, upland treatment, floodplain management, zoning, and structural systems. We look forward to exploring these alternatives as the feasibility study proceeds.

Federally listed species for Linn County, Iowa are the threatened western prairie fringed orchid (*Platanthera praeclara*) and prairie bush clover (*Lespedeza leptostachya*). Habitat for the orchid consists of wet prairie and sedge meadows, and habitat for the bush clover consists of dry to mesic prairie with gravelly soil. Based on the plates provided with your letter, it appears that the proposed activities either occur within the urban developed Cedar River corridor or on actively farmed agricultural lands surrounding the Eastern Iowa Airport, and are unlikely to contain habitat for either of these species. However, we understand that there has been an active bald eagle nest near the river in Cedar Rapids. Therefore, project planning must consider the proximity of proposed construction activities to the nest and include a search for other bald eagle nesting activity near construction alignments. As of August 9, 2007, the bald eagle is no longer included on the list of threatened and endangered species. It remains protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, and may not be harassed, harmed, or disturbed when present nor may nest trees be cleared. For more information, please see http://www.fws.gov/midwest/eagle/guidelines/index.html.

This letter provides comments under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.); and the Endangered Species Act of 1973, as amended. Thank you for the opportunity to comment, and we look forward to continuing the cooperative approach exemplified by this project. Questions regarding this letter may be directed to Mr. Bob Clevenstine at 309-757-5800, extension 205.

Sincerely,

Richard C. Nelson
Field Supervisor

cc: IaDNR (Ford, Foster, Schwake)
EPA RVII (Mulder)

S:\Office Users\Bob\My Documents\Flood\Cedar Rapids\CRFRMFS.doc

STATE HISTORICAL SOCIETY of IOWA

A Division of the Iowa Department of Cultural Affairs

October 4, 2009 **In reference to R&C: 090657190**

Mr. Ron Deiss, Archaeologist
Economic and Environmental Analysis Branch
Corps of Engineers – Rock Island District
Clock Tower Building P.O. Box 2004
Rock Island, IL 61204-2004

RE: COE – LINN COUNTY – CITY OF CEDAR RAPIDS – FLOOD 08 – CEDAR RIVER – FLOOD RISK MANAGEMENT FEASIBILITY STUDY (FRMFS) – DRAFT PROGRAMMATIC AGREEMENT

Dear Mr. Deiss,

The Iowa State Historic Preservation Office (SHPO) has completed its review of draft two of the Corps' *Programmatic Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, City of Cedar Rapids, and Advisory Council on Historic Preservation for Undertaking Implemented Under the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa* and offers the following impressions.

According to the Corps' letter, the second draft incorporates revisions recommended by other consulting parties, including SHPO. However, these changes were not tracked. Consequently, not only was review of the second draft a painstaking and time-consuming process to those in our office involved in its review, we did not have the benefit of knowing whose comments and revisions we were reviewing.

In general, we found that the current draft does not present a coherent and practicable program alternative to 36 CFR Part 800. While components of a programmatic agreement are present in varying degrees of development, such as the roles and responsibilities of the consulting parties, phased identification and evaluation of historic properties, addressing effects programmatically, the coordination of Section 106 compliance with NEPA, and so forth, they are spread out across the document and do not come together to form a logical, clear-cut procedure.

Furthermore, when various scenarios are considered, we foresee the potential for numerous petitions for amendment and dispute resolution situations owing to the rigidity of the instrument's content. This was mentioned in our September 29, 2009 email along with our suggested solution that will not be recounted here.

Excluding the numerous smaller but no less important issues that we noted during our review, we focus on the following as being matters of the greatest concern.

Multiple Agencies. We do not see how the Corps can operate under this agreement independent of other agencies and their actions and agreements. The present agreement states that "the buildings located within the proposed levee and floodwall construction corridors shall be acquired by the City as part of the obligations under the flood protection Project Partnership Agreement" and makes reference to treatment measures involving properties that will be bought out using federal funds. Since property acquisitions are a pre-requisite and integral to the Corps' undertaking, they cannot be separated from the Corps' action. Therefore, FEMA and HUD and any other agency funding property acquisition would have a consultative role here, if for nothing else to ensure that procedures outlined in this agreement are consistent with the procedures set forth in their own.

Lead Federal Agency Designation. In light of the above comment, no provision has been made for designating a lead federal agency in multiple agency situations.

Historic Properties Investigations. The Corps makes mention of a study entitled: *Background Historic Research and Geomorphological Investigation of Measures Under Study for the Cedar River, Cedar Rapids, Iowa Flood Risk Management*

600 EAST LOCUST STREET, DES MOINES, IA 50319-0290 P: (515) 281-5111

Feasibility Study Linn County, Cedar Rapids, Iowa but provides no details about how this and other historic properties investigation conducted since the advent of the 2008 disaster will be utilize under this agreement. With all of the work that has been done to this point, it might be reasonable to assume that the City and the Corps would have some idea of the numbers and types of historic properties located within the preferred and alternative alignments.

Data Recovery and Artifact Curation. The SHPO objects to any agency's practice of funding archaeological data recovery when the ultimate disposition of the artifacts recovered has not been legally secured in advance. Despite the successful outcome of data recovery, after-the-fact loss of artifacts constitutes an adverse effect by barring the refutation or confirmation of original findings through further analyses and by denying future academic study of the material. In our view, the agreement should be conditioned in such a way that all data recovery occurs *after* acquisition either through purchase or condemnation, or once the site and title to its content has been secured under an executed easement.

Mitigation Agreements and Letter Reports. The Corps proposes a system of letter reports and mitigation agreements as a way to memorialize the mitigation of adverse effects, but fails to detail how it will be made operational. There should be a discussion on the content of each document, expectations of each party in their preparation, timeframes, and perhaps example drafts attached as an appendix.

Covenants and Easements. The Corps makes liberal reference to different types of restrictive instruments in their discussion of mitigation of adverse effects without an apparent understanding of how these instruments may be applied under Iowa law.

Office of the State Archaeologist. The Corps has endowed the University of Iowa - Office of the State Archaeologist with executive responsibilities regarding the Treatment of Human Remains (Stipulation V.) and with administrative powers by through recourse to dispute resolution (Stipulation VIII). The State Archaeologist should therefore be a signatory to this agreement.

Amendments. Stipulation XII does not detail the procedure to petition for and adopt an amendment.

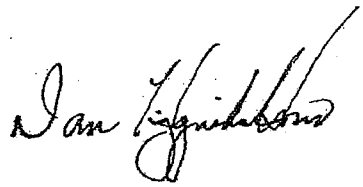
Coordinating NEPA with Section 106. Stipulation XIII makes vague reference to the coordination of NEPA with Section 106 but provides no detail to the reader on how this is to be done.

Duration (Sunset) and Anti-Deficiency Clauses. The current draft does not include clauses covering agreement duration or compliance with the Anti-Deficiency Act.

As mentioned in our previous email, an agreement covering a program of this scope and complexity requires very deliberate, meditative, and open discussion among all of the consulting parties. We therefore recommend that the Corps organize a meeting or series of meetings with the City, FEMA, HUD, the Iowa Department of Economic Development, SHPO, OSA, Iowa Historic Preservation Alliance, the National Trust for Historic Preservation, Cedar Rapids Historic Preservation Commission, and any other party that expresses an interest in the Corps' Iowa Flood risk Management Feasibility Study and its associated undertakings.

Thank you for the opportunity to comment upon the revised draft. We look discussing this with you further in the near future. Until then I can be reached at daniel.higginbottom@iowa.gov or by phone at (515) 281-8744 if you have any questions.

Sincerely,



Daniel K. Higginbottom, Archaeologist
Iowa State Historic Preservation Office

Cc: Jerome Thompson, Interim State Historic Preservation Officer, State Historical Society of Iowa
Barbara A. Mitchell, Deputy State Historic Preservation Officer, State Historical Society of Iowa
Jeremy Ammerman, Architectural Historian, Iowa State Historic Preservation Office
Ralph Christian, Historian, Iowa State Historic Preservation Office
Douglas W. Jones, Archaeologist, Iowa State Historic Preservation Office
John Eddins, Advisory Council on Historic Preservation
Jennifer Sandy, National Trust for Historic Preservation – Midwest Office
Paula Mohr, Certified Local Government Coordinator, State Historic Preservation Office
John Doershuk, State Archaeologist, University of Iowa – Office of the State Archaeologist
Hank Manning, Iowa Department of Economic Development

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT CORPS OF ENGINEERS
PO BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

October 15, 2009

Planning, Programs and Project
Management Division

SEE DISTRIBUTION LIST

The U.S. Army Corps of Engineers, Rock Island District, is preparing an Environmental Assessment (EA) entitled Environmental Assessment, Cedar River, Cedar Rapids, Iowa, Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa. This EA will assess the potential impacts resulting from the construction of a levee system on both sides of the Cedar River, in addition to other structural and non-structural flood risk management alternatives. This levee system is comprised of permanent earthen levees, floodwalls, and removable floodwall segments, and would be designed to mitigate impacts/damages from severe floods as was experienced in 2008. A preferred levee alignment, if one is found to be justified, will be decided upon in the near future, during the planning process for the EA.

Three new borrow areas are proposed for this project that were not coordinated in our previous letter (dated July 30, 2009). At this time, we are requesting your comments regarding any significant resources that might be impacted by the new proposed borrow areas (enclosures 1-4). Federal and/or State listed threatened or endangered species are of particular concern. Also, we request your assistance in identifying any additional existing significant resources that may be impacted such as wetlands, prime farmlands, eagle nests, conflicts with known land-use plans, floodplain issues, etc.

Please provide your comments/concerns regarding this proposal within 30 days of the date of this letter. A timely review of this information and a written response will be greatly appreciated. Should you have any questions regarding this proposal, please contact Mr. Lonn McGuire of our Economic and Environmental Analysis Branch, telephone 309/794-5709. Written responses may be sent to our address above, ATTN: Planning, Programs, and Project Management Division (Lonn McGuire).

Sincerely,

Kenneth A. Barr
Chief, Economic and
Environmental Analysis Branch

Enclosures (4)

DISTRIBUTION LIST

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Feasibility Study

Linn County
Cedar Rapids, Iowa

Mr. Richard Nelson
Ecological Services Field Office
U.S. Fish and Wildlife Service
1511 47th Avenue
Moline, Illinois 61265

Mr. Tom Cox
U.S. Fish and Wildlife Service
10728 County Road X61
Wapello, Iowa 52653-9477

Mr. Mike Griffin
Iowa Department of Natural Resources
206 Rose Street
Bellevue, Iowa 52031

Mr. John Askew, Regional Administrator
U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, Kansas 66101

Ms. Kathy Mulder
Water Resources Protection Branch
U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, Kansas 66101

Mr. Richard Leopold, Director
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand
Des Moines, Iowa 50319-0034

Ms. Diane Ford-Shivvers
Conservation & Recreation
Coordination & Policy
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand
Des Moines, Iowa 50319-0034

Ms. Christine M. Schwake
Water Quality Bureau
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand
Des Moines, Iowa 50319-0034

Linn County Conservation
1890 County Home Road
Marion, Iowa 52302-9753

Mr. Gerald Neff
Iowa Chapter Sierra Club
3839 Merle Hay Road
Suite 280
Des Moines, Iowa 50310

Mr. Ken DeKeyser
Stormwater Utility Engineer
1201 6th Street SW
Cedar Rapids, Iowa 52404

Mr. Bob Godlove, President
Linn County Chapter Izaak Walton League
5401 42nd Street
Cedar Rapids, Iowa 52411

Mr. Bill Northey
Iowa Dept of Ag and Land Stewardship
Wallace State Office Bldg
502 E. 9th Street
Des Moines, Iowa 50319

The Nature Conservancy, Iowa Field Office
303 Locust Street
Suite 402
Des Moines, Iowa 50309

Mr. Doug Harr
Iowa Chapter Audubon Society
P.O. Box 65
Larchwood, Iowa 51241

Mr. Jim Durbin
Cedar Rapids Audubon Society
1764 Sherbrook Dr. NE
Cedar Rapids, Iowa 52411

Mr. Mike Wyrick
Cedar Rapids Sierra Club
4823 Black Ivy Court NE
Cedar Rapids, Iowa 52411

Inga Foster
Iowa Department of Natural Resources
Conservation and Recreation Division
Wallace State Office Bldg
502 East 9th Street
Des Moines, Iowa 50319

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT CORPS OF ENGINEERS
PO BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

October 20, 2009

Planning, Programs and Project
Management Division

See Interested and Consulting Parties List:

The United States Army Corps of Engineers, Rock Island District (Corps), and the City of Cedar Rapids, Linn County, Iowa, are planning to conduct the Cedar River, Cedar Rapids, Iowa – Flood Risk Management Feasibility Study (FRMFS) – for Linn County, Cedar Rapids, Iowa, and flood protection management measures are proposed at various locations. The FRMFS is authorized, as promulgated under GI - General Investigations - House Resolution Docket 2749 adopted April 5, 2006, and Committee on Environment and Public Works, United States Senate, dated May 23, 2006. This correspondence is promulgated under the National Historic Preservation Act as amended (NHPA), and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties."

The FRMFS encompasses the reach of the Cedar River and its floodplain/watershed located in, or adjacent to the City of Cedar Rapids in Linn County. The Corps and the City of Cedar Rapids will manage the FRMFS throughout all stages of flood analysis and protection, project development, construction, and management. The Corps and the City of Cedar Rapids have determined that the implementation of the FRMFS may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP), and will consult with the Advisory Council on Historic Preservation (Council) and the Iowa State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]) (NHPA), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]).

The Corps, the Council, and the City of Cedar Rapids propose to execute a Programmatic Memorandum of Agreement (PMOA), as stipulated by 36 CFR Part 800.14(b) (ii) of the NHPA, to afford protection to known and unknown historic properties accorded by the NHPA. Other agencies and parties can request concurring or participatory status. The appropriate and/or pertinent comments of all parties will be addressed in the final PA and will be provided for execution by the lead participatory and concurring parties to this PA. The executed PA will be in the National Environmental Policy Act (NEPA) document resulting from the FRMFS, as evidence of Corps and City of Cedar Rapids compliance promulgated by the NHPA and the consulting process.

Pursuant to Section 800.3 of the Council's regulations and to meet the responsibilities under the NEPA of 1969, the Corps and the DNR have developed a preliminary Interested and Consulting Parties List. Those on the enclosed Interested and Consulting Parties List will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA.

The Corps and the City invite those on the list to a Corps of Engineers/Interested and Consulting Parties Meeting to discuss flood reduction measures with a tour of the potential locations following the attached Agenda (Enclosure) on October 28, 2009. On October 29, 2009, the Corps plans a conference to discuss the on-site visitation and any other cultural resource concerns. To participate in this teleconference, please call 888-721-6031 and provide pass code 753955. The teleconference will begin at 1:00 p.m. (Central time zone) and will end at 2:30 p.m. Your participation is appreciated.

Please contact Mr. Ron Deiss if you can attend this Corps of Engineers/Interested and Consulting Parties Meeting on October 28, 2009, by telephone 309/794-5185 or by email: Ronald.w.deiss@usace.army.mil.

Also, if you have any questions concerning the PMOA, the FRMFS, or the scheduled meeting, please call Mr. Ron Deiss at the above telephone number.

Sincerely,

Kenneth A. Barr
Chief, Economic and
Environmental Analysis Branch

Enclosure

MFR: Standard coordination letter promulgated under Section 106 of the NHPA to IA SHPO and other consulting parties concerning the Flood Risk Management Feasibility Study and providing them with an agency for the proposed on-site meeting.

(all w/encls):
Dist File (PM-M)
PM-A (Deiss) P:\CEDAR RAPIDS\Cedar Rapids tour\For Distribution.doc
PM-A (McGuire)
PM-M (Haring)
PM-M (Zukowshki)
EC-DM (Sunderman)

Interested and Consulting Parties List
Cedar River, Cedar Rapids, Iowa – Flood Risk Management Feasibility Study,
Cedar Rapids, Linn County, Iowa

AGENCIES AND SOCIETIES

Ms. June Strand
Iowa Historic Preservation Agency
ATTN: Review and Compliance
Program
State Historical Society of Iowa
Capitol Complex
Des Moines, Iowa 50319

ATTN: Mr. Thomas McCullouch
c/o Mr. Don L. Klima
Director
Eastern Office of Project Review
Old Post Office Building
1100 Pennsylvania Avenue,
NW. Suite 809
Washington, D.C. 20004

Mr. Tom Morain
Administrator and SHPO
State Historical Society of Iowa
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. Charles A. Bello, M.A., RPA,
Historic Preservation Specialist - Archaeologist
IA Homeland Security and Emergency Management
4459 Northwest 121st Street
Urbandale, Iowa 50323

Mr. Tim Weitzel
Historic Preservation Specialist
Iowa Department of Economic Development
200 East Grand Avenue
Des Moines, Iowa 50309

Mr. John Doershuk
State Archaeologist
Office of the State Archaeologist
700 South Clinton Street
University of Iowa
Iowa City, Iowa 52242

Ms. Lois Coulter
Crew Leader, Special Considerations (Historical)
FEMA Historic Preservation Specialist
FEMA Iowa Recovery Center
4149 - 120th Street
Urbandale, Iowa 50323

Ms. Maura Pilcher
Chair
Cedar Rapids Historic Preservation Commission
Department of Community Development
3851 River Ridge DR NE
Cedar Rapids, Iowa 52402-3851

Mr. Rod Scott
President
Iowa Historic Preservation Alliance
P.O. Box 814
Mt. Pleasant, Iowa 52641

Mr. Ken DeKeyser
PE CPESC
Cedar Rapids Public Works Dept.
1201 6th Street SW.
Cedar Rapid, Iowa 52404

Ms. Rita Rasmussen
Real Estate
1201 6th Street SW.
Cedar Rapid, Iowa 52404

Mr. Dave Smith
Parks and Recreation
3601 42nd Street NE.
Cedar Rapids, Iowa 52402

Mr. Adam Lindenlaub
Economics
3851 River Ridge Drive NE.
Cedar Falls, Iowa 52402

Mr. Ken Sessa
U.S. Department of Homeland Security
FEMA Region VII
2323 Grand Boulevard, Suite 900
Kansas City, Missouri 64108-2654

Ms. Kristen O'Connell
National Park Service
Historic American Engineering Record
1201 Eye Street, NW. 2270
Washington, D.C. 20005

Mr. Dana Lockett
Architectural Project Manager
National Park Service
Historic American Engineering Record
1201 Eye Street NW. 2270
Washington, D.C. 20005

Ms. Justine Christianson
Historian
Historic American Engineering Record
1201 Eye Street NW. 2270
Washington, D.C. 20005

Mr. David J. Grignon
Tribal Historic Preservation Officer
Menominee Indian Tribe of Wisconsin
P.O. Box 910
Keshena, Wisconsin 54135-0910

National Trust on Historic Preservation
1785 Massachusetts Avenue NW.
Washington, D.C .20036-2117

Ms. Jennifer Sandy
Midwest Office
National Trust for Historic Preservation
53 West Jackson Boulevard, Suite 350
Chicago, Illinois 60604

Ms. Barbara Mitchell
Deputy (SHPO), Architectural Historian
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. Ralph Christian
Historian
600 East Locust Street
Des Moines, Iowa 50319-0290

Ms. Paula Mohr
Local Government Coordinator (SHPO)
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. Daniel Higginbottam
Archeologist, Review & Compliance Program Manager
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. Douglas Jones
Archeologist, Review & Compliance Program Manager
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. David Stanley
President
Bear Creek Archeology, Incorporated
P.O. Box 347
Cresco, Iowa 52136

Mr. Mark Long
President
Wells Fargo Bank Branch
101 Third Avenue SW
Cedar Rapids, Iowa 52404

Ms. Jennifer Pratt
Cedar Rapids Development Coordinator
3851 River Ridge Drive NE
Cedar Falls, Iowa 52402

Mr. Jack Porter
Preservation Consultant
600 East Locust Street
Des Moines, Iowa 50319-0290

Mr. Mike Smith
Assistant General Counsel
National Trust for Historic Preservation
1785 Massachusetts Ave., NW
Washington, D.C. 20036-2117

Ms. Lavonne Grimes
Iowa Historic Preservation Agency
ATTN: Review and Compliance
Program
State Historical Society of Iowa
Capitol Complex
Des Moines, Iowa 50319

Mr. Elwood Garlock
Cedar-Wapsie Group of the
Iowa Chapter the Sierra Club
1700 C Ave NW
Cedar Rapids, Iowa 52405

Mr. Benton Quade
CDBG Project Manager
200 E Grand Avenue
Des Moines, Iowa 50309

Mr. Jeremy Ammerman
Architectural Historian
for Disaster Relief Efforts
600 East Locust Street
Des Moines, Iowa 50319

Mr. Richard Luther
Cultural and Historical Society
City of Cedar Rapids
3851 River Ridge Drive NE
Cedar Rapids, Iowa 52405

Ms. Barbara Wyatt
National Register of Historic Places
National Park Service
1201 Eye Street NW
Washington, D.C. 20005

Mr. Adrain Stroupe
Long Term Community Recovery ESF#4
Federal Emergency Management
500 C Street SW
Washington, D.C. 20472

TRIBES

Sac and Fox of Oklahoma

Mr. George Thurman, Principal Chief
Sac & Fox Nation of Oklahoma
Route 2, Box 246
Stroud, Oklahoma 74079

Ms. Sandra Massey
Sac & Fox Nation of Oklahoma
Route 2, Box 246
Stroud, Oklahoma 74030

Sac and Fox of Missouri

Mr. Twen Barton, Chairman
Sac & Fox Nation of Missouri
305 North Main Street
Reserve, Kansas 66434

Mr. Edmore Green
Sac & Fox Nation of Missouri
305 North Main Street
Hiawatha, Kansas 66434

Sac and Fox of Iowa

Mr. Adrian Pushetonequa, Chairman
Sac & Fox Tribe of Mississippi in Iowa
349 Meskwaki Road
Tama, Iowa 52339

Mr. Jonathan Buffalo
Sac & Fox of the Mississippi
349 Meskwaki Road
Tama, Iowa 52339

Iowa of Kansas

Mr. Leon Campbell, Chairman
Iowa Tribe of Kansas
3345 Thrasher Road # 8
White Cloud, Kansas 66094

Mr. Patt Murphy
Iowa Tribe of Kansas and Nebraska
204 South Buckeye
Salina, Kansas 67410

Iowa of Oklahoma

Ms. Christie Modlin, Chairwoman
Iowa Tribe of Oklahoma
Route 1, Box 721
Perkins, Oklahoma 74059

Ho Chunk Nation of Wisconsin

Mr. Wilfrid Cleveland, President
Ho-Chunk Nation
P.O. Box 667
Black River Falls, Wisconsin 54675

Mr. Larry Garvin
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
P.O. Box 667
Black River Falls, Wisconsin 54615

Mr. William Quackenbush
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
P.O. Box 667
Black River Falls, Wisconsin 54615

Winnebago

Mr. John Blackhawk, Chairman
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, Nebraska 68071

Mr. Charles Aldrich
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, Nebraska 68071

Otoe-Missouria Tribe of Oklahoma

Mr. Charles Michael Harwell, Chairman
Otoe-Missouria Tribe of Oklahoma
8151 Highway 177
Rock Road, Oklahoma 74651

Ms. Mildred Hudson
Otoe-Missouria Tribe of Oklahoma
8151 Highway 177
Rock Road, Oklahoma 74651

Yankton Sioux

Mr. Robert Cournoyer, Chairman
Yankton Sioux
P.O. Box 248
Marty, South Dakota 57361

Mr. Francis Berney
Yankton Sioux
P.O. Box 248
Marty, South Dakota 57361

AGENDA
CORPS OF ENGINEERS/ INTERESTED AND CONSULTING PARTIES MEETING

Concerning the planning for the Cedar River, Cedar Rapids, Iowa
–Flood Risk Management Feasibility Study–

28 October 2009

Crowne Plaza Five Seasons Hotel
350 1st Avenue East, Cedar Rapids Iowa
Phone 319-363-8161

8:00-9:30 Presentation
- Powerpoint Presentation
- Background
- Alignments
- Cultural Resources Status

9:30-11:30 Bus Tour (please dress accordingly)
West Side flood protection management measures & Borrow Areas

11:30-12:30 Lunch
Czeck Village - The Bohemian (Baker, Café & Pub)
95 16th Ave SW, Cedar Rapids, Iowa

12:30-5:00 Bus Tour (please dress accordingly)
East Side flood protection management measures & Borrow Areas

5:00 Return to Hotel Meeting Complete
(***Call Hotel for Room Reservations)***

Iowa
Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

November 5, 2009

Department of the Army
Rock Island District Corps of Engineers
ATTN: Planning, Programs, and Project Management Division (Lonn McGuire)
PO BOX 2004
Rock Island, IL 61204-2004

RE: Environmental Assessment Cedar River, Cedar Rapids, Iowa
~~Flood Risk Management Feasibility Study, Linn County (Additional Borrow Sites)~~

Dear Lonn McGuire:

This letter is in response to the October 15, 2009 letter concerning the additional borrow sites for the Cedar River Flood Risk Management Feasibility project. Thank you for inviting our comments on the impact of the above referenced project.

Waters of the United States (includes wetlands) should not be disturbed if a less environmentally damaging alternative exists. Unavoidable adverse impacts should be minimized to the extent practicable. Any remaining adverse impacts should be compensated for through restoration, enhancement, creation and/or preservation activities. We would ask that Best Management Practices be used to control erosion and protect water quality near the project.

You are encouraged to conduct your construction activities during a period of low flow. You are required to seed all disturbed areas with native grasses and to implement appropriate erosion control measures to insure that sediments are not introduced into waters of the United States during construction of this project.

If you have any questions, please call me at (515)281-6615.

Sincerely,

Christine M. Schwake

Christine Schwake
Environmental Specialist

502 EAST 9th STREET / DES MOINES, IOWA 50319-0034
PHONE 515-281-5918 FAX 515-281-8895 www.iowadnr.gov

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

November 6, 2009

Lonn McGuire
US Army Corps of Engineers, Rock Island District
PO Box 2004
Rock Island, IL 61204-2004

RE: Environmental Review for Natural Resources
Environmental Assessment, Cedar River, Cedar Rapids, Iowa
Flood Risk Management Feasibility Study
New Borrow Areas
Linn County
Oeschger Site, Section 32, Township 83N, Range 8W
Phillips Trucking, Section 2, Township 82N, Range 7W
Tuma Future Parkland, Section 10 and 15, Township 84N, Range 7W

Dear Mr. McGuire:

Thank you for inviting Department comment on the impact of this project. The Tuma Future Parkland borrow site in Section 15 is bisected by Dry Creek. The Department recommends that no excavation or construction take place in the creek to avoid impact to fish and other aquatic resources. If construction or excavation is proposed in Dry Creek, please contact the Department for further review of the project.

The Department has searched for records of rare species and significant natural communities in the project area and found no site-specific records that would be impacted by this project. However, these records and data are not the result of thorough field surveys. If listed species or rare communities are found during the planning or construction phases, additional studies and/or mitigation may be required.

This letter is a record of review for protected species, rare natural communities, state lands and waters in the project area, including review by personnel representing state parks, preserves, recreation areas, fisheries and wildlife but does not include comment from the Environmental Services Division of this Department. This letter does not constitute a permit. Other permits may be required from the Department or other state or federal agencies before work begins on this project.

Any construction activity that bares the soil of an area greater than or equal to one acre including clearing, grading or excavation may require a storm water discharge permit from the Department. Construction activities may include the temporary or permanent storage of dredge material. For more information regarding this matter, please contact Ruth Rosdail at (515) 281-6782.

The Department administers regulations that pertain to fugitive dust IAW Iowa Administrative Code 567-23.3(2)"c." All persons shall take reasonable precautions to prevent the discharge of visible emissions of fugitive dusts beyond the lot line of property during construction, alteration, repairing or demolishing of buildings, bridges or other vertical structures or haul roads. All questions regarding fugitive dust regulations should be directed to Jim McGraw at (515) 242-5167.

502 EAST 9th STREET / DES MOINES, IOWA 50319-0034
PHONE 515-281-5918 FAX 515-281-6794 www.iowadnr.gov

If you have questions about this letter or require further information, please contact me at (515) 281-8967.

Sincerely,

Inga Foster
Environmental Specialist
Conservation and Recreation Division

FILE COPY: Inga Foster
Tracking Number: 3879

CC: Bob Clevenstine, U.S. Fish and Wildlife Service, Rock Island Field Office, 1511 47th Ave., Moline, IL 61265-7022
Christine Schwake, Iowa DNR

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT CORPS OF ENGINEERS
PO BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

February 16, 2010

Planning, Programs, and Project
Management Division

Ms. Lavonne Grimes
ATTN: Review and Compliance
Program
State Historical Society of Iowa
Capitol Complex
Des Moines, Iowa 50319

Dear Ms. Grimes;

The United States Army Corps of Engineers, Rock Island District (Corps), and the City of Cedar Rapids (City), Linn County, Iowa, have been consulting with the State Historical Society of Iowa (SHSI) concerning the Cedar River, Cedar Rapids, Iowa – Flood Risk Management Feasibility Study (FRMFS) – Linn County, Cedar Rapids, Iowa. The FRMFS is authorized, as promulgated under GI - General Investigations - House Resolution Docket 2749 adopted April 5, 2006, and the Committee on Environment and Public Works, United States Senate, dated May 23, 2006. This correspondence is promulgated under the National Historic Preservation Act as amended (NHPA), and its implementing regulations 36CFR Part 800: "Protection of Historic Properties."

The Corps and the City have determined that implementation of the proposed FRMFS flood protection management measures may have an effect upon properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP). The Corps and the City have initiated consultation with the Advisory Council on Historic Preservation (Council) and the Iowa State Historic Preservation Officer (SHPO) pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470[f]) (NHPA), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]). The Corps encloses the final Alternatives with an FRMFS Fact Sheet (enclosure 1) and a revised FRMFS schedule (enclosure 2),

Those on the Interested and Consulting Parties List (enclosure 3) will be provided with public meeting announcements, special releases, and notifications of the availability of report(s), including all draft and final agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Those on the Interested and Consulting Parties lists may not get all of the enclosures, since specific locations of historic and archaeological properties found in enclosure 5 are subject to protection through nondisclosure under Section 304 of the National Historic Preservation Act. This information is not to be released in order to protect the resources at the sites.

By letters dated June 23, 2009, and August 19, 2009, the Corps and the City provided Interested and Consulting Parties (enclosure 3) with: a preliminary description of the FRMFS; maps of alternatives studied; and a draft *Programmatic Memorandum of Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, Cedar Rapids Historic Preservation Commission, and Advisory Council on Historic Preservation for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study – Linn County, Cedar Rapids, Iowa* (PMOA). The Corps and the City have coordinated with your office; with state, local, and other government agencies; with the Advisory Council on Historic Preservation; and with tribes and other consulting parties, concerning the draft PMOA, as well as sacred sites and traditional cultural properties.

On October 28, 2009, the Rock Island District sponsored a meeting with the Iowa State Historic Preservation Office (State Historical Society of Iowa) and the City of Cedar Rapids, and invited the other Interested and Consulting Parties. The meeting agenda included a PowerPoint presentation of the various flood reduction alternatives under study, and cultural resources status relevant to Section 106 of the National Historic Preservation Act procedures and the proposed draft PMOA. The meeting was followed up with a bus tour of the areas under study. On October 10, 2009, the Rock Island District held a telephone conference call which focused on the October 28th follow-up issue resolution, with participants from the State Historical Society of Iowa and the Advisory Council on Historic Preservation. All comments were incorporated into the enclosed draft PMOA (enclosure 4).

Ancillary to the submittal of a final PMOA for execution, the Corps encloses the draft Report (enclosure 5):

> Benn, David W., Joe B. Thompson, Elmer A. Bettis III, and Derek V. Lee. 2010. *Background Cultural Research and Geomorphological Investigation of Measures for the Cedar River Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa: Volume I--Management Summary and Text, Volume II—Figures and Appendices A-F* (Draft Report, BCA 1620, January). Prepared by Bear Creek Archeology, Inc., Cresco, Iowa under U.S. Army Corps of Engineers, Rock Island District Contract W912EK-08-D-0002, Delivery Order 0016, Modifications 1-4.

The Report recommendations and other data relevant to historic properties within the Area of Potential Effect (APE) are included in the *Cedar River, Cedar Rapids, Iowa -Flood Risk Management Feasibility Study (FRMFS) - Linn County, Cedar Rapids, Iowa, Cultural Resources Fact Sheet* (enclosure 6). A major component of the Report is the delineation of areas/landforms/reaches of no, low, medium, and high potential for containing NRHP

potentially eligible, eligible, or listed archeological properties. The Report focuses on those areas where the FRMFS measures are under study and on city-owned properties selected for potential borrow. These investigations were conducted to complement the extensive architectural documentation of the area by the City of Cedar Rapids and the Federal Emergency Management Agency (Department of Homeland Security).

Please provide any information, requests, views, or comments within 30 days, or the Corps will assume you agree with our proposed PMOA and draft Report. If you have questions concerning the FRMFS, please call Mr. Ron Deiss of our Economic and Environmental Analysis Branch, telephone 309/794-5185, or write to our address above, ATTN: Planning, Programs, and Project Management Division (Ron Deiss).

Sincerely,

ORIGINAL SIGNED BY

Kenneth A. Barr
Chief, Economic and Environmental
Analysis Branch

Enclosures

MFR: Standard coordination letter promulgated under Section 106 of the NHPA to IA SHPO and other consulting parties concerning the Flood Risk Management Feasibility Study, review of the revised a draft PA and draft archival background and geomorphological report.

(all w/encls):
Dist File (PM-M)
PD-E (Deiss)
PD-E (McGuire)
PM-M (Haring)
PM-M (Zukowski)
EC-DM (Sunderman)

Enclosure 1
Cedar Rapids Alternative Descriptions
February 11, 2010

Note: In analyzing the varying flood risk management heights investigated in the feasibility study, protection levels for all alternatives are based on the new Corps flow frequency data which establishes flood stages for the 100 year (1 percent), 200 year (.5 percent), 500 year (.2 percent), and the 2008 flood event. The alternative plates show the maximum footprint (2008 level of protection).

Alternative 1:

Areas Protected: This alternative protects the east and west sides of the Cedar River corridor of Cedar Rapids. The neighborhoods protected on the east side are, from north to south: the Cedar Lake Area, Cedar Rapids Downtown-east, the Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. The west side alignment protects, from north to south: the Time Check/Northwest neighborhood, the Cedar Rapids Downtown-west/Taylor neighborhood, and the Czech neighborhood.

Description of Alignment: The east side alignment starts in the north with a tie-back levee along McCloud's Run and proceeds to the Cedar River, then turns south and runs parallel between the railroad tracks and the river. The alignment then turns south and runs parallel along the riverside of the downtown buildings. The alignment then turns east at 8th Street where it creates greenway between the alignment and the river through City-owned properties to 12th Street. From 12th Street the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

The west side alignment starts with a tie-back north of Ellis Lane and runs south between Ellis Boulevard NW and the Cedar River and then turns just north of O Avenue NW. At O Avenue NW and 4th Street NW, the alignment turns south and follows just west of 4th Street NW until K Avenue NW, where it turns east to the railroad bridge. At the railroad bridge, the alignment turns south and follows 1st Street NW until 4th Avenue SW, where it turns southeast in front of the Police Station. The alignment then proceeds south following the Cedar River aligning with A Street SW and tying into high ground at the terminus of A Street SW.

Alternative 1A:

Areas Protected: This alternative protects the east and west sides of the Cedar River corridor of Cedar Rapids. The neighborhoods protected on the east side are, from north to south: southern Cedar Lake Area (Alliant Energy, Cargill, Quaker Oats facilities), Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood. The west side alignment protects, from north to south: the Time Check/Northwest neighborhood, the Cedar Rapids Downtown-west/Taylor neighborhood, and the Czech neighborhood.

Description of Alignment: The east side alignment starts in the north with a tie-back levee protecting the southern Cedar Lake area. The alignment then turns south and runs parallel along the riverside of the downtown buildings. The alignment then turns east at 8th Street where it creates greenway between the alignment and the river through City-owned properties to 12th Street. From 12th Street the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

The west side alignment is the same as that in Alternative 1.

Alternative 4:

Areas Protected: This alternative protects only the east side of the Cedar River corridor of Cedar Rapids. The neighborhoods protected are, north to south: southern Cedar Lake Area (Alliant Energy, Cargill, Quaker Oats facilities), Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood.

Description of Alignment: The east side alignment starts in the north with a tie-back levee protecting the southern Cedar Lake area. The alignment then turns south and runs parallel along the riverside of the downtown buildings. It then turns landward at 8th Street where it creates greenway through City-owned properties to 12th Street. From 12th Street the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

Alternative 5:

Areas Protected: This alternative protects a small portion of the east side of the Cedar River corridor of Cedar Rapids. Protected are portions of the Oakhill-Jackson and Sinclair-Cargill neighborhoods.

Description of Alignment: The alignment starts in the north with a tie-back levee starting at the intersection of 8th Street SE and 12th Avenue SE. The levee alignment runs parallel to 12th Avenue SE then turns south along 5th Street SE and continues in a general southeast direction. The alignment then proceeds downstream with a tie-back levee crossing Otis Road SE just south of Cargill.

Alternative 7:

Areas Protected: This alternative protects a small portion of the east side of the Cedar River corridor of Cedar Rapids. The neighborhood protected is the southern Cedar Lake Area (Alliant Energy, Cargill, Quaker Oats facilities).

Description of Alignment: The alignment starts in the northeast with the levee alignment protecting the backside of the three facilities from Cedar Lake. The alignment then generally runs east to west turning south along the Cedar River. The final tie-back portion of the levee to the south is under Interstate 380.

Cedar Rapids – Feasibility Study
Typical Levee and Floodwall Descriptions

See attached plates for typical cross sections on both an earthen levee and floodwall applied to this feasibility study.

Earthen Levee Section. The proposed levee section represents a clay levee with a ten foot top width and 3H:1V (3 Horizontal:1 Vertical) side slopes. A 10-foot deep inspection trench would be excavated through areas with basements and a 6-foot deep inspection trench through areas without basements. Design height of levees range from 0 to 20 feet depending on the location and depending on the design flood event. The 100-year, 200-year, 500-year and 2008 flood (all with an additional 3-feet of freeboard) are the design levels analyzed in the feasibility study.

Concrete Floodwall Section. The proposed floodwall section represents a T-wall design that varies in wall thickness of 1.5 to 3.0 feet depending upon total wall height. Construction of the floodwall foundation requires trenching 10 feet deep. The bottom 6 feet of the trench is "over excavation" below the footing foundation to account for bad soils typically found along river floodplains. Over excavation voids are backfilled with compacted clay material. A steel sheetpile cutoff wall is driven underneath the concrete footing.

Real Estate Interest. The following real estate interest applies to both the levee and floodwall sections. Measurement of the easement width starts from the toe of levee or the face of floodwall.

Permanent Easements (PE).

Protected Side - Thirty feet of permanent easement is shown for real estate interest on existing ground extending out from the protected side line of protection. The 30 feet accounts for real estate interest to maintain a 15-foot vegetation clear zone and for permanent relocation of utilities and roads.

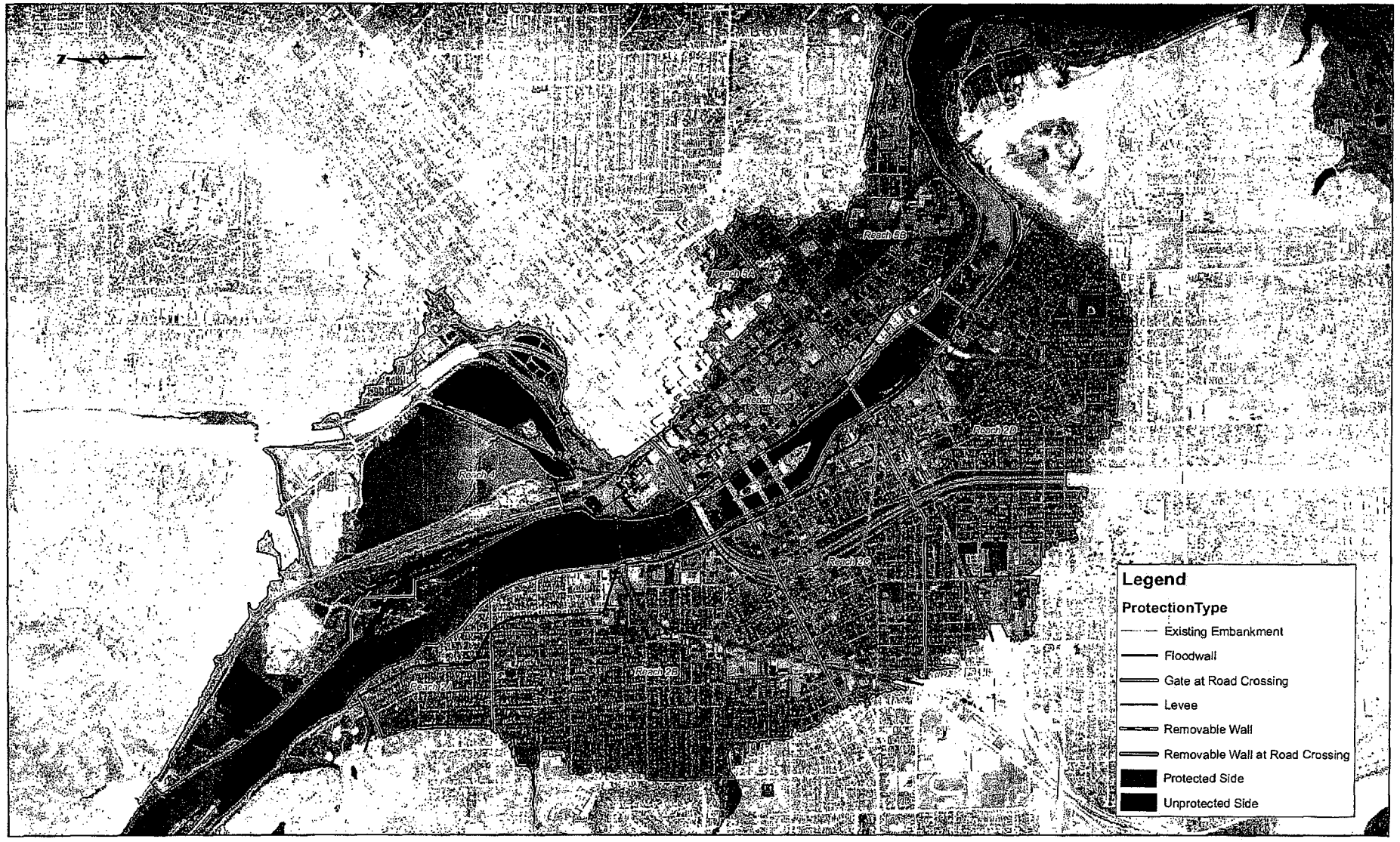
Flood Side – Fifteen feet of permanent easement is shown for real estate interest on the existing ground extending out from the flood side line of protection. This accounts for the real estate interest in order to maintain a 15-foot vegetation clear zone.

Temporary Easements (TE). An additional 15 feet of temporary easement on both the protected and flood side of the line of protection is included beyond the permanent easement areas. The temporary easements are included to account for construction activities along the alignment and to account for construction storage and staging areas.



Stanley Consultants INC.

2008 Year Flood Event Solution
Measure 2B & Measure 18B
Alternative 1



Stanley Consultants INC.

2008 Year Flood Event Solution
Measure 2B & Measure 27B
Alternative 1A



Stanley Consultants INC.

2008 Year Flood Event Solution
Measure 27B
Alternative 4



Stanley Consultants INC.

2008 Year Flood Event Solution
Measure 19B
Alternative 5



Stanley Consultants INC.

2008 Year Flood Event Solution
Measure 28B
Alternative 7

Enclosure 2
Cedar Rapids Flood Risk Management Feasibility Study Schedule (FRMFS)

2-15-2010

Affirmative Analysis Complete/Tentatively Selected Plan	15 March 2010
Draft Feasibility Report to Editing	21 April 2010
Begin Public Review of Feasibility Report	6 July 2010
Complete Public Review	2 August 2010
Division Commander's Transmittal/Final Report Submission	9 August 2010
Chief's Report Signed	27 December 2010

Enclosure 3
Interested and Consulting Parties List
Cedar Rapids, Cedar Rapids, Iowa
– Flood Risk Management Feasibility Study –
Cedar Rapids, Linn County, Iowa

AGENCIES AND SOCIETIES

Ms. June Strand
ATTN: Review and Compliance Program
State Historical Society of Iowa
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Des Moines, IA 50319 *(w/encl 5)*

ATTN: Mr. Thomas McCullouch
c/o Mr. Don L. Klima
Director
Eastern Office of Project Review
Old Post Office Building
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Mr. Jerome Thompson
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State Historical Society of Iowa
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Mr. Tim Weitzel
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COR PBS, General Services Admin.
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Mr. Thomas Moore, Executive Director
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Landscape Architect
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Mr. Daniel Gibbins, City Arborist
Cedar Rapids Public Works Department
3601 42nd Street NE
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Mr. Dave Smith
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Chapter the Sierra Club
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Ms. Peggy Whitworth
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Ms. Sandi Fowler
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Mr. Patrick Roberts
Flood Assistance Team
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Iowa Department of Economic
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TRIBES

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Sac & Fox Nation of Oklahoma
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Stroud, OK 74079

Ms. Sandra Massey
Sac & Fox Nation of Oklahoma
Route 2, Box 246
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Sac and Fox of Missouri

Mr. Twen Barton, Chairman
Sac & Fox Nation of Missouri
305 North Main Street
Reserve, KS 66434

Mr. Edmore Green
Sac & Fox Nation of Missouri
305 North Main Street
Hiawatha, KS 66434 *(w/encl 5)*

Sac and Fox of Iowa

Mr. Adrian Pushetonequa, Chairman
Sac & Fox Tribe of Mississippi in Iowa
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Tama, IA 52339

Mr. Jonathan Buffalo
Sac & Fox of the Mississippi
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Iowa Tribe of Kansas and Nebraska

Mr. Leon Campbell, Chairman
Iowa Tribe of Kansas
3345 Thrasher Road # 8
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Mr. Alan Kelly
Iowa Tribe of Kansas and Nebraska
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Iowa of Oklahoma

Ms. Christie Modlin, Chairwoman
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Ho Chunk Nation of Wisconsin

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Ho-Chunk Nation
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Black River Falls, WI 54675

Mr. Larry Garvin
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
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Black River Falls, WI 54615

Mr. William Quackenbush
Cultural Resources Division
Ho-Chunk Nation of Wisconsin
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Menominee

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Tribal Historic Preservation Officer
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Winnebago

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Winnebago, NE 68071

Mr. Charles Aldrich
Winnebago Tribe of Nebraska
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Winnebago, NE 68071 *(w/encl 5)*

Otoe-Missouria Tribe of Oklahoma

Mr. Charles Michael Harwell, Chairman
Otoe-Missouria Tribe of Oklahoma
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Ms. Mildred Hudson
Otoe-Missouria Tribe of Oklahoma
8151 Highway 177
Rock Road, OK 74651 *(w/encl 5)*

Yankton Sioux

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Yankton Sioux Tribal Historic
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P.O. Box 248
Marty, SD 57361

Mr. Francis Berney
Yankton Sioux
P.O. Box 248
Marty, SD 57361

Enclosure 4

PROGRAMMATIC MEMORANDUM OF AGREEMENT AMONG THE UNITED STATES ARMY CORPS OF ENGINEERS ROCK ISLAND DISTRICT, IOWA STATE HISTORIC PRESERVATION OFFICER, CITY OF CEDAR RAPIDS, AND ADVISORY COUNCIL ON HISTORIC PRESERVATION FOR UNDERTAKINGS IMPLEMENTED UNDER THE CEDAR RIVER, CEDAR RAPIDS, IOWA FLOOD RISK MANAGEMENT FEASIBILITY STUDY, LINN COUNTY, CEDAR RAPIDS, IOWA

WHEREAS, the United States Army Corps of Engineers Rock Island District (hereinafter Corps) and the City of Cedar Rapids, Iowa (hereinafter City) are undertaking the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study (FRMFS), Linn County, Cedar Rapids, Iowa, and propose flood protection management measures in accordance with House Resolution Docket 2749 (General Investigations) adopted April 5, 2006, and Committee on Environment and Public Works U.S. Senate dated May 23, 2006; and

WHEREAS, the Corps has determined that implementation of the FRMFS flood protection management measures will result in undertakings that may affect properties listed or eligible for listing on the National Register of Historic Places (hereinafter NRHP), and has consulted with the Advisory Council on Historic Preservation (hereinafter ACHP), the Iowa State Historic Preservation Officer (hereinafter SHPO), Interested and Consulting Parties, and Native American Tribes (hereinafter Parties, pursuant to 36 CFR § 800.14(b) as promulgated under the regulations implementing Section 106 of the National Historic Preservation Act [16 U.S.C. 470(f) and Section 110(f) of the same Act (16 U.S.C. 470h-2(f)]; and,

WHEREAS, the FRMFS program is complex in its scope and the Corps, in consultation with the SHPO, proposes a phased approach to identify historic properties and to evaluate the level of the undertaking's effects upon them as allowed by 36 CFR 800.4(b)(2); and

WHEREAS, the Corps has not fully determined the areas of potential effects (hereinafter APE) for all of the undertakings envisioned under the FRMFS program but will consult with the SHPO in a timely manner prior to implementation in order to determine the APE for each of the projects subject to the terms of this agreement; and

WHEREAS, the Tribal Historic Preservation Officers of these tribes: Menominee Indian Tribe of Wisconsin and Ho Chunk Nation of Wisconsin (THPOs), and representatives of these federally recognized tribes: Ho Chunk Nation of Wisconsin, Iowa of Oklahoma, Iowa Tribe of Kansas and Nebraska, Menominee Indian Tribe of Wisconsin, Otoe-Missouria Tribe of Oklahoma, Sac and Fox of Iowa, Sac and Fox of Missouri, Sac and Fox of Oklahoma, Winnebago, and Yankton Sioux (Tribes) participated in the consultation and have not requested to be a Signatories/Concurring Party to this agreement (**XVI. SIGNATORIES TO THIS AGREEMENT**); and

WHEREAS, because the City is a Certified Local Government pursuant to 36 C.F.R. Part 61, the Cedar Rapids Historic Preservation Commission (hereinafter CRHPC) participated in the consultation and has been invited to sign this agreement as a Concurring Party (**XVI. SIGNATORIES TO THIS AGREEMENT**); and

WHEREAS, the Office of the State Archaeologist (hereinafter OSA) participated in the consultation and requested to be included as a signatory in the PA (**XVI. SIGNATORIES TO THIS AGREEMENT**); and

NOW, THEREFORE, the Corps, the SHPO, the City, and the ACHP agree that the undertakings shall be implemented in accordance with the following stipulations of this *Programmatic Agreement Among the United States Army Corps of Engineers, Iowa State Historic Preservation Officer, City of Cedar Rapids, and Advisory Council on Historic Preservation Officer, City of Cedar Rapids, and Advisory Council on Historic Preservation for Undertakings Implemented Under the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa* (PMOA) to satisfy the Corps' Section 106 responsibilities for all individual actions (**XVI. SIGNATORIES TO THIS AGREEMENT**).

STIPULATIONS

I. HISTORIC PROPERTY SURVEYS AND TESTING

The Corps will take all measures necessary to discover, preserve, and avoid significant historic properties listed on, or eligible for inclusion in the NRHP, including but not limited to burials, cemeteries, or sites likely to contain human skeletal remains, artifacts, or objects associated with interments or religious activities, and provide this information, and associated studies or reports to the OSA and SHPO through the implementation of historic property surveys and testing, and agreed upon treatments of historic properties. The Corps will ensure that the following measures are implemented:

A. The Corps will provide scholarly evidence of stewardship in the recordation, protection, and management of historic properties within the City through systemic research and studies which have been finalized and approved, then placed in the permanent files of the SHPO as evidence of compliance promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 C.F.R. Part 800: "Protection of Historic Properties." Furthermore, the Corps will make a reasonable and good faith effort to carry out appropriate identification efforts under § 800.4(b)(1).

B. Unless recent and modern ground surface disturbances and/or historic use can be documented, the Corps will conduct necessary surveys on all areas indirectly and directly affected by construction, use, maintenance, and operation of all flood protection measures during the implementation of the FRMFS preferred alternative along with the project related activities and projects. The Corps will evaluate historic properties relative to past surveys and reports and properties deemed ineligible within the last five years will not be reevaluated. If a survey results in the identification of properties that are eligible to the NRHP, the Corps, in consultation with the SHPO, Tribe(s), THPO(s), and/or Parties, shall develop and implement plans for the appropriate treatment of historic properties. In order of preference, treatment will include, but not be limited to preservation of all or part of the historic property, avoidance of the historic property, data recovery of the portion of the historic property to be affected, or data recovery of the entire historic property.

C. All surveys will be conducted in a manner consistent with the Secretary of the Interior's *Standards and Guidelines for Identification and Evaluation* (48 FR 44720-23) and take into account the National Park Service publication *The Archaeological Survey: Methods and Uses* (1978) and any extant or most recent version of the *Guidelines for Archaeological Investigations in Iowa* (1999). The reconnaissance surveys and subsurface testing will be implemented by the Corps, reported, and the reports will be provided to the SHPO for review and comment.

D. In consultation with the SHPO, and, as appropriate, the THPOs/Tribes, the Corps shall evaluate for eligibility all properties by applying the NRHP criteria (36 CFR § 60.4).

1. For those properties that the Corps and the SHPO (and, as appropriate, the THPOs/Tribes) agree are not eligible for nomination to or inclusion in the NRHP, no further historic properties investigations will be required, and the project may proceed in those areas.

2. If the survey results in the identification of properties that the Corps and the SHPO (and, as appropriate, the THPOs/Tribes) agree are eligible for inclusion on the NRHP, such properties shall be treated in accordance with Stipulation **II. TREATMENT OF HISTORIC PROPERTIES**.

3. If the Corps and the SHPO (and, as appropriate, the THPOs/Tribes) do not agree on NRHP eligibility, or if the ACHP or the National Park Service so request, the Corps will request a formal determination of eligibility from the Keeper of the NRHP, National Park Service, whose determination shall be final.

II. TREATMENT OF HISTORIC PROPERTIES

The Corps will adhere to the following guidelines when dealing with historic properties in the project's area of potential effect.

A. Avoidance. The preferred treatment for all archeological, historical, and architectural historic properties is avoidance of direct and indirect effects implemented by the project. The Corps shall, to the extent feasible, avoid historic properties either through project design changes, use of temporary fences or barricades during construction, realignments, landscaping, or other measures that SHPO agrees will adequately protect historic properties.

B. Reduction of Effects on Properties Preserved in Place. When the Corps determines that complete avoidance of historic properties is not feasible, the Corps shall explore ways to reduce the extent of the adverse effects on the properties. Exploration of ways to reduce adverse effects will include the consideration of preservation of historic properties or the protection of historic properties against impacts by project-related activities in close proximity to the property.

C. Alteration/Floodproofing. The Corps shall ensure that alterations to historic buildings or structures required for floodproofing adhere to the recommended approaches in the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitation*. The floodproofing shall also meet the applicable City ordinances, standards, and regulations. The Corps shall coordinate proposed floodproofing plans with the SHPO, City, CRHPC, and Parties and take their comments and recommendations into consideration when deciding on the treatment plan.

D. Mitigation Plans. When the Corps, in consultation with the appropriate SHPO (and, as appropriate, the THPOs/Tribes), determines that project activities will have an adverse effect on buildings, structures, sites, districts, or objects, and that avoidance or in-place preservation is not feasible, the Corps shall ensure that a mitigation plan is developed for these properties in accordance with Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES**.

E. Qualified Professions. The Corps shall ensure that qualified professionals meeting the *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44738-39) are used to develop and implement all treatment plans.

F. Treatment Plans. Unless the SHPO (and, as appropriate, the THPOs/Tribes) objects within 30 days of receipt of any plan, the Corps shall ensure that the treatment plans are implemented by the Corps or its representative(s). The Corps shall revise treatment plans to address comments and recommendations provided by the SHPO and THPOs/Tribes so long as the Corps, SHPO, and THPOs/Tribes can agree that they are technically feasible and economically prudent. Should the Corps and SHPO not agree, the Corps will request the ACHP's comments in accordance with Stipulation **X. DISPUTE RESOLUTION.**

G. Buildings and Structures. When avoidance or in-place preservation is not feasible, treatment plans for NRHP listed or eligible buildings and structures shall adhere to the following guidelines:

1. Acquisition.

a. The buildings or structures located within the proposed levee and floodwall construction corridors shall be acquired by the City as part of their obligations under this flood protection Project Partnership Agreement.

b. Once an historic building or structure has been acquired by the City and prior to any further actions on the building, the Corps will document the building or structure in accordance with Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES**, Section C.1.

2. Relocation.

a. The Corps shall determine, in consultation with the SHPO, City, CRHPC, and Parties, whether it is feasible and prudent to move the historic building or structure to a new location where it can be preserved. Adverse effects upon a structure or building contributing to a Historic District will include consideration of effects to the structure or building, as well as to the entire Historic District.

3. Property Transfer/Marketing.

a. During negotiations, property owners will have the opportunity to reserve historic buildings and structures for offsite removal. Purchase agreements and conveyance documents will specify which improvements are reserved to the owner and the timeframe during which they must be removed. If not removed within the time specified, the improvements will become property of the City.

b. The Corps and City agree to consult with the SHPO and CRHPC when significant historic buildings and structures which are acquired by the City as part of the project are offered for sale in conformance with City code, or demolished, or designated for offsite removal.

4. Demolition.

If relocation is not feasible or if there are no offers for the historic building or structure and no other prudent and feasible creative alternatives present themselves, the Corps will notify the SHPO and shall document the building or structure in accordance with Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES**, Section C.1.

5. New Construction.

For new construction on or adjacent to a significant historic property or historic district (including those properties deemed eligible to be, or listed on the NRHP), the Corps shall ensure that the design and specifications for new construction are developed in consultation with the SHPO and CRHPC and are submitted to the SHPO for final approval. The Corps shall ensure that the project design for new construction is technically feasible and economically prudent; is compatible with the historic and architectural qualities of the historic property or district in question in terms of scale, massing, color, and materials; and is responsive to the recommended approaches to new construction set forth in the *Secretary of the Interior's Standards for Rehabilitation* (National Park Service 1983). The Corps has determined that the FRMFS flood protection management measures of any one of, or a combination of all alternative plan(s), have not been fully finalized and may change or be modified since economical, operational, engineering, and environmental studies are ongoing. The Corps will therefore determine effects as promulgated under Section 106 of the National Historic Preservation Act, as amended and its implementing regulations 36 C.F.R. Part 800: "Protection of Historic Properties." Also, the Corps will:

a. consider the FMRFS visual and physical effects within the Area of Potential Effect (APE), such as all construction areas, as including the construction zones of footprints of the proposed levees, floodwalls, and/or any other flood protection measures, plus road raises, tieback levees, drainage diversions, reservoirs, municipality modifications, borrow areas and any other project-related features and ancillary features proposed.

b. consider and coordinate with the SHPO, areas with the potential for containing submerged historic properties.

c. consider areas where the City selects flood protection measures or betterments to the Corps' proposed flood protection measures (National Economic Development Plan), and if those alternatives or betterments become part of the project, that they will be included under this PMOA.

H. Archeological Data Recovery. The Corps and the City shall ensure that any historic property whose preservation in place is not feasible and that is eligible to the NRHP is subject to data recovery, based on a data recovery plan developed in consultation with the ACHP, SHPO, and THPOs/Tribes and subject to a 30-day review and comment period. All data recovery plans shall be consistent with the *Secretary of the Interior's Standards and Guidelines for Archeological Documentation* (48 FR 44734-37), the *Guidelines for Archaeological Investigations in Iowa* (1999), and take into account the ACHU's publication: *Treatment of Archeological Properties*. Each data recovery plan shall specify, at a minimum

1. the property, properties, or portions of properties where data recovery is to be carried out;

2. the research questions to be addressed through the data recovery, with an explanation of their relevance and importance;

3. the methods to be used, with an explanation of their relevance to the research questions;

4. the methods to be used in analysis, data management, and dissemination of data, including a schedule;

5. the proposed disposition of recovered materials and records;

6. proposed methods for involving the interested public in the data recovery; and

7. a proposed schedule for the submission of progress reports to the Iowa SHPO, the ACHP, and, where applicable, concerned Tribes and Parties.

I. Historic properties of traditional religious and cultural significance to Tribes.

1. If a property of traditional religious and cultural significance to Tribes is identified within the APE, the Corps shall develop a treatment plan for that property in consultation with the Tribe or Parties that could be affected by Corps proposed activity at the specific historic site or property involved. The plan will cover analysis of treatment options and selection of a recommended treatment for the property and the measures which will be undertaken by the Corps to ensure that the plan is implemented.

2. The Corps shall submit the final plan to the SHPO and to the affected Tribe or Parties and shall implement the plan in accordance with the procedures outlined in the plan, if formal objections are not received within 30 days following its distribution.

3. Should a formal objection to the final plan be submitted within 30 days following its distribution, the Corps, the SHPO, and the affected Tribe(s) shall attempt to resolve the objection. If the Corps, the SHPO, and the affected Tribe(s) have not resolved the objection within 90 days, the Corps shall request the comments of the ACHP in accordance with Stipulation **X. Dispute Resolution**.

III. CURATED ITEMS

Artifacts, samples, and associated materials (ecofacts) recovered from federal lands collected and designated for curation and any associated records, will be curated in Iowa in accordance with 36 CFR § 79. When artifacts are collected from non-federal lands, the Corps and SHPO shall encourage landowners to donate the artifacts – preferably to the state – but possibly to a city, or local museum. The Corps shall ensure that materials recovered from non-federally owned lands which are donated to, or owned by the state or City, will be maintained within the state in accordance with 36 CFR § 79. The Corps will ensure that all recovered artifacts are identified as to landowner and that landowners be given the opportunity to have their artifacts curated within the state in accordance with 36 CFR § 79.

IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES

A. The Corps shall provide the SHPO, THPOS/Tribes, and Parties with letter reports summarizing the alternatives considered to avoid adverse effects to historic properties. In the report, the Corps will propose measures that will avoid, minimize, or mitigate adverse effects to those properties. The SHPO may request that the Corps consider other alternatives to avoid, minimize or mitigate adverse effects.

B. After the Corps, SHPO, and, as appropriate, the (THPOs/Tribes, agree on a proposed alternative to mitigate adverse effects, the Corps, in consultation with the SHPO, and, as appropriate, the THPOs/Tribes, will develop a Mitigation Agreement to be used to mitigate the adverse effects to specific historic properties or property types resulting from project implementation. Once the Corps and these parties have finalized the Mitigation Agreement in letter format and received concurrence from the SHPO, and, as appropriate, the THPOs/Tribes, a

copy will be filed with the ACHP and CRHPC. The Corps is responsible for implementing all provisions set forth in each Mitigation Agreement.

C. Standard mitigation measures to be considered include, but are not limited to, the following:

1. Documentation.

a. The Corps shall consult with the SHPO regarding the appropriate level of documentation prior to the substantial alteration, relocation, or demolition of any historic building or structure. Documentation shall be consistent with the *Secretary of the Interior's Standards for Architectural and Engineering Documentation* and the *Secretary of the Interior's Standards for Historical Documentation*.

b. Unless otherwise agreed to by the SHPO, the Corps shall ensure that all documentation is completed and accepted by the SHPO prior to the demolition, alteration, or relocation of the historic building or structure.

c. The Corps will provide copies of the documentation to the SHPO, THPOs/Tribes, and CRHPC, and other local, county, or state organizations in which the SHPO and CRHPC designate.

2. Transfer or Conveyance without Preservation Covenants.

In instances where the historic properties will not be conveyed or transferred with preservation covenants, the Corps shall record these properties to Historic American Building Survey standards or to a level agreed upon with the SHPO. The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the NRHP, sources of funding for significant historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation of historic properties, the Corps and the City, in consultation with the SHPO and CRHPC, shall develop a plan to transfer and convey significant historic property without covenants.

3. Transfer or Conveyance with Preservation Covenants.

In instances where the historic properties will be conveyed or transferred with preservation covenants, the Corps shall record these properties to Historic American Building Survey standards or to a level agreed upon with the SHPO. The City shall provide prospective owners of the properties with information about Federal Preservation Tax Incentives for Historic Buildings listed or in the process of being listed on the NRHP, sources of funding for historic properties, and information regarding rehabilitation of historic properties including the Secretary of the Interior's Standards. Prior to relocation of historic properties, the Corps and the City, in consultation with the SHPO and the CRHPC, shall develop a plan to transfer and convey the historic property with a covenant. The Corps shall submit the covenant to the SHPO and CRHPC for review, comment, and execution.

4. Mitigation for Archeological Sites Eligible Other Than or in Addition to Criterion D.

If preservation in place is not feasible, the Corps shall consult with the SHPO, THPOs/Tribes, and Parties to develop a mitigation plan for any archeological site that is eligible to the NRHP under criteria other than, or in addition to, criterion D of 36 C.F.R. Part 60. The Corps shall submit the plan to the SHPO and THPOs/Tribes for review and comment.

5. Off-Site Mitigation for the Loss of a Historic Property.

The Corps may preserve similar property types or sites outside the project's APE as mitigation for properties that cannot be preserved in place due to flood protection requirements. The Corps, THPOs/Tribes, and the SHPO will consult to determine if off-site preservation is suitable mitigation and to develop appropriate easements, covenants and other legal instruments for the protection of such off-site properties, if off-site preservation is undertaken. Prior to the demolition of historic properties within the APE, the Corps, in consultation with the SHPO, THPOs/Tribes, and Parties, shall consider the appropriateness of developing an off-site mitigation plan to compensate for the loss of historic properties. The Corps shall submit the plans to the SHPO for review and comment.

6. Alteration and Flood Proofing Activities Not Adhering to the Standards.

The Corps shall consult with the SHPO to develop alternate treatment or mitigation plans for those features which cannot meet the *Secretary of the Interior's Standards for Rehabilitation.* The Corps shall submit these plans to the SHPO for review and comment.

7. Other Mitigation Strategies.

The Corps, SHPO, THPOs/Tribes, City, CRHPC, and Parties shall consult to devise other mitigation strategies in instances where those included in this agreement do not satisfactorily mitigate adverse effects to historic properties. It may be necessary to develop separate Mitigation Agreements of effects on specific historic properties.

V. TREATMENT OF HUMAN REMAINS AND ITEMS OF RELIGIOUS AND CULTURAL SIGNIFICANCE

A. If human remains or items of religious or cultural importance to Tribes are encountered either during the data recovery or during any project construction activities, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be under consultation with the OSA and the appropriate Tribes. If finds of human remains or items of religious or cultural importance to Tribes are encountered or collected from Federal lands or Federally-Recognized Tribal lands, the Corps will coordinate with the appropriate Federally-recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*).

B. If items of religious and cultural importance to Tribes are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made by the Corps after consultation with the SHPO, OSA, Tribe(s), and THPO(s). When items of religious or cultural importance to Tribes are encountered or collected from Federal lands or Federally-Recognized Tribal lands, the Corps will coordinate with the appropriate Federally-recognized Native Americans, as promulgated by the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq.*), under consultation with the OSA and SHPO.

VI. REPORTS

The Corps will ensure that all final historic properties reports resulting from the actions pursuant to this PMOA will be provided in a format that conforms to currently acceptable professional standards including the Secretary of the Interior's Professional Standards for Archeological Investigations and Guidelines for Archaeological Investigations in Iowa (1999). The Corps will ensure that all such reports are responsive to contemporary standards utilizing any state guidance, recommendations, forms, and format, and to the Department of the Interior's *Format Standards for Final Reports of Data Recovery* (42 FR 5377-79). Precise locational data must only be provided in a separate – limited distribution - appendix if it appears that the release of this locational data could jeopardize historic properties. Precise locational data of traditional cultural properties or sacred sites, consisting of architectural, landscapes, objects, or archeology sites, identified in coordination with concerned Tribes and Parties, may be determined sensitive information and not be made available for public disclosure, as accorded by Stipulation **VII. CONFIDENTIALITY**. The reports and associated data, minus precise aforementioned locational data and sensitive information, may be made available for publication and public dissemination.

VII. CONFIDENTIALITY

The specific locations of historic and archaeological properties are subject to protection through nondisclosure under Section 304 of the National Historic Preservation Act (16 U.S.C. 470w-3) and Section 22.7 of the State of Iowa Code, under which the State Archaeologist has authority to restrict dissemination of site location information. All maps subject to public review/access shall be formatted in accordance with the *Guidelines for Archaeological Investigations in Iowa (1999)* to not contain sensitive information on archaeological sites, including site locations. All final site reports will be provided to the SHPO and OSA for their permanent files.

VIII. PROVISION FOR POST-REVIEW DISCOVEREIES

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties are discovered during project activities, the Corps will cease, or cause to stop, any activity having an effect and consult with the OSA, SHPO, and, as appropriate, the THPOs/Tribes to determine if additional investigation is required. If further investigations are warranted or required, any treatment plan will be performed in accordance with Stipulation **II. TREATMENT OF HISTORIC PROPERTIES**; Stipulation **III. CURATED ITEMS;** Stipulation **IV. MITIGATION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES:** Stipulation **V. TREATMENT OF HUMAN REMAINS AND ITEMS OF RELIGIOUS AND CULTURAL SIGNIFICANCE**, Stipulation **VI. REPORTS;** and Stipulation **VIII. PROVISION FOR POST-REVIEW DISCOVERIES**. If the Corps, OSA, and the SHPO, under consultation with the appropriate THPOs/Tribes, and Parties determine that further investigation is not necessary or warranted, activities may resume with no further action required. Any disagreement between the Corps, OSA, and SHPO concerning the need for further investigations will be handled pursuant to Stipulation **X. DISPUTE RESOLUTION**.

IX. EMERGENCY ACTIVITIES

For any emergency action, the Corps will follow the procedures outlined in 36 CFR § 800.12.

X. DISPUTE RESOLUTION

Should any signatory to this Agreement object to any action carried out or proposed by the Corps with respect to the implementation of this Agreement, the Corps shall consult with that signatory party to resolve the objection. If the Corps, after initiating such consultation determines that the objection cannot be resolved, the Corps shall forward documentation relevant to the objection to the ACHP, including the Corps' proposed response to the objection. Within forty-five (45) days after receipt of all pertinent documentation, the ACHP shall exercise one of the following options:

1. Advise the Corps that the ACHP concurs in the Corps' proposed final decision, whereupon the Corps shall respond accordingly;

2. Provide the Corps with recommendations, which the Corps shall take into account in reaching a final decision regarding its response to the objection; or

3. Notify the Corps that the objection will be referred to the ACHP membership for formal comment and proceed to refer the objection and comment within forty-five (45) days. The resulting comment shall be taken into account by the Corps in accordance with 36 CFR § 800.7(c)(4).

4. Should the ACHP not exercise one of the above options within forty-five (45) days after receipt of all pertinent documentation, the Corps may assume the ACHP's concurrence in its proposed response to its objections.

5. The Corps shall take into account any ACHP recommendation or comment provided in accordance with this stipulation with reference to the subject of the objection: the Corps' responsibility to carry out all actions under this Agreement that are not the subjects of the objection shall remain unchanged.

XI. TERMINATION

Any of the signatories to this PMOA may request a reconsideration of its terms or revoke the agreement upon written notification to the other signatories by providing 30 days notice to the other Parties, provided that the Parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the advent of termination, the Corps will comply with 36 CFR § 800.3 through § 800.7 with regard to individual undertakings covered by this PMOA.

XII. AMENDMENTS

Any party to this PMOA may request an amendment in accordance with 36 CFR § 800.6(c)(7).

XIII. INTERESTED AND CONSULTING PARTIES

A. Pursuant to 36 C.F.R. Sections 800.2(d), 800.3, 800.5(c), 800.6(a)(2) and 800.8(c)(1)(ix) of the NHPA and to meet the responsibilities under the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321-4335) , the Corps and the City has developed and maintained an Interested and Consulting Parties List comprised of 38 individuals from government organizations or agencies, 20 THPOs/Tribes, and 12 other interested parties (number count of addresses as of August 5, 2009) which:

1. allows agencies, Tribes, individuals, organizations, and other interested parties an opportunity to provide views on any effects of this undertaking on historic properties resulting from the FRMFS and to participate in the review of the draft PMOA. The Corps and the City will provide those on the Interested and Consulting Parties List access to all environmental reports,

2. provides an opportunity to comment and consult as accorded by NHPA (36 C.F.R. § 800.2(d). Being a living document, this distribution list is expected to change and grow as the FRMFS identifies a preferred plan,

3. is integral to the development of the Public Development Plan, as follows: In consort with the Project Delivery Team (PDT), a Public Involvement Plan has been finalized and will be implemented to meet NEPA (42 U.S.C. 4321-4327) scoping requirements and the requirements of Corps of Engineers (Engineering Regulations) ER 1105-2-100. The plan will inform and involve the public throughout the study. Public input will be solicited on problems, issues, and potential solutions for flood damage reduction, environmental effects, and related purposes in Cedar Rapids, Iowa. Public involvement tasks throughout the FRMFS will include developing and maintaining a mailing list of interested publics consisting of 856 names (number count of addresses as of August 5, 2009) which includes those on the Interested and Consulting Parties List), designing/holding public meetings (or open houses) to inform the public of and gather public input on the study's progress, writing after-action reports summarizing the public meetings, and including the Public Involvement Appendix for the Study,

4. will be provided study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 C.F.R. § 800.14(b)(2)(ii) of the NHPA. Comments received by the Corps and the City will be taken into account when finalizing plans for the FRMFS, as promulgated by the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the FRMFS. Although the FRMFS presently lies entirely within the State of Iowa, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Tribes within the Cedar River watershed, the Corps requests any information concerning our Federal trust responsibilities. The Corps' NEPA document will be included within the FRMFS, contain a draft of this PMOA, and be made available to all on the Corps mailing list generated during the implementation of the Public Involvement Plan. This draft PMOA will be provided for review and comment as accorded by 36 CFR § 800.8(c) for the use of the NEPA process for consultation and public participation for meeting the Corps responsibilities under NHPA and,

5. is stipulated by 36 CFR § 800.6(a) for continued consultation with the public during resolution of adverse effects and to garner the views and comments of the affected public. Within the FRMFS, the public will be invited to be included on the Corps Interested and Consulting Parties List. Those on the Interested and Consulting Parties List will be provided access to Corps environmental reports and other documentation concerning undertakings specified in 36 CFR § 800.11(e) subject to the confidentially provisions of § 800.11(c), also Stipulations **VI. REPORTS** and **VII. CONFIDENTIALITY**.

B. The NHPA recognizes that properties of traditional religious and cultural importance to a Tribe may be determined eligible for inclusion on the NRHP. In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Cedar River watershed, the FRMFS will be implemented in compliance with Executive Order No. 13007. Upon request any on the Interested and Consulting Parties List can choose not to disclose locations of traditional cultural properties or sacred sites and the Corps and City can secure this information from the general public.

XIV. PERIODIC REVIEW

A. Corps will provide the SHPO, City, CRHPC, OSA, and ACHP with evidence of compliance with this PMOA by letter on January 30, 2010, and once every year thereafter said date. This letter shall contain the name of the project, title of the documents which contained the PMOA, historic properties identified, determinations of effect, avoidance procedures, and level of investigation(s) and/or mitigation(s) conducted with titles of all project reports related to such investigation(s) and/or mitigation(s) which have been completed.

XV. EXECUTION AND IMPLEMENTATION

Nothing in this PA is intended to prevent the Corps from consulting more frequently with the SHPO, OSA, THPOs/Tribes, Parties, any other interested parties, or the ACHP concerning any questions that may arise or on the progress of any actions falling under or executed by this PMOA. Any resulting modifications to this PMOA will be coordinated in accordance with 36 CFR § 800.6(c)(7).

XVI. SIGNATORIES TO THIS AGREEMENT

A. ROCK ISLAND DISTRICT, U.S. ARMY CORPS OF ENGINEERS

BY: _____ Date: _____

Shawn P. McGinley
Colonel, US Army
Commander and District Engineer

B. IOWA STATE HISTORIC PRESERVATION OFFICER

BY: _____ Date: _____

Ms. Barbara A. Mitchell
Deputy Iowa State Historic Preservation Officer
State Historical Society of Iowa

C. CITY OF CEDAR RAPIDS

BY: _____ Date: _____

Ms. Kay Halloran
Mayor
City of Cedar Rapids and City Council

As attested by:

_____ Date: _____

Mr. Casey Drew
Finance Director

D. ADVISORY COUNCIL ON HISTORIC PRESERVATION

BY: _____ Date: _____

Mr. John M. Fowler
Executive Director
Advisory Council on Historic Preservation

E. THE UNIVERSITY OF IOWA

BY: _____ Date: _____

Mr. John F. Doershuk, Ph.D, RPA
State Archaeologist
Office of the State Archaeologist

CONCURRING PARTY

F. CITY OF CEDAR RAPIDS HISTORIC PRESERVATION COMMISSION

BY: _____ Date: _____

Ms. Maura Pilcher
Chair
Department of Community Development

END

Enclosure 6
Cedar River, Cedar Rapids, Iowa
- Flood Risk Management Feasibility Study (FRMFS) -
Linn County, Cedar Rapids, Iowa
Cultural Resources Fact Sheet

Located in east central Iowa, the City of Cedar Rapids is Iowa's second largest city and reflects its unique development in many ways. The Cedar River attracted the region's earliest settlers and thenceforward influenced urban development with both positive and negative effects. Shallow paths through the river rapids enabled crossing by foot; flows through rapid waters provided the potential energy to turn the wheels for early milling industry. But these waters could also wreak havoc upon nearby communities with flooding. The rapids area of the Cedar River has the potential to contain significant buried deposits dating from Iowa's earliest prehistoric inhabitants to those in the historic period -- as late as the early 20th century. Similarly, the City of Cedar Rapids also has visual remains of its past that are very significant, primarily consisting of surface artifacts and structures/buildings.

In compliance with Section 106 of the National Historic Preservation Act, as amended (and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties,") and the *Programmatic Memorandum of Agreement Among the United States Army Corps of Engineers Rock Island District, Iowa State Historic Preservation Officer, Cedar Rapids Historic Preservation Commission, and Advisory Council on Historic Preservation for the Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study – Linn County, Cedar Rapids, Iowa*, the Rock Island District of the U.S. Corps of Engineers contracted the following Scope of Work (SOW) for investigations that included:

1) Archival and historic research necessary to document, identify, delineate, and interpret:
   a) past occupations,
   b) significant cultural resources (structure, building, archeological sites and deposits, objects, artifacts, features, etc.),
   c) natural and manmade deposits (soil, fill, zone, layers, and other deposits), and
   d) areas of no, low, medium, and high potential to contain significant historic properties.

2) Geomorphological research (prior soil and boring samples) and sampling to reveal the potential for subsurface and buried historic properties and to reconstruct and interpret the stratigraphic sequences of covered or buried landforms:
   a) to supplement the archival and historic research and goals and
   b) provide a context for the past human occupations and settlement.

These investigations are documented in the two volume report:

Benn, David W., Joe B. Thompson, Elmer A. Bettis III, and Derek V. Lee. 2010. *Background Cultural Research and Geomorphological Investigation of Measures for the Cedar River Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa: Volume I--Management Summary and Text, Volume II—Figures and Appendices A-F* (Draft Report, BCA 1620, January). Prepared by Bear Creek Archeology, Inc., Cresco, Iowa under U.S. Army Corps of Engineers, Rock Island District Contract W912EK-08-D-0002, Delivery Order 0016, Modifications 1-4.

The report management summary is as follows:

This report includes prehistoric and historic literature and archival reviews, and geomorphological modeling in support of the Corps of Engineers' flood control risk management feasibility study for the Cedar River in Cedar Rapids, Linn County, Iowa. Bear Creek Archeology, Inc. conducted this investigation for the Rock Island District Army Corps of Engineers under the terms of Contract W912EK-08-D-0002, Delivery Order 0016, Modifications 1–4.

Provisions of the contract call for two types of investigations:

1) Archival and literature research into historic events and architectural history of the city are conducted for the purposes of:

a) interpreting past human occupations of Cedar Rapids and vicinity,

b) identifying National Register of Historic Places eligible and potentially significant cultural resources, such as structures, archeological deposits, objects, and features,

c) recognizing natural and man-made deposits (e.g., fills, layers, soils), and

d) delineating areas of "no, low, medium, and high" potential for the presence of historic properties, and

2) Geomorphological investigations, consisting of advancing 49 cores within the city and landform mapping, are conducted in a geographic information systems framework for the purposes of identifying buried soil horizons and subsurface historic properties, and as a means of interpreting the stratigraphic sequence of landform sediment assemblages (LSA) in the Cedar River valley. Geomorphological modeling is employed as a framework for interpreting the context of historic archival information and for modeling the distribution of prehistoric and "buried" sites in the study area.

This report includes an introduction to the feasibility study; an overview of architectural sites in the history of the city of Cedar Rapids; an overview of prehistoric cultures and geoarcheological contexts for the Cedar Rapids region; cultural resource and geoarcheological modeling for five proposed borrow areas; cultural resource and geoarcheological modeling for the Prairie Creek Generating Station and the Cedar Rapids

Pollution Control Facility; evaluation of archeological site potentials within the proposed Cedar Rapids levee system footprint; and recommendations for conducting a Phase I archeological survey in proposed construction zones. Historic background studies for this project were conducted by Joe B. Thompson between August and November 2009. The geomorphological field investigation was conducted by the three authors from July 31 - September 11, 2009, and on November 23, 2009.

Historic and prehistoric site probabilities are mapped on an ordinal scale of "no-low, medium, and high" within all of the study areas. There are 24 recommendations for conducting Phase I survey investigations within the Cedar Rapids levee planning zones and within the Prairie Creek Generating Station levee zone, Cedar Rapids Pollution Control Facility levee zone, and within the Cedar Rapids Airport, Tuma Future Parkland, Oeschger, and Phillips Trucking borrow areas.

Recommendation 1. The no potential historic areas have either "no" or "very little" potential for containing significant cultural resources. No field investigations are recommended, but if any are planned, they should focus on specific locations.

Recommendation 2. The historic architectural inventorying by the Louis Berger Group, Marion, recorded all the residences in the extant neighborhoods on the west bank inside the study area. Further examination of this work could yield information on specific houses associated with historically significant persons. Further consultation with local historians might also be useful in identifying such properties. The remaining residences could be sampled to collect information on working class domestic components. A comparison study contrasting the material inventory of worker domiciles with specific places of industrial employment (e.g., railroad workers versus smaller industry workers) may shed light on historic worker-class life ways. Similarly, contrasting industrial workers and shopkeepers could illuminate early material/social differences present before the rise of an extensive middle class in Cedar Rapids.

Recommendation 3. For those historic areas of "low" potential covered by parking lots, specifically the neighborhoods on the east bank, it may be possible to do exploratory studies (e.g., bucket augers, Giddings probing) on narrow greenbelts crossing historic residential lots as indicated on the Sanborn maps. Before any significant removal of pavement is agreed upon, the investigation results of east side ethnic neighborhoods having "medium" historic potential in the vicinity of St. Wenceslaus Church, Sinclair plant, and Bohemian Commercial Historic District should be considered. These locations might produce better archeological data than what may (or may not) be under the parking lots.

Recommendation 4. Investigation of the "low" potential industrial sites should be limited, since the odds of finding intact significant remains are relatively small. Giddings drilling may be useful in evaluating contexts at specific locations.

Recommendation 5. Lots slated for immediate house demolition should be examined early during the Phase I investigation to determine component integrity. These results, in turn, could determine if the parking lot-covered ethnic neighborhoods along the river require extensive investigation (i.e., pavement removal).

Recommendation 6. The Iowa Windmill and Pump Company location may require Giddings drilling or backhoe equipment to determine if intact deposits are present. Investigation of this location could be limited by dense surface conditions.

Recommendation 7. Sanborn maps should be used during the field survey where no historic structures are present, especially in the reach along 1st Street NW/SW, to assess the context (e.g., within/outside structure, type of structure, etc.) of individual subsurface tests and to direct any Giddings drilling. Depending on surface conditions, cutbanks in the vicinity of the former Williams & Hunting Company planing mill near A Avenue NW should be inspected.

Recommendation 8. At 1810 A Street SW is a house dating to the nineteenth century that is oriented similar to the early historic Listebarger Brothers' cabin and noticeably askew to nearby houses. While evidence is tenuous, this location should be inspected as a possible early historic cabin/house site.

Recommendation 9. Although it is likely that industrial development, along with building of I-380, completely destroyed the unmarked cemetery at A Avenue East/4th Street NE, an effort should be made to ascertain if any interments are still present. Hand probing and perhaps Giddings drill could be used to evaluate the geologic integrity. Coordination with the Burials Program at the Office of the State Archeologist is necessary prior to undertaking such work.

Recommendation 10. While located at one of the most heavily constructed and reconstructed intersections in Cedar Rapids, geomorphic drilling found evidence for intact deposits within two meters of the modern surface at the northwest corner of 1st Avenue East/1st Street NE. Further drilling or deep testing, at least using bucket augers, should be placed across the park area. The crew should be sensitive to the recovery of 1830s-1840s era ceramics and other diagnostic items at this location, since the identification of intact remains from Shepherd's cabin would be a significant archeological discovery for the history of Cedar Rapids.

Recommendation 11. The depressions at the possible early cabin along 2nd Street SE suggest that intact historic deposits, potentially from the mid-nineteenth century or earlier, are present in addition to those from later decades. Detailed mapping and probing may be useful to more fully evaluate the context along with systematic subsurface testing.

Recommendation 12. Subsurface testing is needed across the river park area near 1st Avenue West to check for King's cabin and, less likely, the ferry landing. Complicating this identification will be materials from several late nineteenth-early twentieth century storefronts. Consequently, identification of early historic artifacts, primarily ceramics, is vital.

Recommendation 13. No maps, other than potentially the 1868 lithograph, document the location for King's late 1840s house. Archival sources indicate it was built near the (later) 2nd Avenue bridge western abutment. Park environs on each side of this avenue offer an opportunity for finding this potentially important resource, and systematic subsurface testing will be required. Hand probing might also be useful for identifying foundations.

Recommendation 14. Subsurface testing, including both shovel testing and hand probing, should be used to survey the Listebarger cabin site at 818 1st Street NW. While shovel testing will recover artifacts, hand probing may identify where privies and wells/cisterns were located (resources highly valued for containing artifacts in stratigraphic sequence). Because log cabins were anchored often by deeply set posts, the crew should also be alert for historic post molds. The Sanborn maps will also guide the work and provide context for each shovel test. A detailed site map, including use of total station mapping equipment, should be generated to precisely record where artifacts were found. Finally, removing portions of the parking lot should be considered if intact early historic deposits are not found elsewhere.

Recommendation 15. The T3 channelbelt in the study area adjacent to the river is deemed to have the "highest" probability for prehistoric archeological sites and should be surveyed systematically with deep probes. Other "high" probability areas include the higher terraces (T4 and T5) and the 1st Avenue west transect that crosses alluvial fans and higher terraces.

Recommendation 16. "No–low" probability zones in the study area include the youngest alluvial units (T1 and T2) and zones where historic disturbances have completely destroyed or modified the natural landscape (e.g., channelized McCloud Run, Mays Island).

Recommendation 17. Zones of "medium" probability are located within the T3 channelbelt, where prehistoric habitations may occur, but mitigating factors reduce the likelihood of finding intact sites. For example, the T3 channelbelt behind the natural levee in the northwest portion of Cedar Rapids (Time Check) may have been seasonally wet and not conducive to prehistoric habitation. Additionally, some portions of the City have been repeatedly over-built, so the likelihood of finding intact sites is greatly reduced.

Recommendation 18. Intensive Phase I archeological survey will be conducted in study areas with "medium–high" probabilities for prehistoric archeological sites and in zones with "medium–high" probabilities for intact or potentially significant historic sites. Survey methodologies will include systematic shovel-bucket auger tests at 20 meter intervals, selective use of hand probing, and backhoe trenching in specific instances of deep, dense historic fills. The archeological survey will be proceeded by landform analysis (by drilling or hand probing) to identify subsurface contexts. The purpose of intensive survey is to locate archeological deposits, obtain samples of diagnostic artifacts, determine cultural stratigraphy, and roughly delineate site boundaries. All survey probes and excavations will be recorded in GIS format. Study areas slated for Intensive Phase I survey include two proposed levee footprints in the northwestern portion of the City (Time Check), three parts of Riverfront Park on both sides of the river in downtown Cedar Rapids, the natural levee in Czech Village, the upstream end of McCloud Run, the Bohemian Commercial District, and the high terrace around St. Wenceslaus Church. Intensive Phase I archeological survey zones cover 41% (164 ac, 66.4 ha) of the Cedar Rapids levee planning study area.

Recommendation 19. Zones of "medium–high" prehistoric archeological potential and specified historic deposits of "low" potential will be investigated by Reconnaissance Phase I survey. Instead of systematic survey, these areas will be reconnoitered by a combination of landform analysis and fortuitous shovel/bucket-augering, hand probing, or backhoeing to test for the presence of significant cultural deposits or to locate archived historic sites. Most of these "medium" prehistoric probability zones were seasonally wet or have been extensively built-over by modern historic development, therefore survey probing can only be conducted where there are no permanent surface obstructions. Zones where Reconnaissance Phase I survey will be conducted include the zone between the NW levee footprints (if impacted), 1st Avenue west and areas adjacent to 1st Avenue along the river, a small portion of west riverfront north of the 8th Avenue Bridge, the Sinclair Plant zone, small portions of downtown Cedar Rapids on the east side of the river, and the eastern shoreline at the northern end of the study area. Reconnaissance Phase I survey zones cover 27% (109 ac, 44.1 ha) of the Cedar Rapids levee planning study area.

Recommendation 20. No archeological surveys will be conducted on proto-historic landforms (T1, T2), except where specific historic sites have been located in the archives, and no survey will be conducted on built-over portions on the east bank in downtown Cedar Rapids. No survey is recommended for 32% (126 ac, 51 ha) of the Cedar Rapids levee planning study area.

Recommendation 21. The Prairie Creek Generating Station has over-built the landscape, and practically all of this study area has been disturbed by earthmoving. Extensive power lines and associated facilities inhibit access for conducting intensive archeological surveys. Reconnaissance Phase I survey is recommended for levee impact zones, when they have been determined, to investigate whether intact landforms and archeological sites are still present.

Recommendation 22. The Cedar Rapids Pollution Control Facility has over-built most of this area, including much of the adjacent landscape where utilities have been emplaced. Intensive Phase I survey is recommended for the western side of the property, including tract 13LN139, and for the riverfront landform on the southern side of the railroad tracks if this zone will be impacted.

Recommendation 23. The Eastern Iowa Airport borrow areas and the Tuma Future Parkland borrow areas are deemed to have "low" probabilities for significant cultural resources, and both areas should be subjected to Reconnaissance Phase I survey methods in the form of pedestrian survey of likely locations for cultural sites (i.e., archival historic locations and prehistoric finds on drainage headwalls).

Recommendation 24. The Oeschger and Phillips Trucking borrow areas contain previously recorded cultural sites and have a "medium" probability of yielding additional sites. The Oeschger area contains a historic cemetery that will require evaluation. Both borrow areas should be subjected to Intensive Phase I survey consisting largely of pedestrian methods (and possibly limited shovel-testing of alluvial terraces along Morgan Creek).

Structures and/or Buildings Determined Eligible for, or Listed on, the National Register of Historic Places

The City of Cedar Rapids completed two architectural and structural reconnaissance surveys to document National Register of Historic places eligible/listed properties prior to the Flood of 2008. The Federal Emergency Management Agency, or FEMA (an agency of the United States Department of Homeland Security), conducted numerous architectural and structural reconnaissance surveys in the aftermath of the 2008 flooding episode prior to debris removal and demolition. The National Register of Historic Places (NRHP) status was reviewed by FEMA, and FEMA received concurrence from SHPO. The reported results of these reconnaissance surveys are summarized in Table 1:

TABLE 1: The Number of National Register of Historic Places Status of Structures and Buildings Affected by Flooding in 2009.

City of Cedar Rapids Reconnaissance Survey of the Ellis Boulevard/Ellis Road Area, Time Czech Area, and Cedar Valley (Rompot Area)	
Number of structures and buildings reviewed for NRHP eligibility	192
Number of structures and buildings that are NRHP eligible, but not in Historic Districts	4
TOTAL:	186
City of Cedar Rapids Reconnaissance Survey of the Young's Hill/Kingston Neighborhood	
Number of structures and buildings reviewed for NRHP eligibility	1,542
Structures and buildings that are NRHP eligible, but not in Historic Districts	71
Number of Historic Districts	38
Number of structures and buildings within existing Historic Districts	2
TOTAL:	1,653
FEMA Reconnaissance Surveys of Residential and Commercial Areas Affected by the Flooding of 2008	
Number of structures and buildings reviewed for NRHP eligibility	3,054
Number of structures and buildings that are NRHP eligible, but not in Historic Districts	91
Number of Historic Districts	2
Number of structures and buildings contributing to the Historic Districts	67
TOTAL:	3,214

Individual buildings or structures determined eligible to the National Register of Historic Places:

Wells Fargo Bank (The Peoples Savings Bank or People's Bank and Trust Company), located at 101 3rd Avenue, was listed in the NRHP March 29, 1978). The People's Bank in Cedar Rapids was designed in 1910 by Louis Sullivan. It consists of a central banking area, 25' x 50', around which includes a single story of offices and other rooms, giving total dimensions of 50' x 90'. The People's Savings Bank was the second of a series of small Midwestern banks designed by Louis Sullivan between 1907 and 1919. While not the best example of this group, nor even the best of his Iowa work, it exhibits many of the hallmarks of Sullivan's art as an architect in "bringing the block to life in different ways through geometry and ornament."

Multiple Property Historic Districts:

The Commercial and Industrial Development of Cedar Rapids, Iowa (circa 1865- 945), Multiple Property Documentation was listed on the National Register of Historic Places in December 12, 1997. These historic resources are considered significant under this context based on their association with the business trends, commercial practices, and business leaders who gave definition to the downtown during the more than six decades (1880 - 1945) when Cedar Rapids grew from a county-wide retail service center to a regional retail and jobbing center in eastern Iowa. The buildings that were constructed to house this change in economic role were erected in the central business district and to a lesser extent in the west side commercial district. A number of buildings demonstrate singular significance by relating the story of the growth and development of specific businesses, their owners, and their success and/or demise over a period of time. Still other buildings derive significance from the architectural styles they embody, the work of an important architect they represent, or the construction methods and materials used.

Criterion A: Properties that reflect the trends and patterns that typified the development of Cedar Rapids' central business district beginning in the decades following the Civil War and concluding with World War II.

Criterion B: Properties directly associated with individuals who played a leading, pivotal or important role in shaping the development of Cedar Rapids' central business district during the period c. 1880toe. 1945.

Criterion C: No single architectural style predominated during this period in downtown Cedar Rapids. Instead, styles that were important during this period on a national basis also appeared in downtown Cedar Rapids including the Richardsonian Romanesque, the Renaissance Revival, the Neo-Classical Revival, and the Commercial Style. These styles and several vernacular variations appear on a number of building types found in the central business district including a fire station, a public library,

wholesale warehouses, bank buildings, stores, office buildings, city and county government buildings, post offices and churches. The one exception to this varied architectural pattern was the group of buildings in the 100 and 200 blocks of 3rd Avenue, SW.

Criterion D: Sites of nonextant properties which contain intact subsurface deposits with the potential to provide information concerning the history of the development of downtown.

Contributing structures and buildings to the Commercial and Industrial Development of Cedar Rapids, Iowa, are as follows:

1st A venue
200 1st Avenue, NE - Roosevelt Hotel, 1925 - NRHP
203 1st Avenue, SE - Golden Eagle Building, 1888
205 1st Avenue, SE - Reserve National Insurance Co.
301 1st Avenue, SE - Iowa Theater Building, 1928
411 1st Avenue, SE - Burlington, Cedar Rapids & Northern Building, (First Avenue Building)
417 1st Avenue, SE - Irvine Building, 1926

2nd Avenue, SE
201-207 2nd Avenue, SE - Dows Building, 1930
215-221 2nd Avenue, SE - Martin Dry Goods Co. (Ginsberg Jewelry), c. 1881
222 2nd Avenue, SE - Merchant's National Bank Building, 1925
305 2nd Avenue, SE - Cedar Rapids Post Office, (Witwer Senior Center), 1908-1910 – NRHP
320 2nd Avenue, SE - (Kurtz Pub)
325-329 2nd Avenue, SE -Muskvaki Block (Dragon Restaurant), c. 1900
419 2nd Avenue, SE - Coffits Building, (Hall Bicycle), 1902
526 2nd Avenue, SE - Inter-State School Building, 1908

3rd Avenue, SE
97 3rd Avenue, SE - Smulekoffs Furniture
116 3rd Avenue, SE - Sindelar Saloon, 1898
119 3rd Avenue, SE - Fawcett Building, 1906
123 3rd Avenue, SE - Paramount Theater Building, 1927 - NRHP
200 3rd Avenue, SE - Granby Building, 1893
302-308 3rd Avenue, SE (also 216-224 3rd Street, SE) - Cedar Rapids Savings Bank, (Guaranty Bank & Trust Building), 1896,1910
311 3rd Avenue, SE - Cedar Rapids Supply Company, 1902
314-318 3rd Avenue, SE - Strand Theater, (World Theater), 1915
313-315 3rd Avenue, SE - Cedar Rapids Marble & Granite Works (Foreman & Clark), 1893 & 1905

420 3rd Avenue, SE - Cedar Rapids Public Library, (Cedar Rapids Museum of Art), 1904 - NRHP
600 3rd Avenue, SE - First Universalist Church - NRHP
@ 10th Street, SE - Immaculate Conception Catholic Church

3rd Avenue, SW
101 3rd Avenue, SW - People's Savings Bank (Norwest Bank) - NRHP
102-104 3rd Avenue SW - Gatto Building, 1912
108 3rd Avenue SW - Colonial Theater (Lederman Bail Bonds), 1914
110 3rd Avenue SW - Local Drug Co. (Stalker Electric), 1932
201 3rd Avenue SW - Acme Greeting Card Co. (Acme Graphics Building), 1924
219-221 3rd Avenue SW - Warner Building, 1911
220 3rd Avenue SW - Great A & P Tea Co. (Barren Motor Co.), 1942

1st Street, SE
101 1st Street, SE - Old Post Office (Federal Building), 1932
401 1st Street, SE - Hamilton Brother's Building (Hach's Coffee & Tea Co.), 1899 - NRHP
415 1st Street, SE - (Charlies On the River Restaurant)
427 1st Street, SE - Fire Station No. 1 (Science Station), 1917
600 1st Street, SE - John Blaul's Sons (Great Furniture Mart), 1914
610-612 1st Street, SE - Orr-Newell Building, 1912
614 1st Street, SE - Grissel Co. Building, 1913
616 1st Street, SE - Baker Paper Co. Building, c.1914
618 1st Street, SE - Baker Paper Co. Building, 1909
620 1st Street, SE - Aurox Tool & Die Building, c.1945

2nd Street, SE
103 2nd Street, SE - American Building, 1913
118 2nd Street, SE - (Ajax Balloon)
125 2nd Street, SE - United Fire & Casualty, 1933
203 2nd Street, SE - Security Building, 1908 - NRHP
219-223 2nd Street, SE - Mullin Building (Drake's Salad Bar & Enzler's), 1912
225 2nd Street, SE - Higley Building, 1918
230 2nd Street, SE - Granby Building, 1893

3rd Street, SE
100-112 3rd Street, SE - Iowa Theater Building (Community Theater), 1928
216-224 3rd Street, SE (also 302-308 3rd Avenue, SE) - Cedar Rapids Savings Bank (Guaranty Bank & Trust Building), 1896,1910
302-308 3rd Street, SE -
321 3rd Street, SE - Welch Cook Beals Co. (MCI), 1909
417 3rd Street, SE - Sokolovna Gymnasium Building, 1908
419 3rd Street, SE - Hutchinson Building (Borden Building), 1921

Miscellaneous
130 B Avenue, NE - Jones, Douglas & Co. cracker factory (Ohsman & Sons Co.), c. 1880
501 A Avenue, NE - St. John the Baptist Greek Orthodox Church, 1946
525 A Avenue, NE - Grace Episcopal Church, 1851,1873,1890
616 A Avenue, NE - Scottish Rite Temple, 1908
217 4th Avenue, SE - Lattner Auditorium Building - NRHP
221 4th Avenue, SE - Lyman Building (Iowa Building), 1914 - NRHP
117-123 5th Street, SE - Palmer Building (MCI), 1905

Commercial and Industrial Development of Cedar Rapids, Iowa, c. 1860-c. 1945
310 5th Street, SE - First Presbyterian Church, 1869
318 5th Street, SE - YWCA, 1911
May's Island Historic District - NRHP

The May's Island Historic District was listed October 19, 1978, and the boundaries are the same as the shape of the island. Architecturally, the Federal Building and county courthouse are straightforward examples of Beaux Arts civic design. The Memorial Building, on the other hand, combines elements of this style with the verticality of the Moderne, the whole topped with classical funerary features which advertise its purpose as a war memorial. Beyond this obvious visual symbolism, this building represents a joint effort on the part of veterans' groups, local government, and commercial and business interests, to combine in this structure a variety of functions: war memorial, city hall, and convention center.

The area included in this nomination comprises a discontinuous district made up of May's Island; its river walls and structures located thereon (Memorial Building, Linn County Courthouse, Linn County Jail); and a portion of land on the east bank of the Cedar River (on which is located the Federal Building): bounded on the north by 1st Avenue, on the east by 1st Street, on the south by 2nd Avenue, and on the west by the Cedar River. Due to the fact that the 1st, 2nd, and 3rd Avenue bridges, as well as the river walls on the east and west banks of the Cedar River, have been extensively altered since their original construction, these elements are not considered significant in terms of this nomination. Acreage: May's Island, approximately 9½ acres; Federal Building lot, approximately 2 acres.

The Bohemian Commercial District/Little Bohemia Historic District derives significance under Criterion A reflecting the categories "Commerce" and "Ethnic Heritage/European." The Bohemian Commercial Historic District is associated with nearly 60 years of commercial development in Cedar Rapids' Bohemian South Side from the 1880s through the 1930s. The development and redevelopment of the six blocks along the route of 3rd Street SE and 14th Avenue SE as they pass through this neighborhood highlight the settlement patterns of multiple generations of Bohemian-American commercial and civic leaders.

Under Criterion C, the Bohemian Commercial Historic District is significant under the theme "Architecture" as a representative collection of the commercial architectural styles and vernacular building forms that appeared in Cedar Rapids from the 1880s through the 1930s. Examples of the work of an important Cedar Rapids architect and one nationally significant architect have been identified to date. In addition to narrow-front commercial buildings and corner blocks, the district contains an important railroad corridor factory building, a fire station, a movie theater, two banks, several filing stations, and two important fraternal halls.

The Bohemian Commercial Historic District was cited as a potential historic district in the Downtown & Industrial Corridors in Cedar Rapids, Iowa, MPD that was listed on the National Register of Historic Places in 1997. In addition, two individual properties within the district are already listed on the National Register: the C.S.P.S. Hall and the Lesinger Block. The period of significance for the district is 1880-1952. These dates mark the date for the earliest known building in the district and the 50 year cut off period for buildings to be considered significant. Throughout this entire time period the Bohemian Commercial Historic District served as a commercial center for the Bohemian-American community of Cedar Rapids.

The boundaries for this historic district form an irregular L-shape comprising the collection of commercial, residential, and industrial properties that formed the heart of Cedar Rapids' oldest Bohemian-American neighborhood. The neighborhood follows the six-block route of 3rd Street SE and 14th Avenue SE along the east side of the Cedar River. This route also formed a section of the Red Ball Highway/U.S. Highway 218 through Cedar Rapids. Sections of intersecting streets along 3rd Street SE and 14th Avenue SE have been included where historically related properties with sufficient integrity to merit inclusion survive. The district includes facing blocks except for two instances where all buildings had been razed (the northwest side of 100 block of 14th Avenue SE) or substantially altered (northeast side of the 1100 block of 3rd Street SE). Since the historical significance of this neighborhood includes the story of change from a residential neighborhood to a mixed commercial, industrial and residential neighborhood the historic district's pattern of mixed land use is to be expected.

The NRHP evaluation of the Czech Village Historic District is currently underway. The field survey of this area has been completed, and a substantial number of the commercial buildings will be included in the expanded boundary of the Bohemian Historic Commercial District which is already listed on the Register. The boundaries of this expanded district are not finalized at this moment but will likely be so in two to three weeks.

The NRHP eligible St. Wenceslaus Historic District evaluation is currently underway. There will likely be a recommendation for a district but boundaries have not been finalized. We will have a better idea of size and scale of such a district in two to three weeks as well.

STATE HISTORICAL SOCIETY of IOWA

A Division of the Iowa Department of Cultural Affairs

March 17, 2010

In reply refer to:
R&C#: 090657190

Mr. Ron Deiss, Archaeologist
Economic and Environmental Analysis Branch
Corps of Engineers – Rock Island District
Clock Tower Building P.O. Box 2004
Rock Island, IL 61204-2004

RE: COE – LINN COUNTY – CITY OF CEDAR RAPIDS – FLOOD CONTROL DRAFT FEASIBILITY STUDY – DRAFT PROGRAMMATIC AGREEMENT

Dear Mr. Deiss,

Thank you for your recent submittal regarding the City of Cedar Rapids Flood Control Draft Feasibility Study and for inviting our participation in the Section 106 consultation process. We have had an opportunity to review the Corps' latest draft programmatic agreement outlining alternative procedures for complying with provisions of the National Historic Preservation Act and offer the following views.

We agree that the envisioned project has the potential for affecting properties listed on or eligible for listing on the National Register of Historic Places. However, at this time, we find it challenging if not impossible to realize alternative procedures that will be implemented in lieu of 36 CFR Part 800 without more definite parameters regarding the scope and location of the undertaking.

Therefore, we offer the following draft programmatic agreement that would serve as the framework for such alternative procedures once the Corps has established its undertaking. As you will see this document includes the usual recitals, discussion of executive roles and responsibilities, and administrative conditions. Details regarding the actual implementation of alternative procedures would be included as an appendix to the agreement document.

We will be pleased to resume our consultation with the Corps, the Advisory Council, the project proponent and other consulting parties in developing alternative procedures and details pertaining to the treatment of historic properties once the Corps' undertaking has been established. After this has been completed the Iowa State Historic Preservation will be prepared to execute the finalized agreement.

Until then, I can be reached at (515) 281-8744 or by email at Daniel.higginbottom@iowa.gov if you have any questions or require further assistance.

Sincerely,

Dan Higginbottom

Daniel K. Higginbottom, Archaeologist
Iowa State Historic Preservation Office

600 EAST LOCUST STREET, DES MOINES, IA 50319-0290 P: (515) 281-5111

CEDAR RAPIDS
City of Five Seasons

June 14, 2010

Colonel Shawn McGinley
U.S. Army Corps of Engineers Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

Re: Support of Corps' Tentatively Selected Plan in the Cedar River Feasibility Study

Dear Colonel McGinley:

The purpose of this letter is to express the City of Cedar Rapids' support of the U.S. Army Corps of Engineers' Tentatively Selected Plan of Alternative 4C, which is a portion of the City's Preferred Flood Management System.

The City's Preferred Flood Management System was approved by the City Council on November 12th, 2008 after a four month planning process that included the input of 2,680 citizens. This plan includes protection for both sides of the river in the form of greenway, levees, and floodwalls (permanent and removable). The City's Preferred Plan differs from Alternative 4C in the following ways:

- It provides protection to both sides of the river – not just the east side
- It extends north to protect the Cedar Lake area, including the City's water treatment plant
- It contains removable floodwalls in the downtown area

Thank you for your work and support of this very important project.

Sincerely,

THE CITY OF CEDAR RAPIDS

Allan T. Thoms
Interim City Manager

c: Christine Butterfield,
Dave Elgin,
Mike Dufoe,
Adam Lindenlaub

Office of the Cedar Rapids City Manager
City Hall • 3851 River Ridge Drive NE • Cedar Rapids, Iowa 52402 • (319) 286-5080 • FAX (319) 286-5144

CEDAR RAPIDS
City of Five Seasons

June 22, 2010

Colonel Shawn McGinley
U.S. Army Corps of Engineers Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

Re: Cedar River Feasibility Study

Dear Colonel McGinley:

The purpose of this letter is to request that the Rock Island District in accordance with Paragraph 10.2 of the Federal Principles and Guidelines, and Paragraph 7 of USACE EC 1105-2-409, seek approval from the Assistant Secretary of the Army for Civil Works to recommend selection of Feasibility Study Alternative 1A-C as the plan judged to have the greatest beneficial effects. This recommendation would be based on full consideration of the Other Social Effects (OSE) and Regional Economic Development (RED) accounts in addition to the National Economic Development (NED) and Environmental Quality (EQ) accounts, which in the aggregate, support recommendation of this alternative.

Although the City of Cedar Rapids is supportive of the U.S. Army Corps of Engineers' Recommended Plan of Alternative 4C, this is only a portion of the City's Preferred Flood Management System.

The City's Preferred Flood Management System was approved by the City Council on November 12th, 2008 after a four month planning process that included the input of 2,680 citizens. This plan includes protection for both sides of the river in the form of greenway, levees, and floodwalls (permanent and removable). The City's Preferred Plan builds on Alternative 4C in the following ways:

- It provides protection to the west side of the river as well as the east side
- It extends north to protect the Cedar Lake area, including the City's water treatment plant
- It contains removable floodwalls in the downtown area

Alternative 1A-C provides protection to both sides of the river and differs from the City's Preferred Plan only in its lack of utilizing removable floodwalls and protecting the Cedar Lake area (see attached map). The City believes that Feasibility Study Alternative 1A-C is justified based on a combination of OSE, RED, and NED benefits and appropriately should be identified as the Recommended Plan.

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CEDAR RAPIDS

City of Five Seasons

The City has developed an OSE report that highlights the severe Environmental Justice, economic re/development, and sustainability impacts to only providing flood protection to one side of the river. The City has also developed an RED report that examines the impacts of not providing flood protection on both sides of the river. Executive summaries of both reports are included as attachments.

It is important to note that the City has taken a multi-strategic approach to flood recovery and risk management (see attached). Some of these approaches include encouraging over 1,200 property owners to participate in a voluntary acquisition program to move them out of the flood impacted area, updating the floodplain management ordinance, sanitary sewer and water system improvements, and an interim flood protection plan. The City has taken an active role in working closely with Federal and State agencies in order to effectively utilize various funding sources for flood recovery.

The City is supportive of the proposed changes to the Principles and Guidelines under consideration and believes, when enacted, these changes would support a project that provides protection to both sides of the river. We continue to strongly support implementing Feasibility Study Alternative 4C as a key portion of the City's overall Flood Management Strategy should it remain the Recommended Plan.

Thank you for your work and support of this very important project.

Sincerely,

THE CITY OF CEDAR RAPIDS

Allan T. Thoms
Interim City Manager, City of Cedar Rapids

Encl.

Office of the Cedar Rapids City Manager
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STATE HISTORICAL SOCIETY of IOWA

A Division of the Iowa Department of Cultural Affairs

July 20, 2010 **In reference to R & C#: 090657190**

Mr. Ron Deiss, Archaeologist
Economic and Environmental Analysis Branch
Corps of Engineers – Rock Island District
Clock Tower Building P.O. Box 2004
Rock Island, IL 61204-2004

RE: COE – LINN COUNTY – CITY OF CEDAR RAPIDS – CEDAR RIVER FLOOD RISK MANAGEMENT FEASIBILITY STUDY (FRMFS) – ARCHAEOLOGICAL/GEOMORPHOLOGICAL BACKGROUND STUDY [BCA 1620] FINAL DRAFT – PROGRAMMATIC MEMORANDUM OF AGREEMENT

Dear Mr. Deiss,

We have received the Corps' July 21, 2010 coordination letter and copies of the draft programmatic memorandum of agreement, and the final draft of *Background Cultural Research and Geomorphological Investigation of Measures for the Cedar River Flood Risk Management Feasibility Study Linn County, Cedar Rapids, Iowa [BCA 1620]* prepared by Messrs. David W. Benn, Joe B. Thompson, E. Arthur Bettis III, and Derek V. Lee of Bear Creek Archeology, Cresco, Iowa for the U.S. Army Corps of Engineers – Rock Island District. Thank you for providing the Iowa State Historic Preservation Office (SHPO) with the opportunity to review these documents. We offer the following for your consideration.

The Bear Creek report provides and excellent overview of the physiography, history, and archaeology of the Cedar Rapids locality. Information gleaned from archival and field sources is effectively engaged in developing a viable, landform suitability model that will aid in the detection of archaeological resources within the study area. This will serve as a baseline study to City planners and researchers well into the future. During our review we noted a few minor technical errors, but none that affect the substance or meaning of thoughts conveyed.

The draft programmatic memorandum of agreement (PMOA) is attached along with our comments and recommended revisions. The Corps letter and attachments identify FRMFS Alternative 4C as the Undertaking for the purposes of Section 106 compliance. With this in mind, many of the modifications we suggest are toward tailoring the general prototype PMOA template sent to you on March 17, 2010 into a more specific agreement that addresses the needs of the preferred alternative. Please note that revisions to the amendments clause makes allowance for adoption of other FRMFS alternatives.

One concern raised during our review of enclosures 1 and 2 (Appendix B) is that the area of potential effects is presently limited to the footprint of the flood control structures and does not take into account the reasonably foreseeable effects to historic properties (e.g. Mays Island Historic District) existing in unprotected areas where conditions during flood events will be made worse through the presence of FRMFS flood protection measures. We realize that project scoping has yet to be completed and that the APE will no doubt be redefined as plans near finalization. However, we feel it prudent to draw your attention to this concern so that it can be addressed in the planning process.

Also, the Corps' letter identifies 12 of 24 recommendations made by Bear Creek for Phase I archaeological survey that it intends to pursue in investigation of Alternative 4C (Recommendations 1, 3, 4, 5, 10, 11, 15, 16, 17, 18, 19, and 23). We agree, but also consider recommendations 2, 7, 8, 9, 20, and 23 as being relevant to Alternative 4C. The relevance of others may present themselves as the scope and APE of the undertaking are better understood. Nonetheless, all relevant recommendations that are approved by the consulting parties should be included as a stipulation in Appendix C.

You will agree that finalizing an agreement for an undertaking of this scope and complexity is difficult through emails and telephone conversations. Perhaps a meeting with all of the interested parties is in order to discuss the details now that the Corps has selected its preferred alternative and is in the process of defining its undertaking and area of potential effects. SHPO staff would be more than willing to participate in a working group to finalize this agreement. Please contact me at

(515) 281-8744 or by email at Daniel.higginbottom@iowa.gov if you are interested in organizing such a group or if you have any questions.

Sincerely,



Daniel K. Higginbottom, Archaeologist
Iowa State Historic Preservation Office

Cc: John Doershuk, State Archaeologist, Office of the State Archaeologist, University of Iowa
David Stanley, Project Manager, Bear Creek Archeology
Barbara Mitchell, Deputy State Historic Preservation Officer, State Historic Preservation Office
Ralph Christian, Historian, State Historic Preservation Office
Jeremy Ammerman, Architectural Historian, State Historic Preservation Office
Jennifer Sandy, Midwest Office, National Trust for Historic Preservation
Tom McCulloch, Advisory Council on Historic Preservation
The Honorable Ron Corbett, Mayor, City of Cedar Rapids

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

CM
LD
#377545
#569099

AUG 13 2010

Mr. Allan T. Thoms
Interim City Manager
Cedar Rapids City Hall
3851 River Ridge Drive NE
Cedar Rapids, Iowa 52402

Dear Mr. Thoms:

Thank you for your letter of June 22, 2010, concerning the proposed Corps of Engineers Cedar River, Iowa, flood damage risk reduction study. Your letter requests that I support a recommendation to authorize Plan 1 A-C, which would provide protection to both banks of the Cedar River within the City of Cedar Rapids. You further request that justification for this recommendation be based on a combination of National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ) and Other Social Effects (OSE) benefits.

At this time, the Army Corps of Engineers (Corps) has not completed or submitted the Cedar Rapids' feasibility study to my office for Administration review. Therefore, without the benefit of the Corps' report, I have no basis on which to make any determination on Plan 1A-C or any other plan. However, I am providing your evaluation to the Corps for consideratrion in selection of the recommended plan for authorization. I have also requested that the Corps brief me on the current status of the study. Once I receive the finalized feasibility report and the Report of the Chief of Engineers, all benefit categories will be given thoughtful and full consideration in the Administration's review process.

RED and OSE benefits are very important in addition to NED and EQ benefits. However, current criteria for determining and prioritizing Federal investment in flood damage risk reduction projects are primarily based on maximizing net NED and National Ecosystem Restoration benefits. But, it is important that OSE and RED benefits to the region be fully described and presented in the Corps' feasibility report.

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CITY OF CEDAR RAPIDS
CITY CLERK

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The Corps and the Army appreciate the City's strong support of and participation in the Cedar River feasibility study. If you need additional information on this matter, please feel free to contact Ms. Marianne Matheny-Katz of my staff at 202-761-0027.

Very truly yours,

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX M
RECREATIONAL FACILITIES

APPENDICES M-1 INVENTORY OF
CITY OF CEDAR RAPIDS RECREATIONAL FACILITIES

EVALUATION OF RECREATIONAL COMPONENTS IMPACTED
BY PROPOSED FLOOD PROTECTION ALTERNATIVE 4C

March 16, 2010
Revised August 6, 2010

I. INTRODUCTION

Stanley Consultants has conducted an investigation of the recreational facilities that will be impacted by the construction of Alternative 4 Flood Protection. The following tasks were completed:

- Obtained the usage estimates for the existing facilities that are to be impacted as a result of the proposed flood protection construction.
- Determined the operation and maintenance costs for each facility.

II. EXISTING FACILITIES

The City owns and maintains a number of recreational facilities along the riverfront of the Cedar River. Flood protection construction will impact a limited extent of the existing recreational facilities. Only one trail segment— Cedar River trail—would be directly impacted by the construction of Alternative 4C and 10E, while the park areas are impacted to varying degrees. Alternative 4C provides protection to properties along the left descending bank of the Cedar River. Alternative 10E protects portions of the left descending bank through the use of ring levees. Specific information on these alignments are presented I n Section IV of the main report. Refer to figure M-1 for the approximate location of the existing parks/facilities and the approximate location of the flood protection alignment.

Cedar River Trail – This trail segment located along the east bank of the Cedar River beginning at Cedar Lake to the Cedar River Crossing at 14th Avenue SE was inventoried. The lengths of trails offset from the Cedar River bank on the east side of the Cedar River and the lengths of trails on the bridges which cross the Cedar River will not be impacted by the flood protection construction as described in this appendix. The segments of the Cedar River trail impacted by Alternative 4C are shown in figure M-2. Figure M-3 is the proposed alignment for Alternative 4C.

Information related to the number of users for the existing recreational facilities was obtained from the Linn County Trail Association and the City of Cedar Rapids Parks and Recreation Department. Survey methodology measures the popularity of outdoor recreation facilities in user days. A user day is defined as ‘one instance of participation in a single outdoor recreation activity by one person’. The information obtained was reviewed and presented for the facilities for which user information was available.

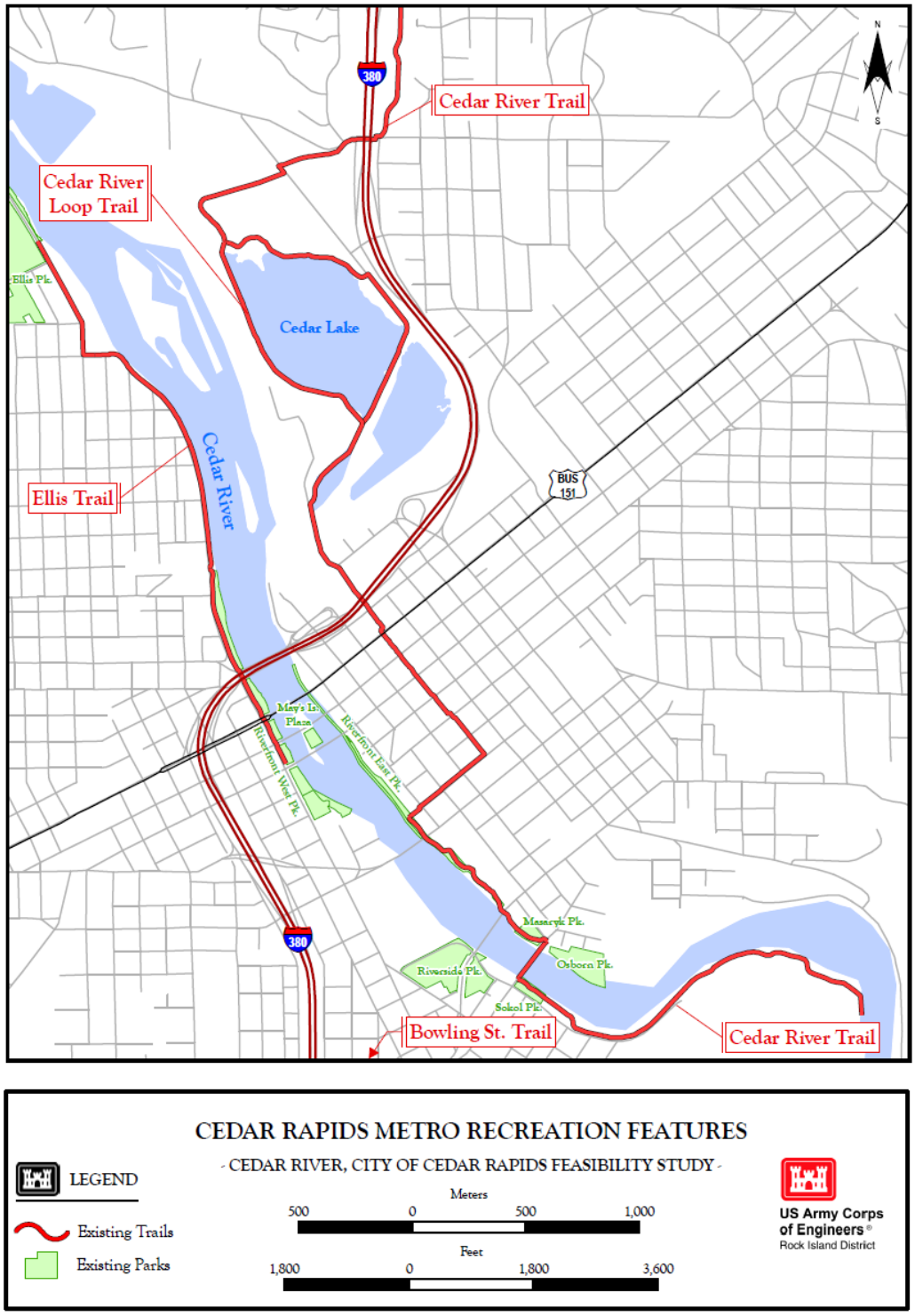

Figure M-1. Cedar Rapids Existing Trails and Parks



Figure M-2. Cedar River Trails Impacted by Alternative 4C



Figure M-3. Alternative 4C – Proposed Alignment

The Linn County Trails Association has installed infra-red counting devices to determine usage on several trails within Linn County. The trail counts provided for the Cedar River Trail segment were gathered at Sokol Park, which is generally located at 15th Avenue SW and A Street SW. The historic results are shown as average weekly counts during June-July (peak usage) and Sept-Dec (non-peak usage) (table M-1).

Table M-1. Average Weekly Counts of Recreational Users [1]

June-July					Sept - Dec		
2005	2006	2007	2008	2009	2005	2006	2007
3,608	3,497	3,629	796	1,696	1,215	1,096	1,820

[1] Numbers are provided in user days.

Total counts for this trail segment were also available for 2008 and 2009. In 2008, 37,048 user days were counted between January 6 and December 7 and in 2009, 24,391 user days were counted between April 19 and July 26.

The City of Cedar Rapids Parks and Recreation Department (Parks & Rec Department) indicated that the counts may be applied to the lengths of the trail located on both sides of the Cedar River. For estimating purposes, these user numbers were applied to the entire Cedar River Trail segment referred to in this report.

There are four urban parks located along or near the alignment of flood risk management Alternatives 4C and 10E.

Mays Island Plaza is located on Mays Island in the middle of the Cedar River between 1st Avenue and 5th Avenue. Mays Island is the governmental center for the City of Cedar Rapids and Linn County It is located adjacent to the Cedar River Trail West. User days at this park are not tracked by the Parks & Rec Department; however, since the Cedar River Trail passes in the proximity of the park, it may be assumed that the park area will have similar user counts as the Cedar River Trail. Mays Island Plaza will not be impacted by the construction of Alternative 4C.

Riverfront East is located along 1st Street East from 1st Avenue to Dam Avenue , and 1st Street East from 12th Avenue to 5th Avenue SE. User days at this park are not tracked by the Parks & Rec Department; however, since the Cedar River Trail passes through the park, it may be assumed that the park area will have similar user counts as the Cedar River Trail. There may be impacts to Riverfront Park East resulting from the implementation of Alternative 4C and 10E. These impacts could range from possible ground disturbance during construction to the use of the park for the construction of the flood protection works. The degree of impact will be more clearly understood once the final alignment is determined.

Masaryk Park is located at 14th Avenue and 1st Street SE. User days at this park are not tracked by the Parks & Rec Department; however, since the Cedar River Trail passes through the park, it may be assumed that the park area will have similar user counts as the Cedar River Trail. There may be impacts to Masaryk Park from the implementation of Alternative 4C and 10E. These impacts could

range from possible ground disturbance during construction to the use of the park for the construction of the flood protection works. The degree of impact will be more clearly understood once the final alignment is determined.

Osborn Park is located at 14th Avenue and 13th Street SE. User days at this park are not tracked by the Parks & Rec Department; however, since the Cedar River Trail passes through the park, it may be assumed that the park area will have similar user counts as the Cedar River Trail. There may be impacts to Osborn Park resulting from the implementation of Alternative 4C. These impacts could range from possible ground disturbance during construction to the use of the park for the construction of the flood protection works. The degree of impact will be more clearly understood once the final alignment is determined.

III. PROPOSED FACILITIES

Stanley Consultants has obtained information regarding the proposed recreational facilities from Sasaki Associates Inc's. recreational facilities master plan titled *City of Cedar Rapids Parks and Recreation Master Plan Elements*, February 1, 2010. New recreational facilities that will replace, enhance and supplement the City's existing recreational facilities are proposed in this planning document. Implementation of Alternative 4C or 10E will have no direct impact on any of these proposed recreational venues

IV. REFERENCES

1. Sasaki Associates, Inc. City of Cedar Rapids Parks and Recreation Master Plan Elements, February 1, 2010.
2. City of Cedar Rapids Parks and Recreation Department
3. Linn County Trail Association
4. City of Cedar Rapids Website. Parks Department. http://www.cedar-rapids.org/parks/parks_quad.asp; http://www.cedar-rapids.org/parks/walktrail.asp
5. US Cellular Center. Cedar Rapids Ice Arena. Yearly Attendance for Public Skate.
6. Indian Creek Nature Center. Elementary & Middle School Study Trip Programs. http://www.indiancreeknaturecenter.org/PDF/Elem.%20&%20Middle%20School%20Program%20brochure-2008.pdf
7. Cedar Rapids Community School. District Enrollment. http://www.cr.k12.ia.us/.

Cedar Rapids Flood Study ALT 4C - Trails - Option 1 10JUNE10 Cost Estimate

The trails that will be impacted by the construction of Alternative 4C flood protection alignment along the east bank of the Cedar River. The Cedar River Trail segment located from Cedar Lake on the east side of the Cedar River to the Cedar River Crossing at 14th Avenue SE. The length of this trail segment offset from the Cedar River bank on the east side of the Cedar River and the lengths of the trail on the bridge which cross the Cedar River will not be impacted by the flood protection construction.

The estimate entails only replacement of existing trail and construction of new trail systems. Surface restoration and demolition of trails which would be performed in the levee projects was not included.

Estimated by	Stanley Consultants
Designed by	Stanley Consultants
Prepared by	Glenn Jensen & Joe Burmeister
Preparation Date	6/10/2010
Effective Date of Pricing	6/10/2010
Estimated Construction Time	Days

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Description	Page
Library Properties	i
Project Notes	ii
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Earthwork	1
Recreational Trail-Asphalt 6 inch	1
Recreational Trail-Concrete 5 inch	1
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Earthwork	5
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Designed by
Stanley Consultants
Estimated by
Stanley Consultants
Prepared by
Glenn Jensen & Joe Burmeister

Design Document	Feasibility Study
Document Date	6/10/2010
District	Rock Island
Contact	Mike Barndollar
Budget Year	2009
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost

Timeline/Currency

Preparation Date	6/10/2010
Escalation Date	6/10/2010
Eff. Pricing Date	6/10/2010
Estimated Duration	0 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB08EB: MII English Cost Book 2008

Labor LNS2009: Labor National - Linn County Iowa 2010

d on the Davis Bacon Wage Rates For Linn County General Decision Number IA20100001 03/12/2010 IA1, IA20100037 04/16/2010 IA37, IA20100104 03/12/2010 IA104. Using 80% Non taxable fringe & 20%

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP07R05: MII Equipment Region 5r 2007

05 MIDWEST

Sales Tax	7.00
Working Hours per Year	1,400
Labor Adjustment Factor	1.00
Cost of Money	3.25
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.083
Gas	2.800
Diesel Off-Road	3.000
Diesel On-Road	3.250

Shipping Rates

Over 0 CWT	10.65
Over 240 CWT	10.00
Over 300 CWT	8.23
Over 400 CWT	7.51
Over 500 CWT	4.48
Over 700 CWT	4.15
Over 800 CWT	3.18

Date	Author	Note
8/18/2009	Wage Rates and Markups	Costs were derived from local contractors and suppliers where applicable. Means Cost data was also used in the cost development. Taxes: Local taxes will be applied to all materials. The computed tax rate in Cedar Rapids, Iowa is 7% on materials. Reference the Iowa Department of Revenue website: https://www.idr.iowa.gov/salestaxlookup/allresults.asp Escalation is not included in this estimate. Contingency is applied at 25% Prime Contractor mark ups are included: JOOH - 15% HOOH-5% Profit - 6.96% Bond - 1% Project Markups, including Engineering, O&M, and Administration are not included and willl be applied by the USACE.
8/18/2009	Cost Estimator Contact Information	Glenn Jensen: (563) 264-6478, jensenglenn@stanleygroup.com Joe Burmeister: (563) 264-6775, burmeisterjoseph@stanleygroup.com
8/31/2009	Assumptions	Hauling costs are based on the use of the borrow sites near the Eastern Iowa Airport Properties.

Direct Cost Markups	Category	Method
Sales Tax	TaxAdj	Running % on Selected Costs
MatlCost		

Contractor Markups	Category	Method
JOOH %	Allowance	Running %
HOOH	HOOH	Running %
Profit Weighted	Profit	Profit Weighted Guidelines

Guideline	*Value*	*Weight*	*Percentage*
Risk	*0.040*	*20*	*0.80*
Difficulty	*0.040*	*15*	*0.60*
Size	*0.040*	*15*	*0.60*
Period	*0.071*	*15*	*1.07*
Invest (Contractor's)	*0.070*	*5*	*0.35*
Assist (Assistance by)	*0.120*	*5*	*0.60*
SubContracting	*0.118*	*25*	*2.95*
Total		*100*	*6.96*

Profit	Profit	Running %
Bond	Bond	Running %

Owner Markups	Category	Method
Contingency	Contingency	Running %

Description	Quantity	UOM	ProjectCost
Bid Schedule Summary			464,590
Reconstruction/Relocation of Existing Trails - Option 1	6,430.0	LF	464,590
Mobilization	1.0	LS	1,422
Earthwork	6,619.0	CY	40,627
Recreational Trail-Asphalt 6 inch	4,033.0	SY	146,105
Recreational Trail-Concrete 5 inch	4,535.0	SY	276,436

Description	Contractor	UOM	Quantity	ContractCost	Escalation	Contingency	ProjectCost
Project Owner Summary				371,672	0	92,918	464,590
				57.80			*72.25*
Reconstruction/Relocation of Existing Trails - Option 1	Unrestricted Prime	LF	6,430.0	371,672	0	92,918	464,590
Mobilization	Unrestricted Prime	LS	1.0	1,138	0	284	1,422
				4.91			*6.14*
Earthwork	Unrestricted Prime	CY	6,619.0	32,501	0	8,125	40,627
				28.98			*36.23*
Recreational Trail-Asphalt 6 inch	Unrestricted Prime	SY	4,033.0	116,884	0	29,221	146,105
				48.76			*60.96*
Recreational Trail-Concrete 5 inch	Unrestricted Prime	SY	4,535.0	221,149	0	55,287	276,436

Description	UOM	Quantity	DirectCost	Payroll	WCI	Allowance	JOOH	HOOH	Profit	Bond	ContractCost
Project Indirect Summary			284,924	8,403	2,933	42,739	0	16,383	23,946	3,680	371,672
			44.31								*57.80*
Reconstruction/Relocation of Existing Trails - Option 1	LF	6,430.0	284,924	8,403	2,933	42,739	0	16,383	23,946	3,680	371,672
Mobilization	LS	1.0	872	59	18	131	0	50	73	11	1,138
			3.76								*4.91*
Earthwork	CY	6,619.0	24,916	775	257	3,737	0	1,433	2,094	322	32,501
			22.22								*28.98*
Recreational Trail-Asphalt 6 inch	SY	4,033.0	89,603	632	213	13,440	0	5,152	7,530	1,157	116,884
			37.38								*48.76*
Recreational Trail-Concrete 5 inch	SY	4,535.0	169,533	6,936	2,444	25,430	0	9,748	14,248	2,190	221,149

Description	Quantity	UOM	LaborCost	EQCost	MatlCost	BareCost	Productivity	Overtime	TaxAdj	MiscDirect	DirectMarkup	DirectCost
Project Direct Summary			76,961	15,409	169,362	261,733	0	0	11,855	0		284,924
			11.97	*2.40*	*26.34*	*40.71*	*0.00%*	*0.00%*				*44.31*
Reconstruction/Relocation of Existing Trails - Option 1	6,430.00	LF	76,961	15,409	169,362	261,733	0	0	11,855	0		284,924
Mobilization	1.00	LS	502	293	0	795	0	0	0	0		872
			1.12	*1.83*	*0.62*	*3.57*	*0.00%*	*0.00%*				*3.76*
Earthwork	6,619.00	CY	7,385	12,141	4,072	23,598	0	0	285	0		24,916
			1.46	*0.74*	*18.52*	*20.71*	*0.00%*	*0.00%*				*22.22*
Recreational Trail-Asphalt 6 inch	4,033.00	SY	5,873	2,976	74,681	83,530	0	0	5,228	0		89,603
			13.94	*0.00*	*19.98*	*33.92*	*0.00%*	*0.00%*				*37.38*
Recreational Trail-Concrete 5 inch	4,535.00	SY	63,201	0	90,609	153,810	0	0	6,343	0		169,533

Description	Contractor	Quantity	UOM	Duration	LaborCost	EQCost	MatlCost	SubBidCost	BareCost
Detailed Estimate				**745.91**	**76,961**	**15,409**	**169,362**	**0**	**261,733**
				0.12	*11.97*	*2.40*	*26.34*	*0.00*	*40.71*
Reconstruction/Relocation of Existing Trails - Option 1	**Unrestricted Prime**	**6,430.00**	**LF**	**745.91**	**76,961**	**15,409**	**169,362**	**0**	**261,733**
Mobilization	**Unrestricted Prime**	**1.00**	**LS**	**6.25**	**502**	**293**	**0**	**0**	**795**
				2.00	*163.80*	*80.32*	*0.00*	*0.00*	*244.12*
USR Mobilization or demobilization, vibratory roller, up to 50 miles	Unrestricted Prime	1.00	EA	2.00	164	80	0	0	244
(Note: Unit cost derived from cost of mobilizing and demobilizing a backhoe or excavator (RSM 015436500020). Costbook does not contain item for vibratory roller, work assumed to be similiar.)									
				0.25	*11.06*	*13.25*	*0.00*	*0.00*	*24.31*
RSM 015436500700 Mobilization or demobilization, scraper, self propelled, 24 C.Y. capacity, up to 50 miles	Unrestricted Prime	1.00	EA	0.25	11	13	0	0	24
				2.00	*163.80*	*118.79*	*0.00*	*0.00*	*282.59*
USR 015436502200 Mobilization or demobilization, crane, lattice boom	Unrestricted Prime	1.00	EA	2.00	164	119	0	0	283
(Note: Output was adjusted to account for both mobilization and demobilization.)									
				2.00	*163.80*	*80.32*	*0.00*	*0.00*	*244.12*
USR 015436500021 Mobilization or demobilization, Asphalt Distributor/Paver, up to 50 miles	Unrestricted Prime	1.00	EA	2.00	164	80	0	0	244
				0.02	*1.12*	*1.83*	*0.62*	*0.00*	*3.57*
Earthwork	**Unrestricted Prime**	**6,619.00**	**CY**	**113.54**	**7,385**	**12,141**	**4,072**	**0**	**23,598**
				0.00	*0.03*	*0.04*	*0.00*	*0.00*	*0.06*
RSM 312323250110 Compaction,subgrade, non cohesive soils, 85% proctor, 12" depth	Unrestricted Prime	7,144.00	SY	3.66	188	254	0	0	442
(Note: Formula: 64.3 Stations x 10' wide x 100' long = 64,300 sf / 9 sf/sy = 7,144 sy. Use for Special Compaction of Subgrade.)									
				0.01	*0.44*	*0.31*	*1.14*	*0.00*	*1.90*
RSM 312323239010 Compaction, water for, 3000 gallon truck, 6 mile haul	Unrestricted Prime	3,572.00	ECY	19.79	1,589	1,119	4,072	0	6,780
(Note: Formula: Compaction at 6" Depth. 64.3 Stations x 10' wide x 100' long = 64,300 sf / 9 sf/sy = 7,144 sy x 6" depth = 3,572 cy)									
				0.01	*0.83*	*1.62*	*0.00*	*0.00*	*2.44*
HNC 312316503320 Excavation, bulk, bank measure, medium soil, scraper excavation for roadway	Unrestricted Prime	6,619.00	BCY	88.25	5,485	10,694	0	0	16,179
				0.03	*1.90*	*1.15*	*0.00*	*0.00*	*3.05*
RSM 329113233200 Soil preparation, structural soil mixing, scarify subsoil, large commercial, 135 H.P. grader with scarifier	Unrestricted Prime	64.30	MSF	1.84	122	74	0	0	196
(Note: Use to Scarify Subgrade. Formula: 64.3 Stations x 10' wide x 100' long = 64,300 x 1MSF/1000 sf = 64.3 MSF)									
				0.01	*1.46*	*0.74*	*18.52*	*0.00*	*20.71*
Recreational Trail-Asphalt 6 inch	**Unrestricted Prime**	**4,033.00**	**SY**	**26.99**	**5,873**	**2,976**	**74,681**	**0**	**83,530**

Description	Contractor	Quantity	UOM	Duration	LaborCost	EQCost	MatlCost	SubBidCost	BareCost
				0.00	*0.49*	*0.23*	*6.35*	*0.00*	*7.07*
RSM 321216130380 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick	Unrestricted Prime	4,033.00	SY	5.08	1,982	924	25,610	0	28,515
				0.00	*0.68*	*0.32*	*11.30*	*0.00*	*12.30*
RSM 321216130200 Plant-mix asphalt paving, for highways and large paved areas, binder course, 4" thick	Unrestricted Prime	4,033.00	SY	7.79	2,757	1,274	45,573	0	49,604
				0.00	*0.27*	*0.13*	*5.75*	*0.00*	*6.15*
HNC 320113623190 Pavement overlay, polypropylene, prime coat, bituminous, 0.28 gallons/S.Y.	Unrestricted Prime	362.97	CSF	1.21	97	48	2,087	0	2,233
(Note: Formula: 4,033 sy x 9sf/1sy = 36,297 sf x 1csf/100 sf = 362.97 CSF)									
				0.00	*0.26*	*0.18*	*0.35*	*0.00*	*0.79*
RSM 320113623200 Asphalt surface treatment, tack coat, emulsion, 0.05 gallons per S.Y., 1000 S.Y.	Unrestricted Prime	4,033.00	SY	12.91	1,036	730	1,412	0	3,178
				0.13	*13.94*	*0.00*	*19.98*	*0.00*	*33.92*
Recreational Trail-Concrete 5 inch	**Unrestricted Prime**	**4,535.00**	**SY**	**599.12**	**63,201**	**0**	**90,609**	**0**	**153,810**
				0.01	*1.55*	*0.00*	*2.22*	*0.00*	*3.77*
RSM 320610100350 Sidewalks, driveways, and patios, sidewalk, concrete, cast-in-place with 6 x 6 - W1.4 x W1.4 mesh, broomed finish, 3000 psi, 5" thick, excludes base	Unrestricted Prime	40,815.00	SF	599.12	63,201	0	90,609	0	153,810
(Note: Formula: 4,535 sy x 9sf/sy = 40,815 sf)									

CEDAR RAPIDS, IOWA
TRAIL IMPACT STUDY

DOWNTOWN CEDAR RAPIDS
EAST SIDE - RIVER EDGE
FLOOD PROTECTION
ALIGNMENT ALTERNATIVE 4C
(2% PROBABILITY FLOOD)

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Revisions

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ROCK ISLAND, ILLINOIS

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CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

TRAIL IMPACT STUDY
COVER SHEET

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G-102-4C-T	FP33-G-102-4C-T			TRAIL IMPACT STUDY - DRAWING INDEX
G-103-4C-T	FP33-G-103-4C-T			TRAIL IMPACT STUDY - OVERALL SITE LOCATION PLAN
C-101-4C-T	FP33-C-101-4C-T			TRAIL IMPACT STUDY - BASE - SHEET 1
C-102-4C-T	FP33-C-102-4C-T			TRAIL IMPACT STUDY - BASE - SHEET 2
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C-113-4C-T	FP33-C-113-4C-T			TRAIL IMPACT STUDY - TYPICAL TRAIL SECTION A-A
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CEDAR RIVER
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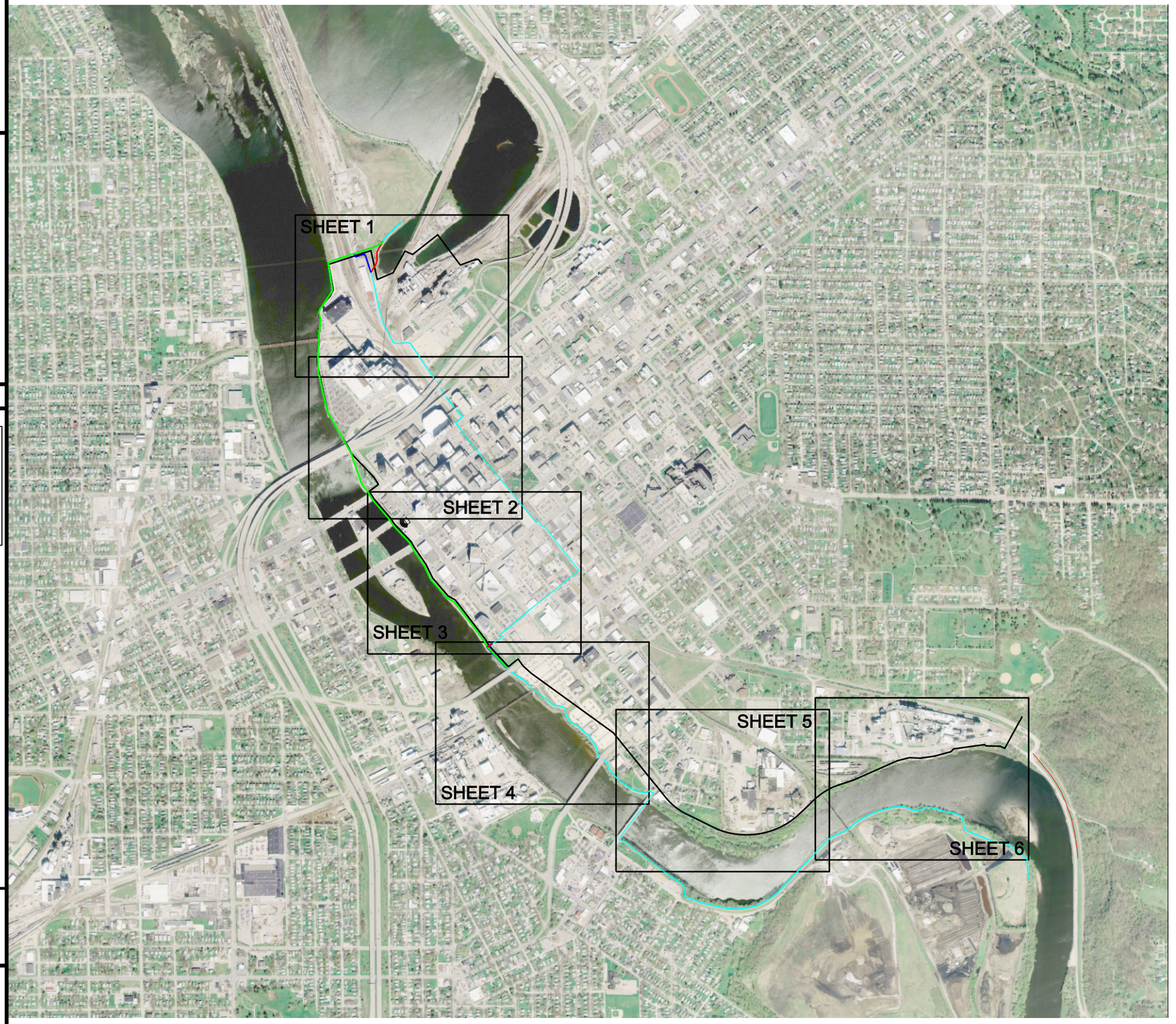

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LEGEND

ALTERNATIVE 4C

- LEVEE
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- PARCEL BOUNDARY
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TRAIL IMPACT STUDY
OVERALL SITE LOCATION PLAN

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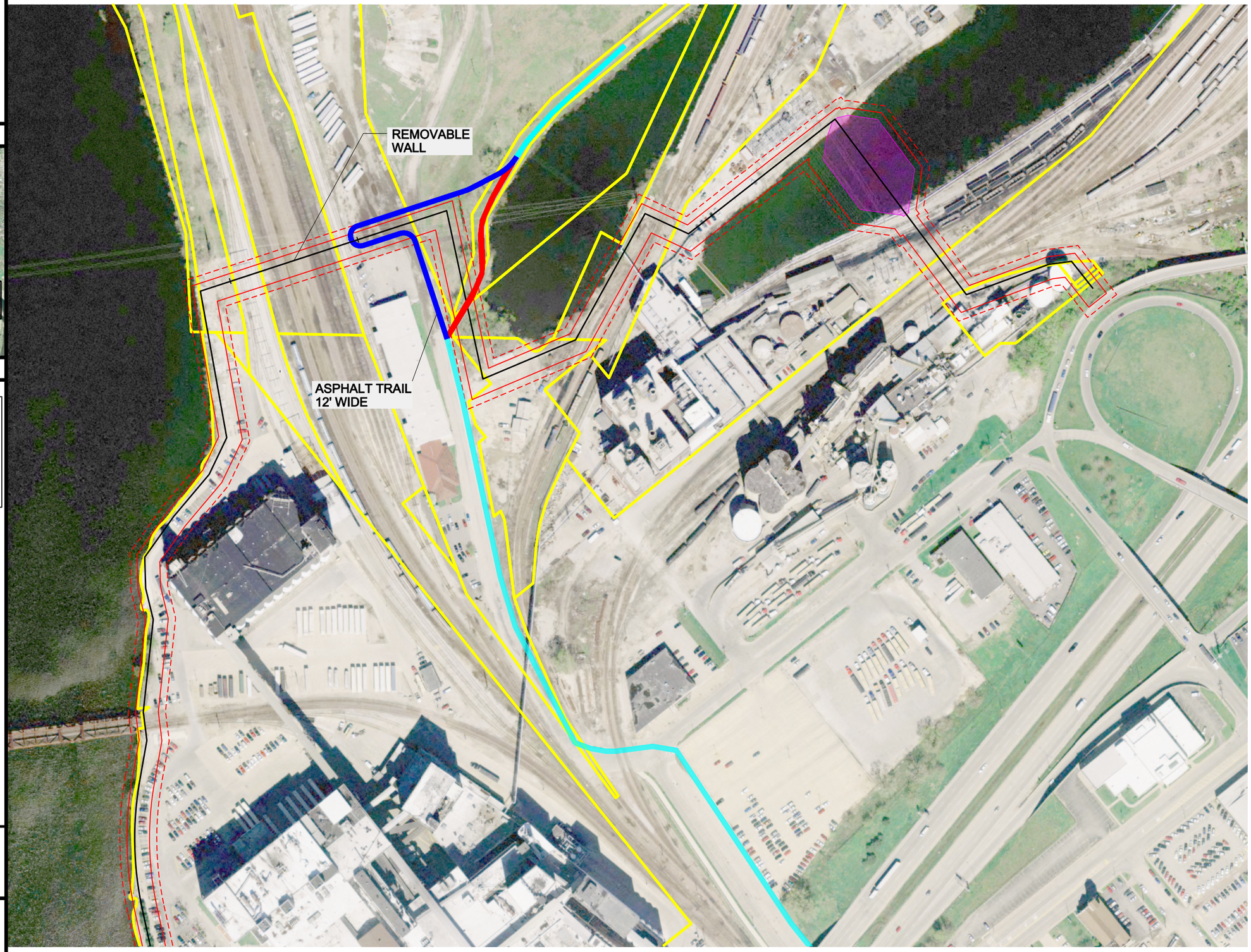

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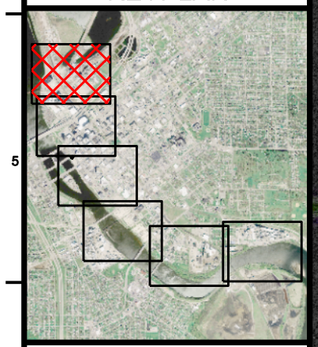

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GENERAL INVESTIGATION
FEASIBILITY STUDY

TRAIL IMPACT STUDY BASE SHEET 1

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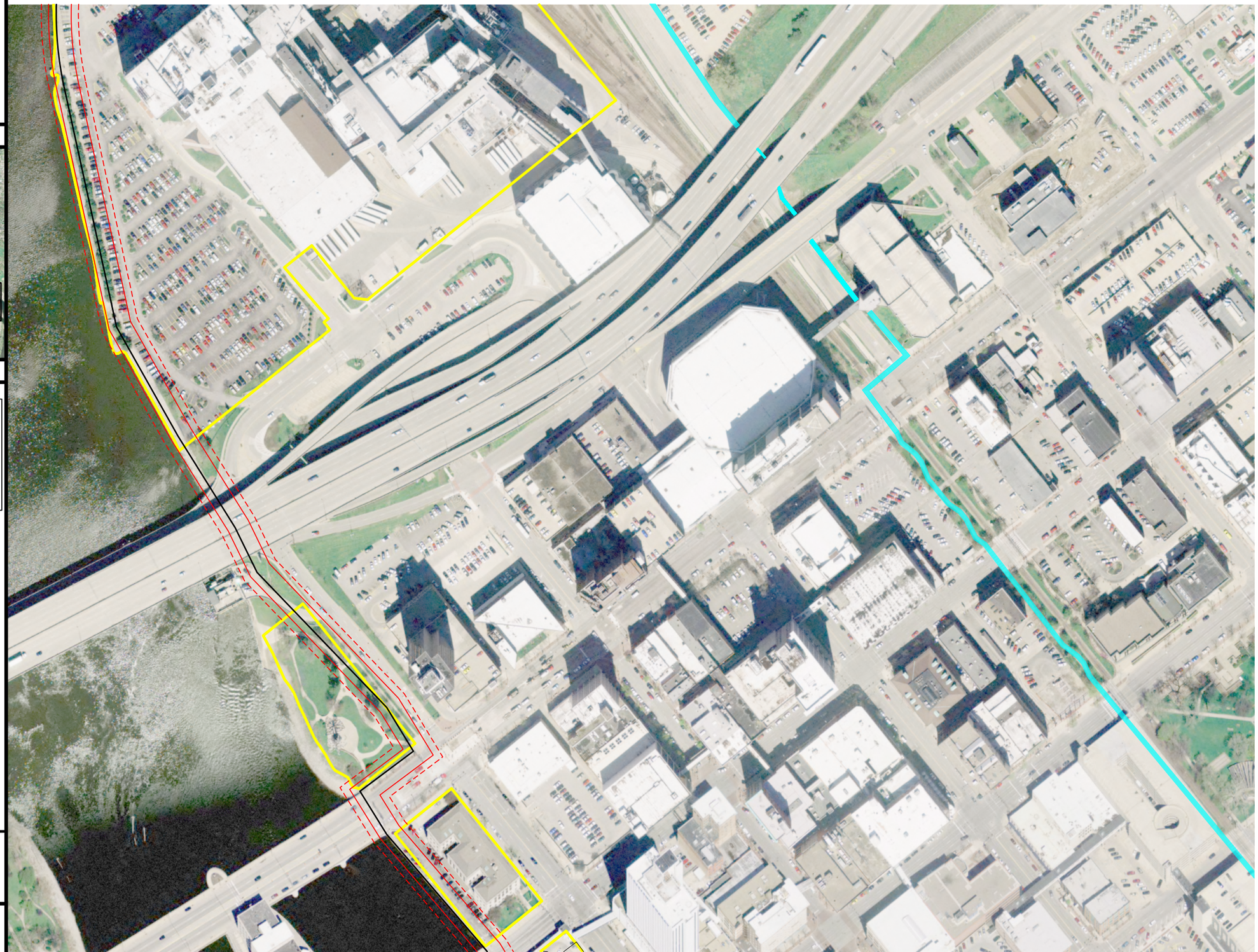

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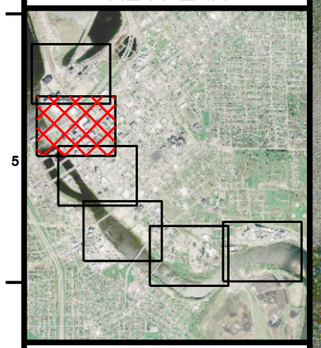

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GENERAL INVESTIGATION
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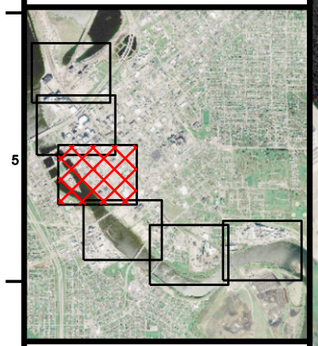

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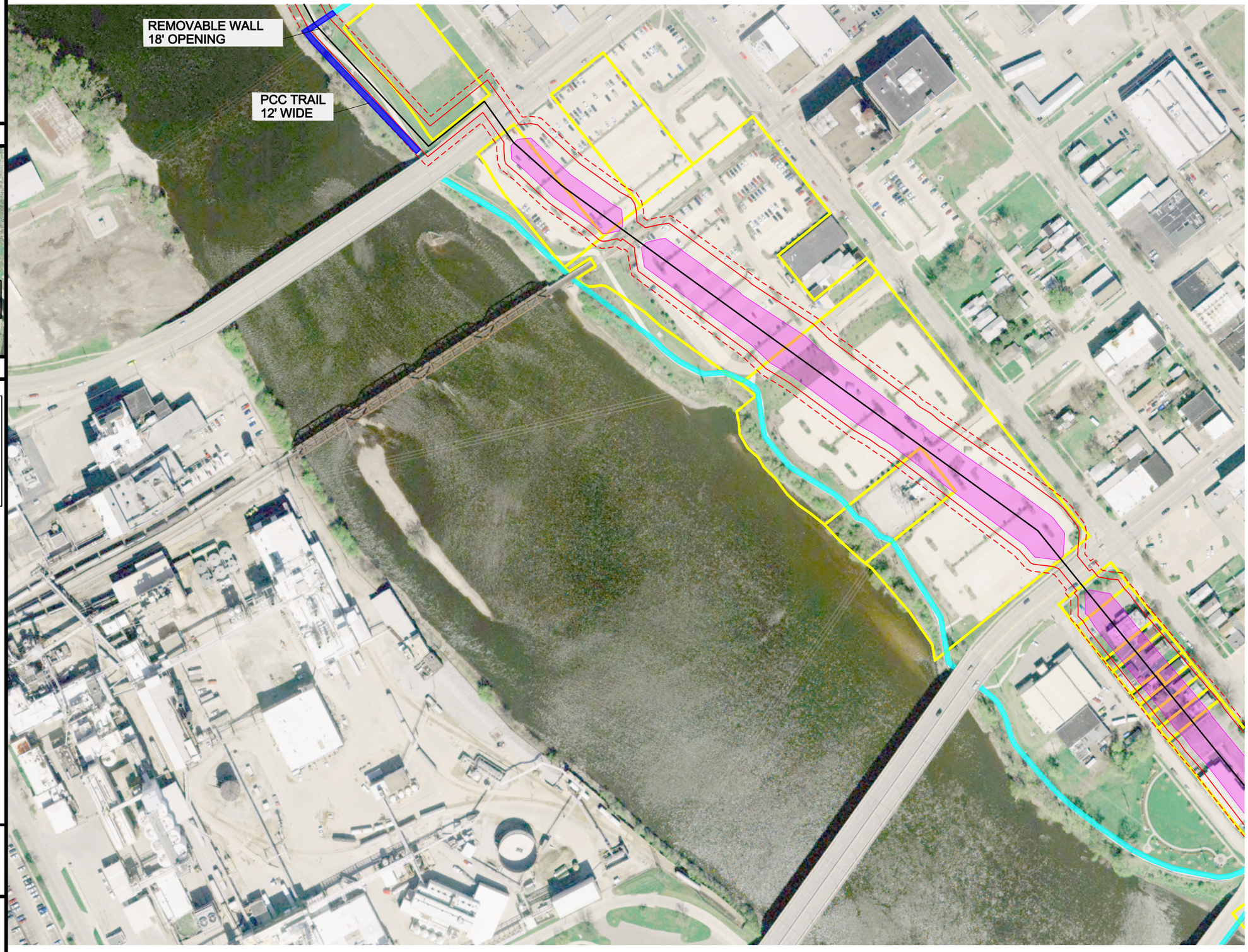

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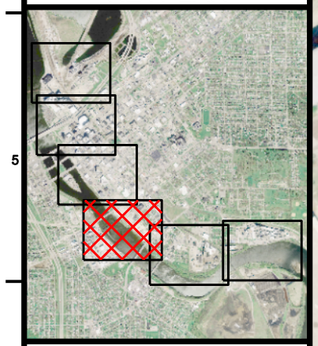

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CEDAR RIVER
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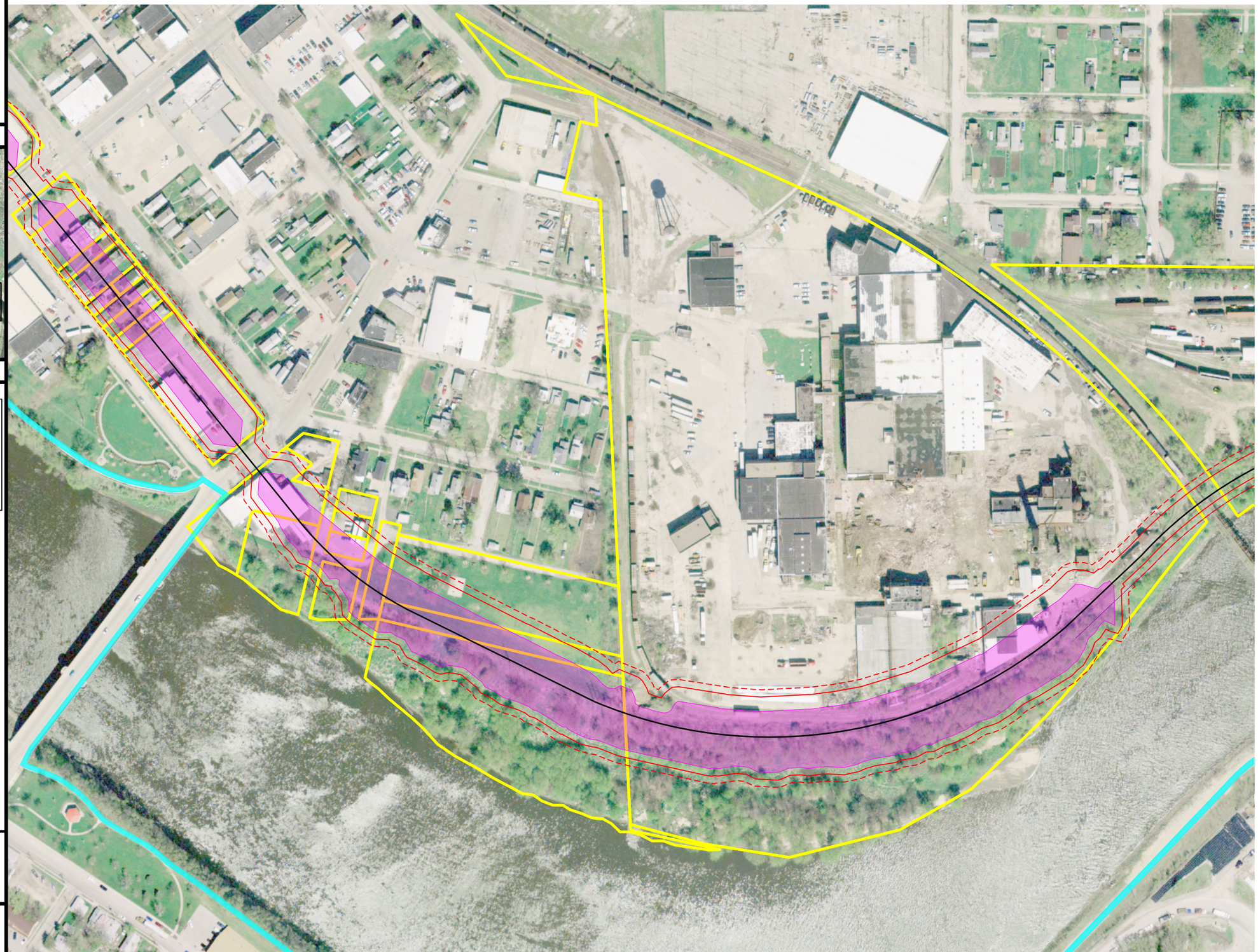

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GENERAL INVESTIGATION
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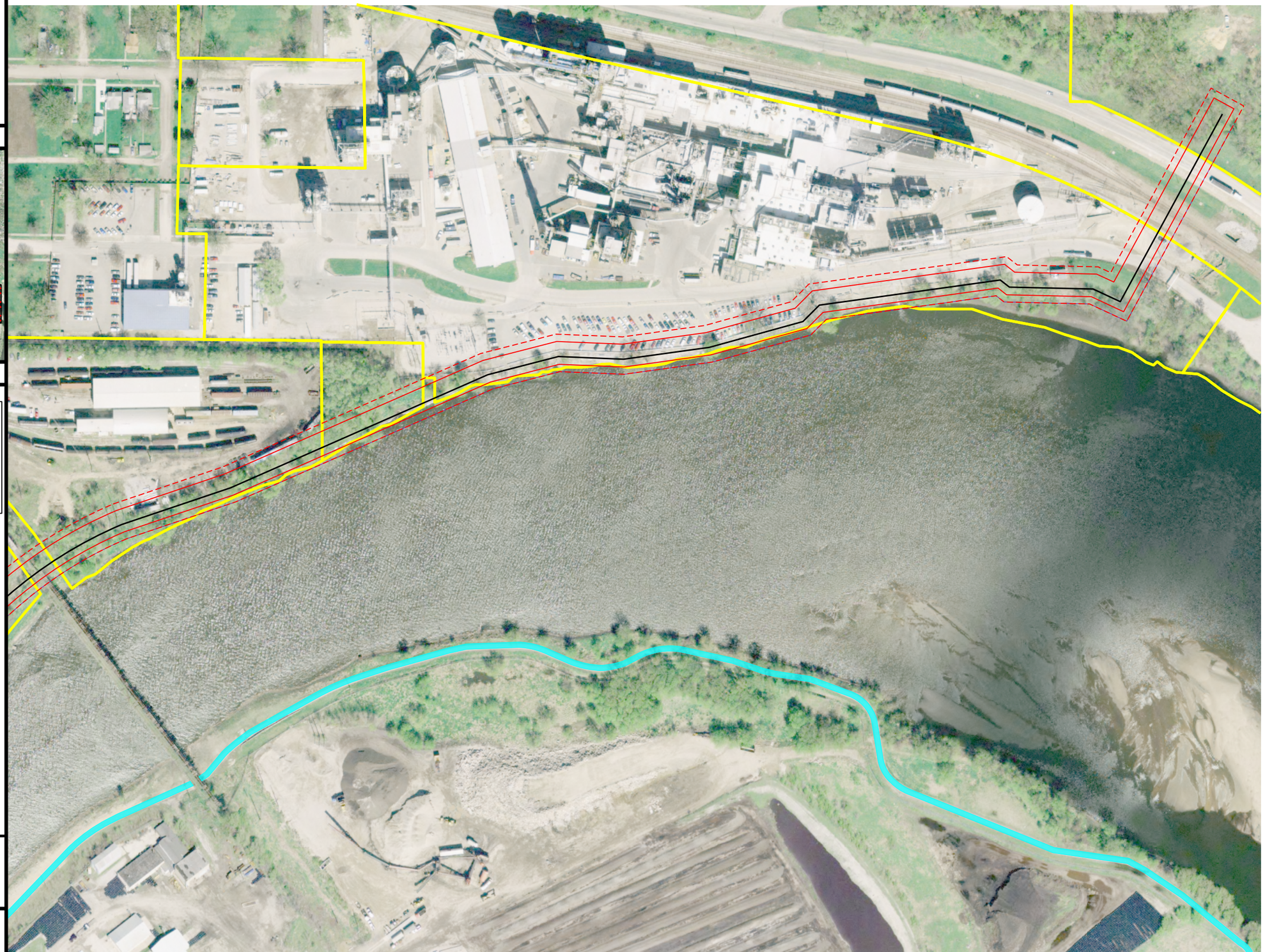

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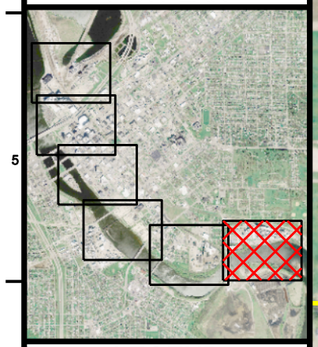

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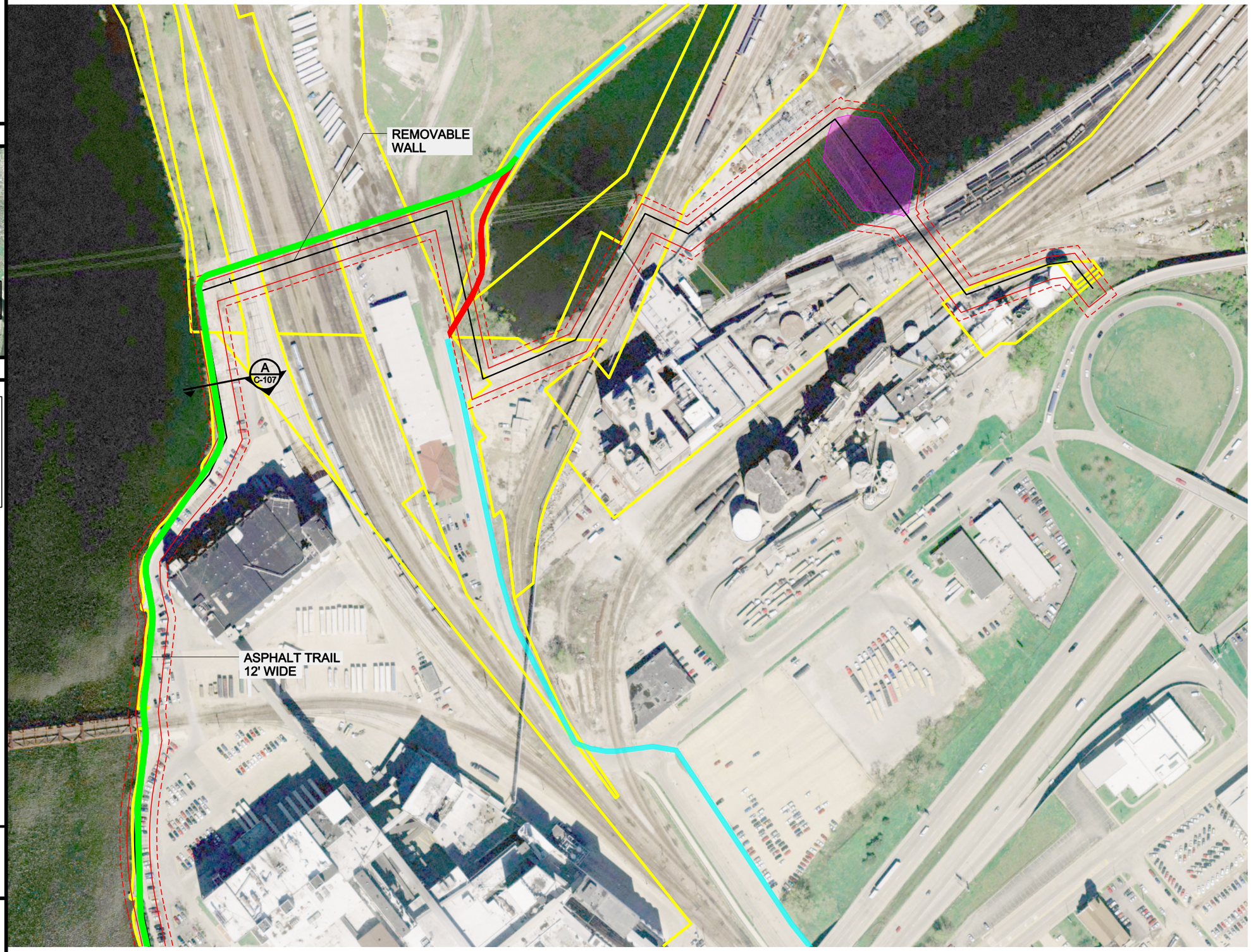

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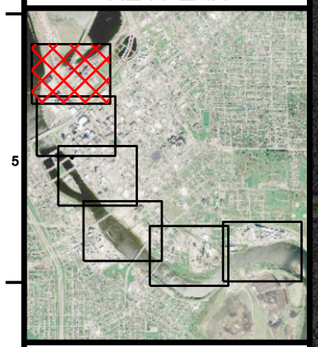

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CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
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TRAIL IMPACT STUDY
OPTION 1 & 2
SHEET 1

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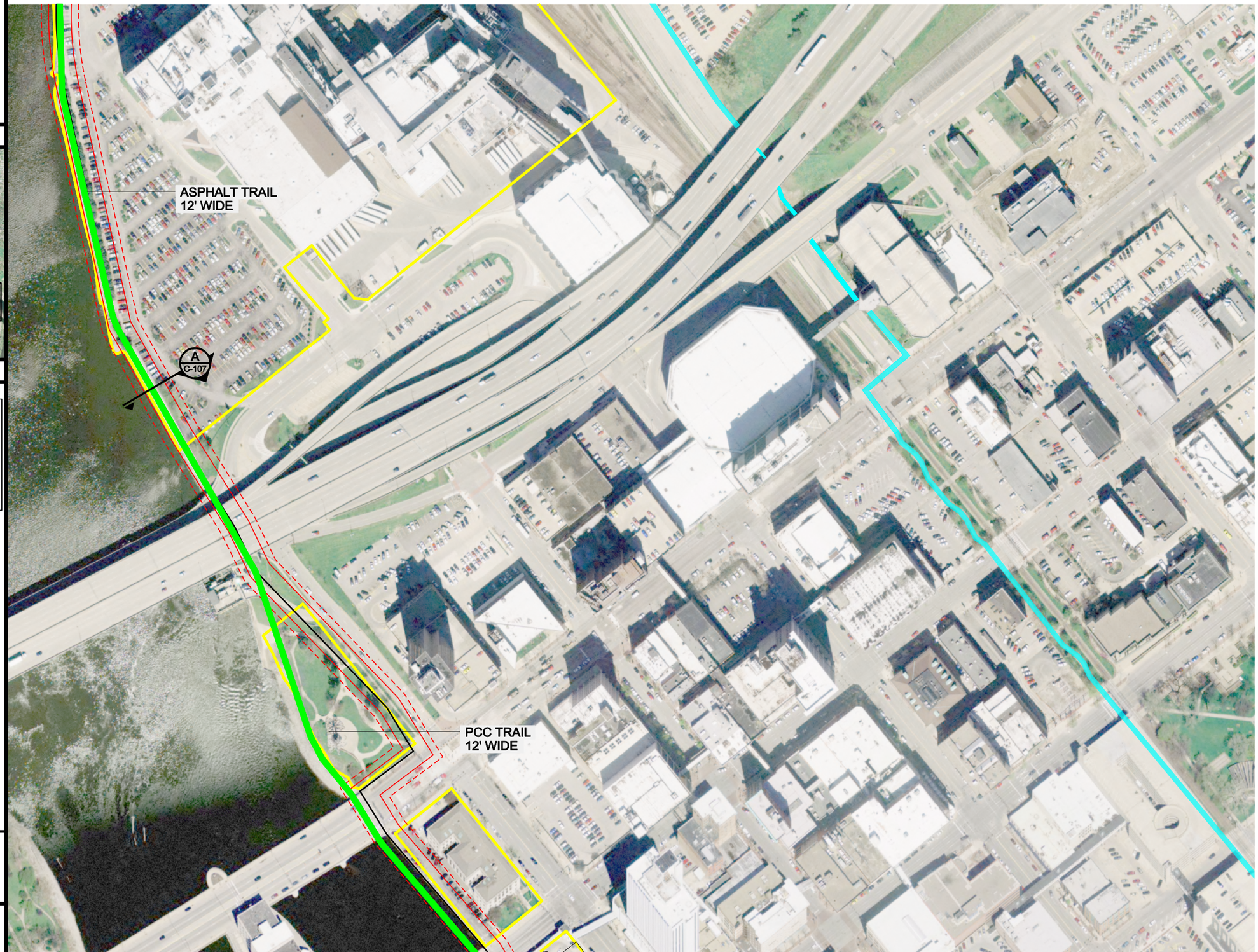

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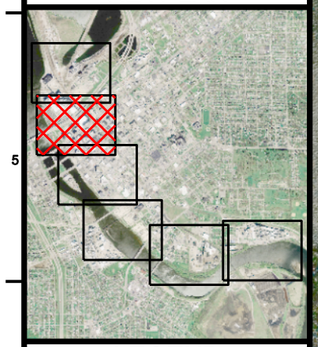

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CEDAR RIVER
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TRAIL IMPACT STUDY
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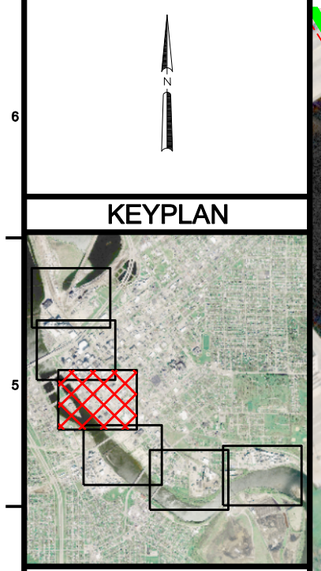

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AMPHITHEATER
OPTION 2

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PCC TRAIL
12' WIDE

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TRAIL IMPACT STUDY OPTION 1 & 2 SHEET 3

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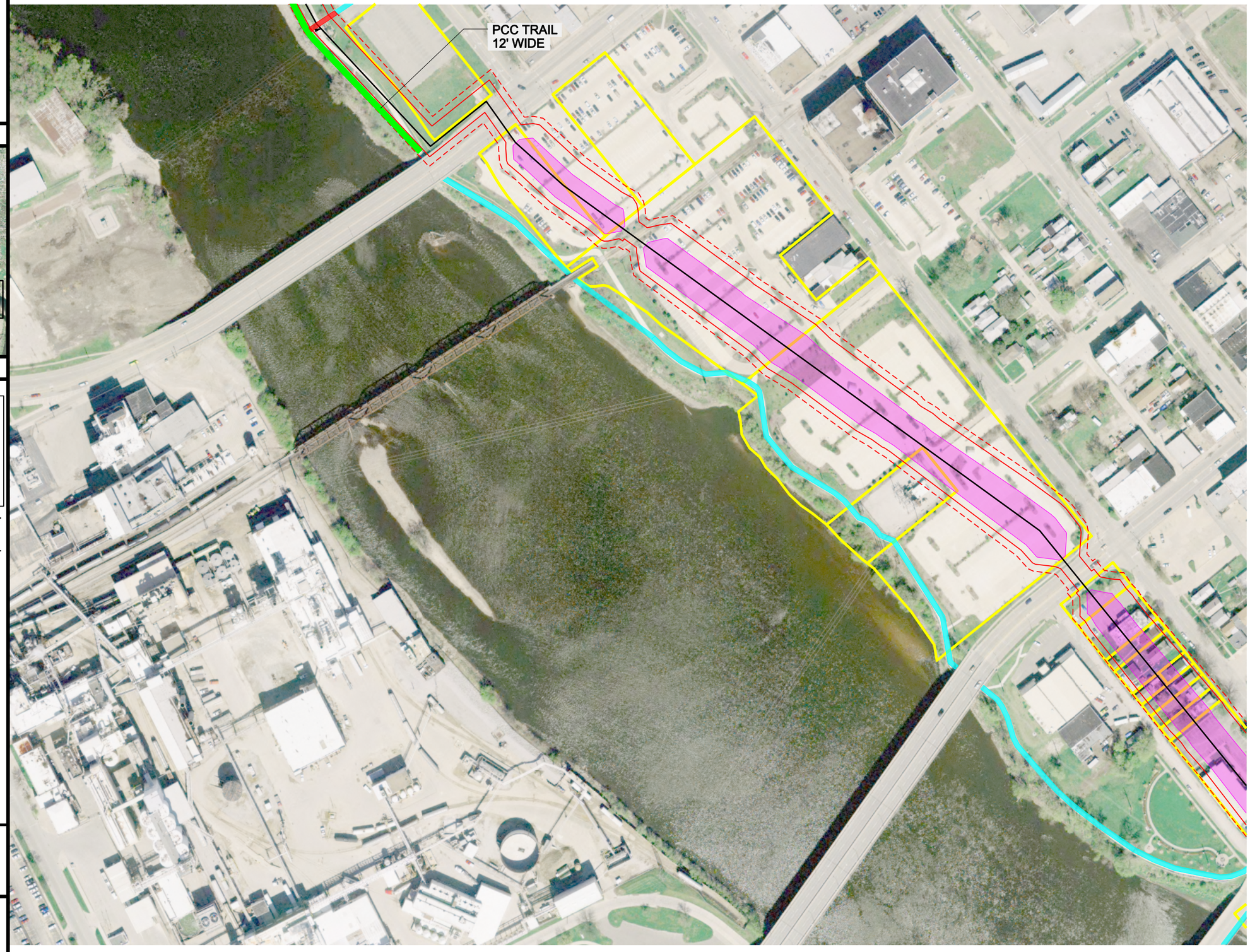

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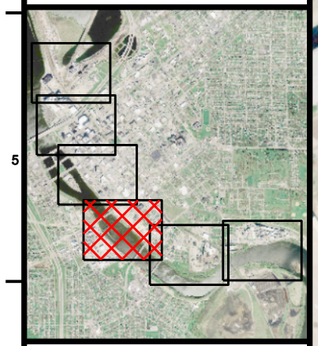

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Rock Island District

Revisions

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Designed By: AM	Drawn By: JLB	Checked By: JAZ	Reviewed By: MRH
Date: 10-JUNE-2010	Scale:	Project Code:	Solicitation Number:

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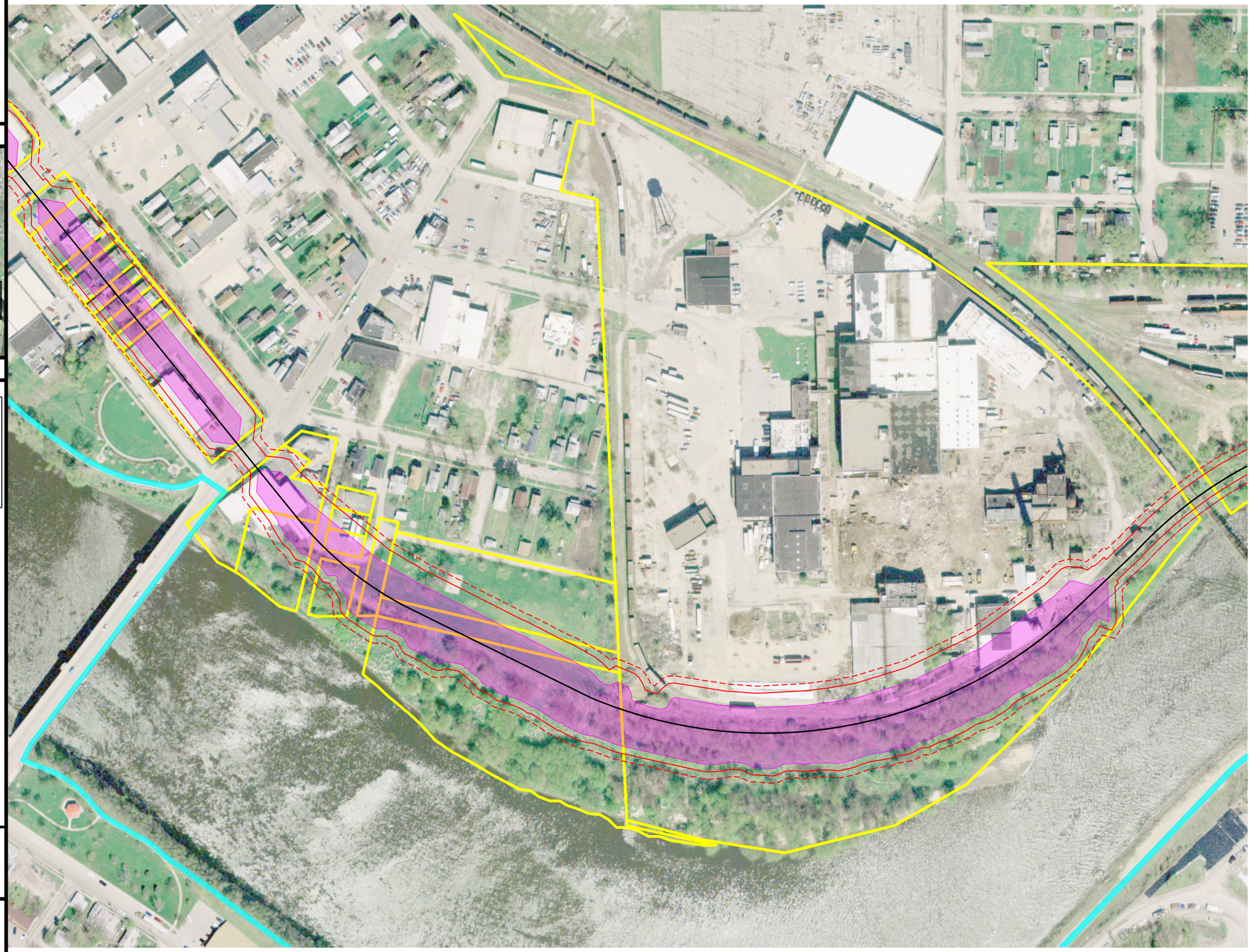
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Stanley Consultants INC.

CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

TRAIL IMPACT STUDY OPTION 1 & 2 SHEET 4

Sheet Reference Number:
C-110-4C-T
Sheet 13 of 17



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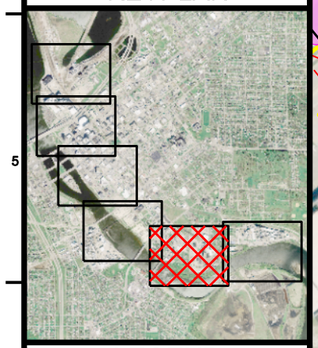

LEGEND

ALTERNATIVE 4C

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PROPOSED TRAIL RE-ALIGNMENT BASE PLAN
- PROPOSED TRAIL RE-ALIGNMENT OPTION 1
- EXISTING TRAIL IMPACTED
- EXISTING TRAIL NOT IMPACTED

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FEASIBILITY STUDY

TRAIL IMPACT STUDY OPTION 1 & 2 SHEET 5

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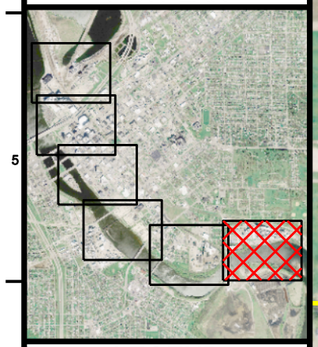

LEGEND

ALTERNATIVE 4C

- LEVEE
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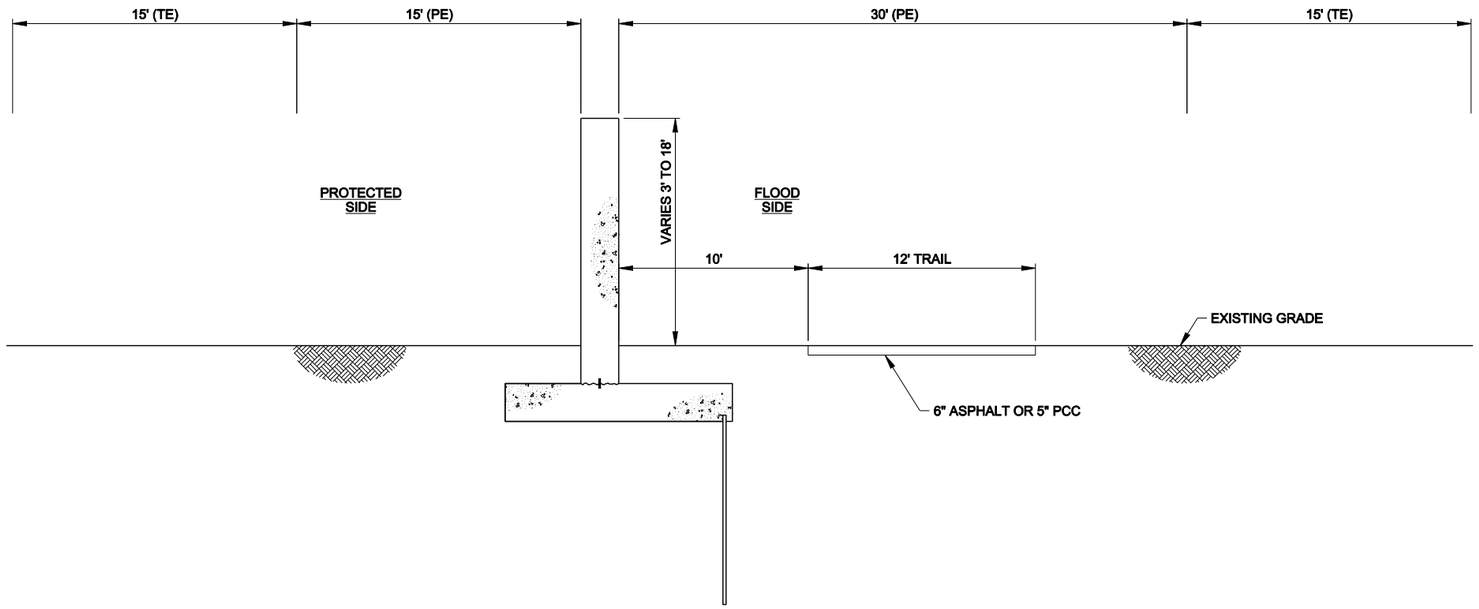

A TYPICAL TRAIL SECTION
NO SCALE

ABBREVIATIONS

PE - PERMANENT EASEMENT
TE - TEMPORARY EASEMENT

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FEASIBILITY STUDY

TRAIL IMPACT STUDY
TYPICAL TRAIL SECTION A-A

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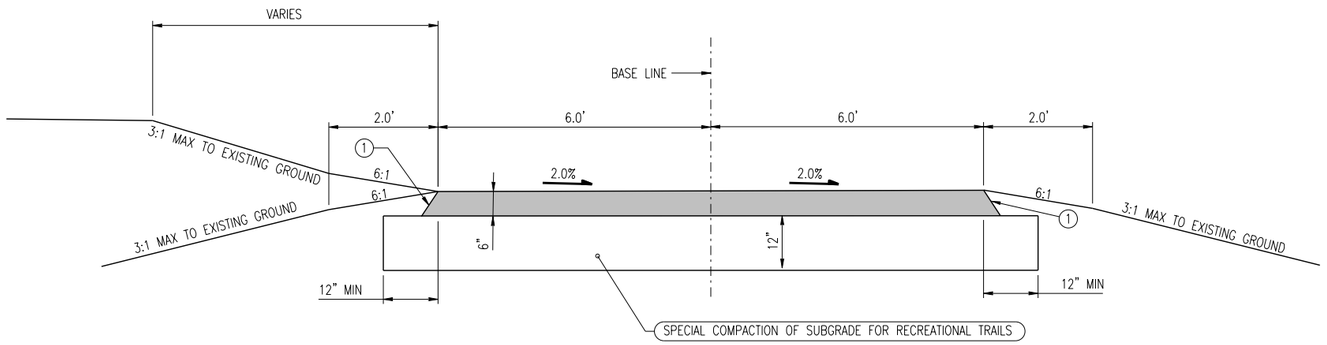
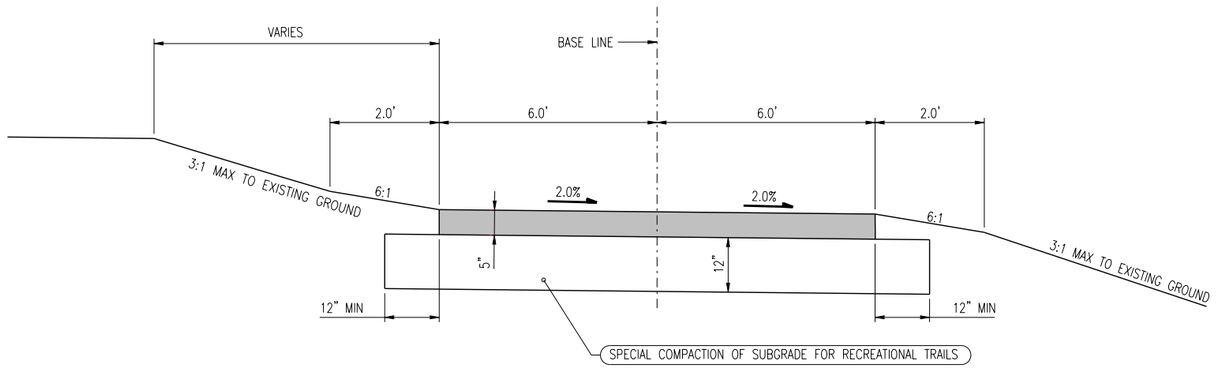


NOTES:

(1) NOMINAL 1:1 SLOPE

TYPICAL SECTION – ASPHALT RECREATIONAL TRAIL

NTS



TYPICAL SECTION – P.C.C. RECREATIONAL TRAIL

SCALE: NONE

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

TRAIL IMPACT STUDY
TYPICAL TRAIL SECTIONS

Sheet Reference Number:
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CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX N
CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

CEDAR RIVER
CEDAR RAPIDS, IOWA

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APPENDIX N
CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

I. PROJECT DESCRIPTION

A. Location and Description. See the main report of the *Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study With Integrated Environmental Assessment* (Study*),* sections *Introduction/Background* and *Study Area and Location*. The application of this CWA 404(b)(1) Evaluation covers impacts to the waters of the United States from implementation of Alternative 4C through the placement of dredged or fill material in Cedar Lake. No other 404 fill related activities would occur, outside those discussed below in Cedar Lake under any other alternative.

B. Authority and Purpose. See the main report, *Study Information.*

C. General Description of Dredged/Fill Material. For the construction of levee embankment cohesive materials of low plasticity (CL), such as silty clay, should be used. Granular (GW, GP, GM, GC, SW, SP, SM, SC), silty (ML), cohesive materials of high plasticity (MH, CH, OH) and organic soils (p_t) should not be used for the construction of the levee embankment.

To protect the portion of the levee crossing Cedar Lake from erosion, rock will be placed along the levee side slope at a 3H on 1V angle. A 6-inch thick layer of bedding stone of 3 inch maximum size stone would be overlain with a 24 inch thick layer of riprap with a maximum stone size of 400 pounds.

Construction would be bound by the requirements and conditions set forth in *Guide Specification, Civil Works Construction for Environmental Protection,* CW-1430, July 1978, section 7.3.

D. Description of the Proposed Placement Site. Cedar Lake is approximately 121 acres and serves as a cooling facility for operations of the Sixth Street power generating plant for Alliant Energy. The lake is segmented into two bodies of water by an existing causeway. The northern segment is approximately 90 acres while the southern segment of approximately 31 acres. The segments are connected by bridge openings. Due to the fact that Cedar Lake serves as a cooling facility, the temperatures generally range above 90 degrees F during the summer and 40 degrees during winter. The southern segment of the lake normally remains free of ice during the winter, while surface freezing generally occurs over a portion of the northern segment during the coldest winter periods.

Both segments continue to operate as they have for many years (since 1890) as a vital cooling facility for the power generator plant located at the southwest end of the lake. Approximately 0.85 acre of Cedar Lake would be covered by the levee segment through the lake. An additional 0.15 acre of Cedar Lake would be temporarily impacted for the construction zone. The length of the levee through Cedar Lake is 250 feet.

E. Description of the Proposed Placement Methods. Material for new levee construction through the southern segment of Cedar Lake would be done mechanically (trucks, bulldozers, backhoes, etc).

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation. Substrate elevation in the Study area/Cedar Lake is approximately 627.42 feet National Geodetic Vertical Datum 1929 (NGVD), (94.4 feet City Datum).

2. Substrate Type. The substrate in the area of proposed Cedar Lake levee portion is comprised of flocculent black, mucky silt 2 to 3 feet deep.

3. Dredged/Fill Material Movement. No movement of the levee construction material is anticipated. The riprap erosion protection should prevent significant dredged/fill material movement.

4. Actions Taken to Minimize Impacts. Numerous potential levee alignments were evaluated, and the current alignment has the least impact on the aquatic environment. Other alignments went across the middle of the northern segment of Cedar Lake and another alignment (Alternative 1) would have impacted approximately 24 acres of the Cedar River backwater complex adjacent to the railroad embankment adjacent to Cedar Lake. This new levee portion would be constructed in the dry, behind bulkheads/cofferdams/sheet piling to minimize impacts from Cedar Lake sediment disturbance. A total of approximately 1 acre of Cedar Lake would be impacted (0.85 acre for the levee and 0.15 acre for construction disturbance). The layer of riprap along the levee side slopes should minimize impacts. Alternative 1A and 10 would result in the same impacts to the aquatic environment of Cedar Lake as does Alternative 4C.

B. Water Circulation and Fluctuation

1. Water. The earthen material for the new levee construction would be basically inert material that would have little effect on water chemistry. Water clarity, odor, taste, pH, temperature, and dissolved gas levels would not change. The nature of all fill materials would not cause any significant changes in nutrient levels. The construction of the new levee should not impair the capability of the ecosystem to sustain life, or reduce the suitability of the Cedar Lake for populations of aquatic organisms, recreation, and aesthetics.

2. Current Patterns and Water Circulation. The construction of a new levee would not result in significant changes to Cedar Lake current patterns and water circulation. The levee would be designed with tubes running through it so the cooling water would flow from Cedar Lake, through the levee segment and into the power plant. These tubes could be closed during periods of high water to prohibit floodwater from entering the inside of the levee. During construction, pumps would provide cooling water to the power plant, by-passing the construction zone, until construction is complete. Any minor change would be localized in nature and would not produce large-scale changes in lake or river velocities. No changes to bottom contours or sediment composition are anticipated.

3. Normal Water Level Fluctuation. Construction of the new levee would not alter normal water level fluctuations in the area, or cause prolonged periods of inundation, exaggerated extremes of high and low water, alter erosion or sedimentation rates, aggravate water temperature extremes, or upset the nutrient and dissolved oxygen balance of the aquatic ecosystem. Therefore, this project should not alter or destroy communities and populations of aquatic animals and vegetation, induce populations of nuisance organisms, reduce food supplies, or restrict movement of aquatic animals.

4. Actions Taken to Minimize Impacts. Numerous potential levee alignments were evaluated, and the current alignment has the least impact on the aquatic environment. Other alignments went across the middle of the northern segment of Cedar Lake and another alignment (Alternative 1) would have impacted approximately 24 acres of the Cedar River backwater complex adjacent to the railroad embankment adjacent to Cedar Lake. Levee design with closable pipes to allow cooling water to flow through during normal operation, but could be closed to prevent floodwater from entering the inside of the levee would minimize impacts.

C. Suspended Particulate/Turbidity Determinations

1. Effects on Physical and Chemical Properties of the Water Column. The construction of a new levee should not change the kinds and concentrations of suspended particulate/turbidity in the construction area, after construction is complete. During construction temporary turbidity impacts would be experienced due to excavation, placement of construction material and movement of equipment. Impacts should be localized and limited to physical changes to the water column. No significant chemical impacts are anticipated. The deposition of any/all construction materials should not cause any violation of applicable water quality standard, or lead to loss of environmental values.

2. Effects on Biota. Deposition of the construction materials for the new levee in the waters of the United States should not cause significant reductions in levels of light penetration that could lower photosynthesis and plant growth. Sight dependant species should not suffer reduced feeding ability, growth rates, or resistance to disease.

3. Actions Taken to Minimize Impacts. Numerous potential levee alignments were evaluated, and the current alignment has the least impact on the aquatic environment. Other alignments went across the middle of the northern segment of Cedar Lake and another alignment would have impacted approximately 24 acres of the Cedar River backwater complex adjacent to the railroad embankment adjacent to Cedar Lake (Alternative 1). Levee design with closable pipes to allow cooling water to

flow through during normal operation, but could be closed to prevent floodwater from entering the inside of the levee would minimize impacts. Building the levee segment in the dry, behind bulkheads/cofferdams/sheetpiling would also minimize impacts.

D. Contaminant Determinations. Cedar Lake is currently listed as a Category 5a Impaired Water by the Iowa DNR. This is based on a Fish Consumption Advisory issued by Region 7 US EPA for Total PCB's (polychlorinated biphenyls) on carp and channel catfish. A Fish Advisory was delisted in March 2008 for chlordane. Based on the Fish Consumption Advisories and other data, it is assumed that Cedar Lake sediments contain PCB's and chlordane. As the proposed levee material would be inert, it is not anticipated that construction activities would contribute to the preexisting contaminant conditions. Best management practices will be incorporated to reduce the disturbance of pre-existing contaminants. Any removal of sediments from the bottom of the levee footprint would require proper handling and disposal according to state and Federal regulations.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on Plankton and Nekton. Both phytoplankton and zooplankton may be impacted during construction. These organisms shouldn't be significantly impacted for the long-term. Nektonic (free-swimming) organisms should be able to avoid the Study area during construction and shouldn't be impacted.

2. Effects on Benthos. The benthic community within the footprint of the levee would be lost. This loss constitutes only a small fraction of the over-all benthic community in the Study area, or this reach of Cedar Lake.

3. Effects on Aquatic Food Web. The loss of the benthic organisms within the footprint of the new levee should not cause any significant impact to any level/segment of the aquatic food web, or disrupt the flow of energy between any trophic level. This small benthic loss should not result in the reduction or potential elimination of food chain organism populations and should not cause any decrease in the overall productivity and nutrient export capability of the ecosystem.

4. Effects on Special Aquatic Sites. There are no geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values that would be significantly impacted in the Study area. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. No sanctuaries or refuges, quality wetlands, mudflats, vegetated shallows, or riffle/pool complexes would be impacted. The habitat at the new levee segment through Cedar Lake is open water with unconsolidated sediments.

5. Threatened and Endangered Species. No threatened or endangered species would be impacted by this project.

6. Other Wildlife. Refer to section *Environmental Impacts/Effects* of the main report.

7. Actions Taken to Minimize Impacts. Numerous potential levee alignments were evaluated, and the current alignment has the least impact on the aquatic environment. Other alignments went across the middle of the northern segment of Cedar Lake and another alignment would have impacted approximately 24 acres of the Cedar River backwater complex adjacent to the railroad embankment adjacent to Cedar Lake. Levee design with closable pipes to allow cooling water to flow through during normal operation, but could be closed to prevent floodwater from entering the inside of the levee would minimize impacts.

F. Proposed Placement Site Determinations

1. Mixing Zone Determinations. A mixing zone is an area in which discharge water is allowed to mix with the receiving water. The large assimilation capacity of the Cedar River and Cedar Lake in the vicinity of the levee would provide an adequate mixing zone for any sediment related contaminants that may be present. No violation of any water quality standard resulting from dredged or fill material connected with this project is anticipated.

2. Determination of Compliance with Applicable Water Quality Standards. No violations to any State of Iowa water quality standard should occur. State certification under Section 401 of the Clean Water Act would be obtained before any construction activities begin.

3. Potential Effects on Human-Use Characteristics. Implementation of this project would have no significant effect either directly, indirectly, or cumulatively on municipal or private water supplies; commercial or recreational fishery; parks; national or historic monuments; wilderness areas; or other similar preserves.

G. Determination of Cumulative Effects on the Aquatic Ecosystem. Cumulative effects are the total effect, including both direct and secondary (indirect) effects, on a given resource, ecosystem, and human community of all actions, regardless of which agency (Federal, non-Federal, or private) has taken the actions.

The small levee segment impacting Cedar Lake should not result in any significant impact, either direct, indirect, or cumulatively on any water resource category.

H. Determination of Secondary Effects on the Aquatic Ecosystem. Secondary or indirect effects/impacts are those associated with the discharge of dredged or fill material, but do not result from the actual placement of the dredged or fill material. They occur at some place distant from the actual placement and at some time after the discharge has occurred. No secondary (indirect) effects are anticipated as a result of the action.

CEDAR RIVER
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FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

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CLEAN WATER ACT SECTION 404(b)(1) EVALUATION

FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH RESTRICTIONS ON PLACEMENT

A. No significant adaptations of the 404(b)(1) Guidelines were made relative to this evaluation.

B. Alternatives which were considered for the proposed action are:

No Action
Alternative 1C - Levee protection on both sides of the Cedar River
Alternative 1A-C - Levee protection on both sides of the Cedar River
Alternative 4C - Levee protection on east side of the Cedar River
Alternative 10E – Levee protection for two industrial sites on the east side of Cedar River

C. Section 401 Water Quality Certification from the State of Iowa would be received before project construction on the new levee segment in Cedar Lake would begin.

D. The project, as proposed, would not cause concentrations of hazardous substances or other regulated contaminants in the waters of the United States to exceed applicable or relevant and appropriate limits.

E. No significant adverse impacts to state- or federally-listed endangered or threatened species are anticipated from this project.

F. No municipal or private water supplies would be adversely affected. There would be no adverse impacts to recreational or commercial fishing. No significant adverse changes to the ecology of the Cedar River or Cedar Lake would result from this action.

G. No contamination, over and above ambient levels, of Cedar Lake is anticipated. The project would cause only minimal and short-term adverse environmental impacts.

H. No other practicable alternative has been identified that would address the project goals and objectives better than the Recommended Plan, Alternative 4C. The proposed action would not significantly impact water quality. The proposed action is in compliance with Section 404(b)(1) of the Clean Water Act, as amended.

15 OCT 10

Date

Shawn P. McGinley
Colonel, US Army
Commander & District Engineer

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
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APPENDIX O
PLANNING FORMULATION

CEDAR RIVER
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FLOOD RISK MANAGEMENT PROJECT

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APPENDIX O PLANNING FORMULATION

I. INTRODUCTION

This appendix describes the planning process used during the *Cedar River, Cedar Rapids, Iowa Flood Risk Management Feasibility Study* (Study). It documents the major activities, study assumptions, screening of measures and alternatives, and conclusions drawn during the various phases of the study.

II. STUDY PURPOSE

This appendix was prepared to record and document the results of the screening process for the initial array of measures and to identify the measures that would be considered in greater detail. The initial array of alternatives being considered was developed as part of the scoping process as presented in the documents titled *City of Cedar Rapids – Framework Plan for the Reinvestment and Revitalization* (River Corridor Redevelopment Plan) Sasaki and Associates, December 2008; and *the Cedar Rapids River Corridor Redevelopment - Flood Mitigation Options*, prepared by Stanley Consultants Inc., March 2009. These two documents outline the planning efforts for the City of Cedar Rapids, Iowa (City) in combination with the U.S. Army Corps of Engineers' (Corps) study process.

The Study measures and alternatives were developed in three phases that will be outlined in this appendix. Federal planning efforts must comply with Federal laws including the National Environmental Policy Act (NEPA) and the Clean Water Act. The Corps must also comply with applicable executive orders such as Executive Order (EO) 11988, Floodplain Management.

III. PLANNING POLICY AND PROCESS

A. Policy. The Corps conducts planning efforts in accordance with the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, established by the Water Resources Council in 1983. These principles and guidelines, referred to as the "O&G," establish Federal water resource planning policy for the Corps, Bureau of Reclamation, Tennessee Valley Authority, and the Natural Resources Conservation Service (formerly Soil Conservation Service). Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, defines the specific planning policies of the Corps based upon the O&G. The Corps has published several other ERs, guidance letters and engineering circulars pertinent to specific aspects of planning and project implementation.

B. Planning Process. The Corps' planning process consists of six major steps:

(1) Specification of water and related land resources problems and opportunities
(2) Inventory, forecast and analysis of water and related land resources conditions within the study area
(3) Formulation of alternative plans
(4) Evaluation of the effects of the alternative plans
(5) Comparison of the alternative plans
(6) Selection of the recommended plan based upon the comparison of the alternative plans

The six steps are presented in a linear fashion, but the actual planning process is not linear. In fact, the six steps are applied in several iterations over time as more information is developed to inform the process. Early iterations focus on defining the problems and assessing the existing conditions while also exploring possible solutions. Later iterations focus on formulation, evaluation and comparison of alternative actions, but they still seek to clarify the problems and expected future conditions.

C. Study Goals. The Project Delivery Team (PDT), which consisted of City Staff, a City-hired consulting group, and the Corps' internal PDT developed the following study goals:

1. Reduce flood damages to private and public infrastructure caused by Cedar River flooding in the City through 2060
2. Improve the response by local, state, and Federal agencies to the all flood events along the Cedar River in the City
3. Increase public awareness to the risk of flooding from the Cedar River in the City through 2060
4. Increase recreational opportunities in the City along the Cedar River that are compatible with an implementable FRM plan.

D. National Planning Objectives. The national or Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

E. Public Concerns. A number of public concerns have been identified during the course of the Study. Initial concerns were expressed in the City's Study request. Additional input was received through coordination with the City, coordination with other agencies, public review of draft and interim products, and through public meetings. A discussion of public involvement is included in the Main Report Section 6, *Public Involvement, Review and Consultation*. The public concerns that are related to the establishment of planning objectives and planning constraints are as follows:

- flooding and impacts to urban infrastructure
- the potential for implemented FRM measures to increase flood stages

- the desire for additional flood storage in the watershed
- the desire for increased recreational opportunities in the Study area
- the need to protect watershed and local riverside habitat and connectivity

IV. PLANNING ITERATIONS

The Study was conducted in an iterative fashion. A wide array of potential features, measures, and subsequent alternatives were identified during the planning phases. The Reconnaissance Phase was first phase of the process followed by Iteration One, which included the initial development of the management features. Measure development occurred in Iteration Two, and Iterations Three and Four were completed with detailed data analysis and selection of the Recommended Plan. The planning steps of formulating, evaluating, and comparing alternative plans were accomplished iteratively as information about the measures and subsequent alternatives was developed.

- Reconnaissance Phase (April 2003-July 2004)
- Feasibility Iteration One (July 2008-March 2009)
- Feasibility Iteration Two (April 2009-November 2009)
- Feasibility Iteration Three (December 2009-February 2010)
- Feasibility Iteration Four (March 2010-July 2010)

A. Reconnaissance Phase. In a letter dated April 25, 2003, the City, acting on behalf of itself and other impacted communities in the Indian Creek and Dry Creek watersheds, requested the District to undertake a study effort to identify economical flood damage reduction measures. In October 2003, Cedar Rapids in coordination with the District, initiated a Section 205-Small Flood Damage Reduction Reconnaissance Study. The Initial Assessment/Reconnaissance Report was completed in May of 2004 and approved by memorandum July 8, 2004. The original study included analysis of the Time Check Levee System, and Indian Creek and Dry Creek Watersheds; the latter two are not covered in this document. The reconnaissance report indicated that a significant number of homes and businesses in the Time Check Neighborhood (figures O-1 and O-2) are within the 100-year floodplain of the Cedar River and that failure of the existing Time Check levee could result in these structures sustaining major flood damage. The study determined that an improved levee system would reduce potential flood damage to the Time Check Neighborhood of Cedar Rapids. Therefore, the reconnaissance report concluded that an acceptable alternative could be developed in the Study that would satisfy Federal interest criteria.

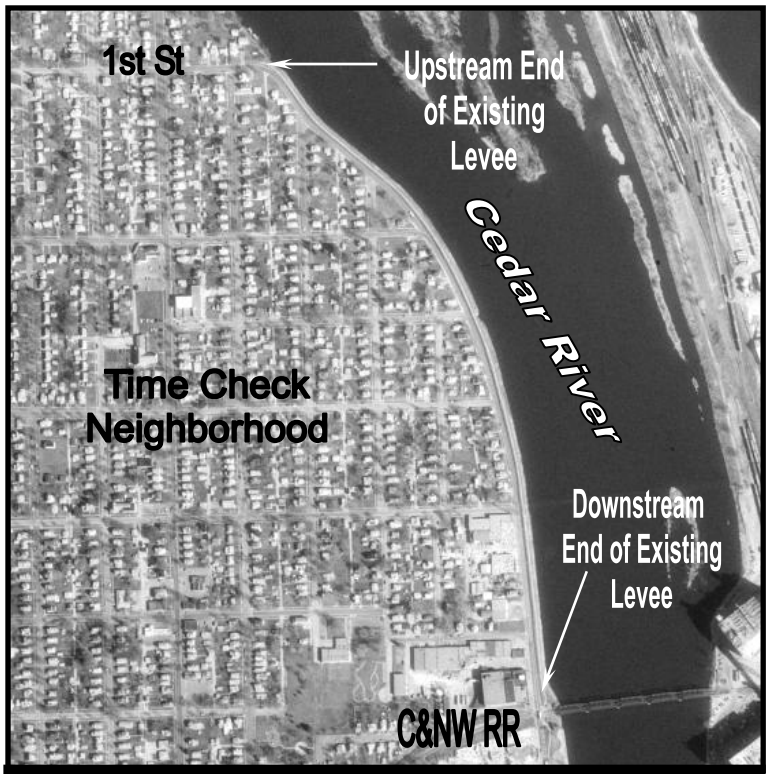

Figure O-1. Time Check Neighborhood

Figure O-1. Time Check Neighborhood

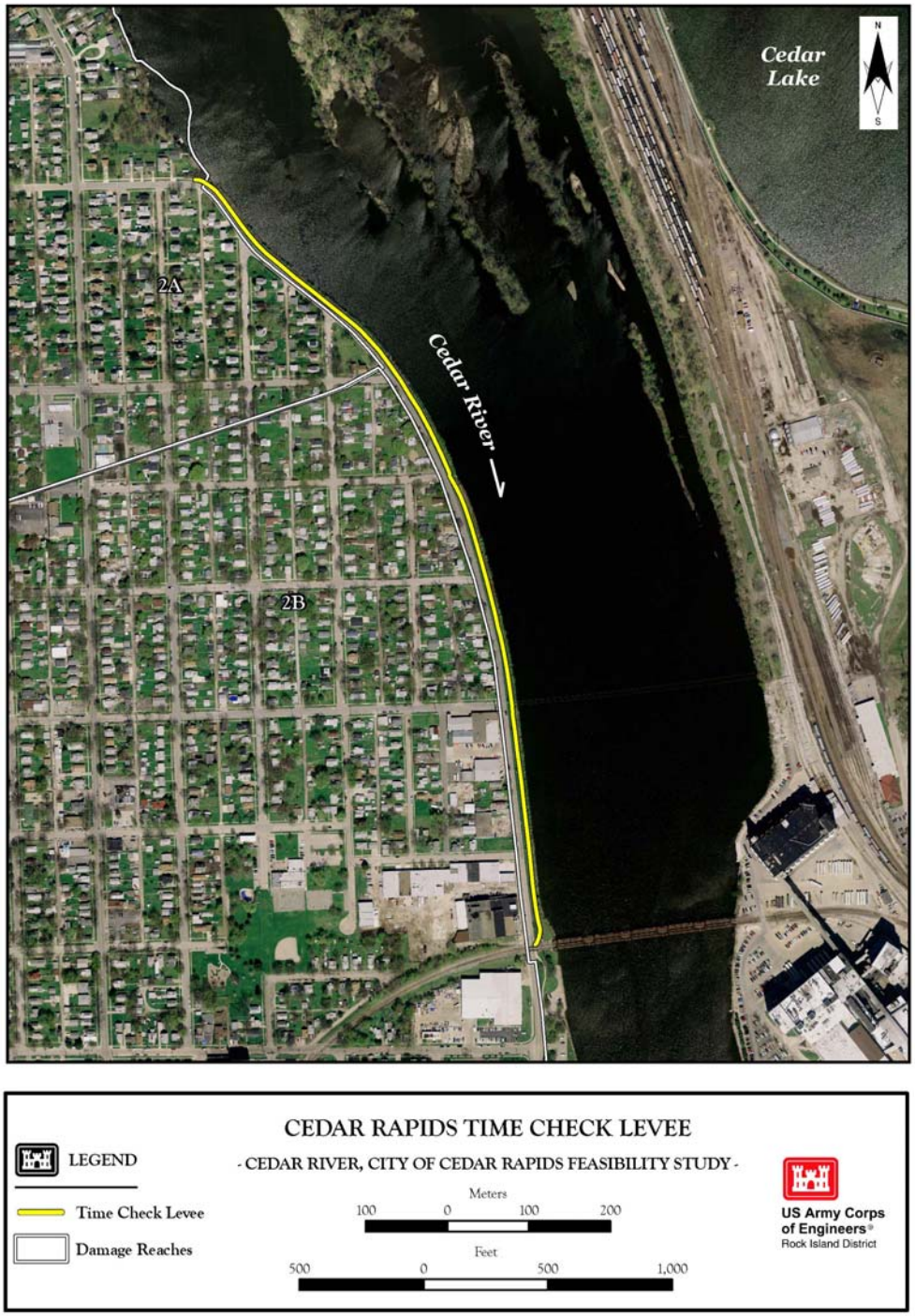

Figure O-2. FEMA FIS Flood Plain (1991), Time Check Neighborhood

B. Iteration One: The majority of the process outlined in this phase is in the main report. The additional information is background feature development and analysis.

Structural Measures

1. **Reservoirs.** This type of structural measure involves storing runoff to reduce flows in the river.

- **S1 Locate Large Reservoir Upstream.** A large reservoir upstream of Cedar Rapids would be constructed to retain runoff and reduce the flood flows downstream.

- **S2 Locate Multiple Reservoirs Upstream.** Multiple reservoirs would be built upstream to retain runoff and reduce the flood flows downstream. Two locations were investigated upstream of Waterloo, which do not provide the required volume of storage. To meet the required storage volume a small version of the reservoir described in S1 would have to be included for a total of three reservoirs.

Screening Reservoirs S1 and S2. Reservoirs were sized to contain the 2008 flood. The Rough Order of Magnitude (ROM) cost estimate for building the reservoirs was based on the *Department of the Army, Rock Island District, Corps of Engineers, Final Feasibility Report, Iowa-Cedar River Basin*, June 1982. The costs were in agreement with the cost of building Saylorville Reservoir in 1975. Option S1 is a single reservoir option and is evaluated knowing the available flood control storage and the percent of Cedar Rapids' total drainage area that it controls. The multiple reservoir option, (S2) is harder to evaluate without specifically modeling the period of record to evaluate effective regulation plans. This study is sufficient to remove these options from further consideration as they are not cost effective compared to the levee options.

- **S3 Use Cedar Lake for Flood Storage.** New pumps would be provided to reduce the water level in Cedar Lake providing floodwater storage. This requires an input structure to divert flow from the Cedar River to Cedar Lake during large flood events.

- **S4 Use Jones Golf Course as Retention / Detention Basin.** Jones Golf Course would be excavated to provide a retention/detention basin providing flood storage. Requires berms and an inlet structure to control the flow into the area during large flood events.

- **S20 Use Chain Lake Wildlife Area for Flood Storage.** Chain Lakes Wildlife Area is approximately 1,353 acres. This option assumes flood water can be stored to a depth of 5 feet. Storage volume is approximately 6,765 acre-feet. A system of berms and inlet/outlet structures are required to store water.

Screening of Retention Storage S3, S4, and S20. Cedar Lake (S3), Jones Golf Course (S4), and Chain of Lakes Wildlife Area (S20) were each evaluated as possible flood storage detention basins. There is not enough storage available at any of these locations to effectively lower flood stages in Cedar Rapids. Stanley Consultants analysis of these options is comprehensive enough to remove them from further consideration.

- **Mini Basins (Measure generated after publication of Flood Mitigation Options report).** The mini-retention basin concept calls for constructing 5,800 basins within the Cedar River watershed upstream of Cedar Rapids. Automatic water control gates will be installed at locations like existing road culverts to store runoff. Landowners would receive a financial benefit each year for having a basin constructed on their land. In years that flooding occurs, the landowners receive reimbursement for crop loss and any other damage due to the flooding.

Screening of Mini Basins. As a stand-alone flood protection alternative for the City, the mini retention basin concept is not feasible. The mini retention basin concept is better implemented on a smaller scale like a sub-basin within the Cedar River watershed. The stakeholders can prioritize the goals for the sub-basin and begin implementation. Any runoff reduction gained from implementation of watershed management will enhance other flood protection measures, but is not a replacement for flood protection measures.

2. Levees/Floodwalls. This type of structural measure involves constructing a barrier, typically earthen levee and floodwall, between the river and protected area.

- **S5 Construct Flood Protection (Levees/Floodwalls) at the River's Edge.** A line of protection adjacent to the edge of the Cedar River would be constructed. Three feet of freeboard is added to the calculated water surface elevation.

- **S6 Construct Flood Protection (Floodwalls / Levees) Offset from River at 100-Year Elevation.** A line of protection offset from the Cedar River at the FEMA 100-year boundary would be constructed. Three feet of freeboard is added to the calculated water surface elevation.

- **S7 Construct Flood Protection (Floodwalls/Levees) Offset from River at 500-Year Elevation.** A line of protection offset from the Cedar River at the FEMA 500-year boundary would be constructed. Three feet of freeboard is added to the calculated water surface elevation.

- **S19 Introduce Flood Protection Around Mays Island.** Local flood protection would be added to structures on Mays Island. Flood protection would be incorporated into existing walls along the sides of the island and a demountable system of flood walls at each end of buildings.

- **S22 Construct Flood Protection (Floodwalls / Levees) at Cedar Valley Neighborhood.** A line of protection would be constructed around the Cedar Valley Neighborhood. Three feet would be added to the expected flood water surface elevation for freeboard. The potential reduction listed in table 1 relates to the Cedar River and not the local reduction on the dry side of the flood protection.

- **S25 Construct Flood Protection (Floodwalls/Levees) at Ellis Road West of Edgewood Road.** A line of protection would be constructed around the homes along Ellis Road. Three feet would be added to the expected flood water surface elevation for freeboard. The potential reduction listed in table O-1 relates to the Cedar Rapids and not the local reduction on the dry side of the flood protection. This type of structural measure involves removing flow from the Cedar River upstream of Cedar Rapids and returning the flow to the river downstream of Cedar Rapids.

Screening of Levees/Floodwalls S5, S6, S7, S19, S22, and S25. The ROM costs are reasonable and levees/floodwalls are the least expensive of the options that can effectively protect against a large flood. These options will be considered further.

3. Channels (Manipulation of Existing Channel Capacity). This type of structural measure involves modifying the channel geometry to allow the same amount of flow in the river with reduced water surface elevations. This also includes modifications to culverts, roads, bridges and dams.

- **S9A Increase Cedar River Channel Cross Section by Dredging.** The channel would be dredged to provide an increased section to allow a higher flow rate. It is assumed that dredging occurs in the river from the Five in One Dam to the south side of the landfill. The typical cross section uses a minimum bottom width of 300 feet sloping from an invert elevation of 699.0 feet to 692.0 feet. Approximately 183,000 cubic yards of material is removed from the channel, which includes rock excavation.

- **S9B Increase Cedar River Channel Cross Section by Widening Channel.** The Cedar River channel would be dredged and widened to provide an increased cross section area to allow a higher flow rate. This option is based on widening the river channel from the Five in One Dam to the south side of the landfill. The typical cross section uses a minimum bottom width of 700 feet sloping from an invert elevation of 699.0 feet to 692.0 feet. Approximately 1,644,000 cubic yards of material is removed from the channel, which includes rock excavation and 1,150,000 cubic yards of material removed form the banks.

- **S12A Demolish Buildings and Remove Mays Island.** Mays Island is located in the middle of the river and is the site for City Hall. The island restricts the flow area in the river. The buildings and island would be completely removed. Construction/modification to the bridges is required to connect spans through the removed island.

- **S12B Remove Island Upstream of Interstate 380.** The island located in the Cedar River reduces the available area for the flow in the river. Removing the island improves flow characteristics at this location. Removal quantity is estimated at 1,160,000 cubic yards.

- **S21 Increase Channel Capacity by Removing "Pinch Points" on Either Side of Corridor.** Much of the channel area downstream of I-380 is narrow and confines the

flow. Increasing the channel width will increase channel capacity. Channel would be increased at two locations—the west bank around 8th Avenue and the east bank downstream of 16th Avenue Bridge. The existing bridge opening sizes were not modified.

- **S24 Build Canal Through West Side of Cedar Rapids.** Construct a canal offset from the river in the west overbank. The canal extends from cross section W to cross section L. The canal is 240 feet wide with vertical sides and a concrete lining. The invert at each end of the canal match the Cedar River inverts. Approximately 2,400,000 cubic yards of material to be removed for the canal construction.

- **S10 Elevate CRANDIC Railroad Bridge Above 2008 Flood Crest.** The bridge superstructure would be elevated above the 2008 flood crest. Low chord is elevated approximately 10 feet. The existing pier number, locations and sizes remain for this analysis.

- **S11A Elevate all Bridges and Approaches Above 2008 Flood Crest.** The highway and railroad bridges cause a restriction in flow and elevating would help reduce the flood crest. The following bridges are elevated: UP railroad upstream of I-380, 1st Avenue, 2nd Avenue, 3rd Avenue, 8th Avenue, CRANDIC railroad downstream of 8th Avenue, 12th Avenue, 16th Avenue and CRANDIC railroad downstream of 16th Avenue.

- **S11B Elevate Select Bridges Above 2008 Flood Crest.** The highway and railroad bridges cause a restriction in flow and elevating would help reduce the flood crest. This option is based on elevating 1st Avenue, 2nd Avenue, 3rd Avenue, and CRANDIC railroad bridge downstream of 16th Avenue.

- **S13 Construct Lift Bridge Spans.** Lift bridges minimize the construction of embankments for the bridge approaches through the floodplain. Four bridges, which contribute to the backwater effect, would be replaced, including 1st Avenue, 2nd Avenue, 3rd Avenue, and railroad bridge downstream of 16th Avenue.

- **S18A Elevate Edgewood Road With Increase in Culvert Opening.** Edgewood Road Bridge was above flood crest but the south approach was below the 2008 flood crest elevation. The road (south approach) would be elevated so that access is maintained across the river. The south approach is overtopped at approximately a 10-year event. During 2008, the I-380 bridge provided the only access across the Cedar River at the crest. To minimize the increase to upstream water surface elevations, provide bridges/culverts in the approach. Increases based on Anderson-Bogert drawing “Concept C.”.

- **S18B Elevate Edgewood Road With Same Culvert Opening.** Edgewood Road Bridge was above flood crest but south approach was below the 2008 flood crest elevation. The road (south approach) would be elevated so that access is maintained across the river. The

south approach is overtopped at approximately a 10-year event. During 2008, the I-380 bridge provided the only access across the Cedar River at the crest. Do not add additional waterway openings to see if bridge embankments will hold water upstream (to address public comments).

- **S23 Construct Additional CMP Culverts in UPRR at C Street.** The Union Pacific railroad near C Street has three 114-inch corrugated metal pipes in the embankment on the east side of the river. Five additional 114-inch corrugated metal pipes would be built in the embankment to bring the total number to eight.

- **S14 Replace Five in One Dam Gates With Rubber Dams.** The Five in One Dam would be replaced with inflatable rubber dams. Install the rubber dams within the existing Five in One Dam structure. During higher flows on the Cedar River, the Dam could be deflated to reduce the backwater created by the Dam. A rubber dam in the deflated position creates less obstruction to the flow than the exiting gates of the Five in One Dam.

- **S15 Provide Rubber Dam at South to Maintain Water Elevation During Low Flow.** A rubber dam would be constructed south of existing Five in One Dam. The Five in One Dam would remain. The normal pool of the new dam would be approximately 708.0 feet with normal pool of the Five in One Dam at 718.0 feet. There would be 10 feet of elevation change between the dam pools.

- **Sensitivity Analysis – Remove Dams.** A model simulation (based on an existing FEMA HEC-RAS Model-1991 FIS) for removing the Five in One Dam and the roller dam south of the UP railroad at C Street was completed. There was very few impacts the on the water surface elevations of the lower frequency events.

- **Sensitivity Analysis – Remove All Bridges.** A model simulation (based on an existing FEMA HEC-RAS Model-1991 FIS) in which all bridges were removed to study the maximum possible effect the bridges have on the water surface elevations. There was very few impacts the on the water surface elevations of the lower frequency events.

Screening of Channels S9A, S9B, and S21. Dredging (S9A) and removing pinch points (S21) are not effective and the more ambitious channel widening (S9B) is too expensive compared to levees and are not as effective at providing flood protection. Another factor for these options is the uncertainty of the long term stability of the solutions because of changes in siltation, and erosion patterns caused by the channel modification. Evaluation of these options is sufficient to eliminate them from further consideration in the Feasibility Study.

Screening of Bridge and Approaches - S10, S11A, S11B. Elevating CRANDIC Railroad Bridge (S10), all the bridges through the downtown area (S11A), or a select group of 4 bridges (S11B) over the elevation of the 2008 flood was studied. The high cost of raising a bridge makes these

options economically infeasible. On an individual basis, when a bridge is going to be replaced, raising it to an elevation above the 2008 flood elevation should be considered.

Screening of Remove Islands - S12A (Mays Island) and S12B (island upstream of I380). Clearing and removing islands has a small positive effect upstream of the island but is an ineffective solution to overall flooding. Evaluation of these options is sufficient to eliminate these options from further consideration in the Feasibility Study.

Screening of Construct Lift Bridge Spans - S13. Bridges include 1st, 2nd, 3rd and railroad near 16th. This option is an ineffective means of reducing overall flooding and is prohibitively expensive. Evaluation of these options is sufficient to eliminate these options from further consideration in the Feasibility Study. Similar to raising bridges above 2008 flood levels, this option could be considered when it becomes time to replace one or more of the bridges.

Screening of Replace Five in One Dam with Rubber Dams - S14. During floods, the rubber dam would be deflated to reduce backwater caused by the dam. This option has the advantage of essentially removing the dam during flood periods while being able to control the water levels during normal and low flows. Like lifting bridge spans and raising bridges, this option is expensive and results in very small flood reduction benefits. Evaluation of this option is sufficient to eliminate these options from further consideration in the Feasibility Study.

Screening of Rubber Dam Downstream - S15. Constructing a rubber dam downstream of the present Five in One Dam. This option has some advantages for low flow periods but has no flood reduction benefits. Evaluation of this option is sufficient to eliminate these options from further consideration in the Feasibility Study.

Screening of Tunnel Through Downtown - S16. This option is similar to the diversion channels in that it diverts excess water out of the river and into tunnels to reduce flooding. Because of the high cost of digging a tunnel Stanley evaluated a plan for four, 20 foot diameter tunnels. This option resulted in very low overall flood reduction benefits. The costs for constructing these tunnels were provided from tunneling companies. Evaluation of this option is sufficient to eliminate this option from further consideration in the Feasibility Study.

Screening of Elevate Edgewood Road With or Without Increased Culvert Opening - S18A and S18B. Other than keeping Edgewood Road open during large flood events, these options offer no flood protection to the city.

4. Diversions (Increase Conveyance With Channel Diversion). This type of structural measure involves removing flow from the Cedar River upstream of Cedar Rapids and returning the flow to the river downstream of Cedar Rapids. These measures include diversion channels and tunnels.

- **S8A Build Diversion Channel Around Cedar Rapids (East Route).** A 23.8 mile open channel diversion would be constructed to carry a portion of the flow around the east side

of City of Cedar Rapids. The flow would be returned to the Cedar River downstream of the city. Reductions are based on bypassing 80,000 cfs in a concrete lined channel with a 330 feet top width, 1:1 side slopes, and 20 feet of water depth.

- **S8B Build Diversion Channel Around Cedar Rapids (West Route).** A 19.7 mile open channel diversion would be constructed to carry a portion of the flow around the west side of City of Cedar Rapids. The flow would be returned to the Cedar River downstream of the city. Reductions are based on bypassing 80,000 cfs in a concrete lined channel with a 350 feet top width, 1:1 side slopes, and 20 feet of water depth.

- **S16 Add Tunnels Through Cedar River/Cedar Rapids Corridor.** Tunnels would be constructed to divert flow from the Cedar River near Cedar Lake and outlet downstream of the landfill. Potential reduction is based on four tunnels with a diameter of 20 feet. A tunnel diameter of 20 feet is a common size for the tunnel boring machines currently in use. An inlet and outlet structure is required to connect the tunnels to the river. Capacity of one 20 feet diameter tunnel is 2, 400 cfs. Total capacity of four tunnels is 9,600 cfs.

- **S17 Build Diversion Channel Through Downtown Cedar Rapids.** An open channel would be constructed through the 4th Street corridor to divert water from the Cedar River near Cedar Lake and return to the Cedar River downstream near the railroad bridge on the north side of the landfill. The potential flow in the channel is estimated as 36,800 cfs. The potential flow is based on a concrete lined channel 100 feet wide, vertical walls, and 20 feet of water depth.

Screening of Diversion Channels (S8A, S8B, S17) and Tunnels S16. Diverting excess flood waters from the Cedar River east of the city (S8A), west of the city (S8B), and through the city (S16 & S17) was evaluated as a way to reduce flooding. While effective as flood protection, the cost of constructing the channels is so high it makes these measures cost-ineffective. The ROM costs are high too compared to levees to consider them as cost effective measures (S8A, S8B) and not effective enough for the downtown measures (S16 & S17). Evaluation is sufficient to eliminate these options from further consideration in the Feasibility Study.

For more details, descriptions, and maps on the structural features; please see the Cedar Rapids River Corridor Redevelopment - Flood Mitigation Options-Stanley Consultants Inc., March 2009.

Non-Structural Measures - NS1 thru NS10

- **NS1 Floodproof Structures by Dry Floodproofing Methods.** Dry floodproofing is defined as sealing a building to ensure that a building is watertight or impermeable to floodwaters. Normally, dry floodproofing is applied to building entrances, windows and equipment rooms located inside a building for protection from flooding., Flood panels are the most effective form of flood protection for interior spaces, equipment and the contents of a building.

- **NS2 Floodproof Structures by Wet Floodproofing Methods.** Wet floodproofing is defined as permanent or contingent measures applied to a structure and/or its contents that prevent or provide resistance to damage from flooding while allowing flood waters to enter the structure. A wet flood-proofed structure is designed such that all areas below the flood level can be flooded with minimal damage to the structure and building contents. Typically the ground floor of such structures is of limited use. These areas are typically parking, storage or building accesses and constructed of flood proof materials. Appliances and utilities are relocated away from wet area.

- **NS3 Incorporate Agricultural Lands Policy (Watershed Management).**
    - This option centers on working with property owners in the Cedar River watershed to manage lands to reduce runoff potential. Management measures include: remove field drain tiles, plant riparian buffer strips, convert row crop lands to grasslands, and other management practices. Such land use practices increase infiltration rates and help hold both water and soil in place.
    - Wetlands in the Cedar River watershed would be restored to increase flood storage. Effective for smaller floods but diminishes in value as storage capacity is exceeded in larger floods such as 1993 and 2008.
    - Establishing a watershed management program would require the following steps: identify stakeholders, identify problems, develop goals, public involvement, develop plan, implement plan, monitor progress, and adjust plan.

- **NS4 Acquire / Buyout Heavily Damaged Structures.** Selected structures would be removed from the floodplain. May result in a small flood level reduction by removing buildings obstructing flow in the floodplain.

- **NS5 Develop Flood Warning System Along Cedar Rapids Corridor.** The flood monitoring and warning system would be upgraded. Additional river level gages would be installed in addition to rain gages along the Cedar River and its tributaries to gather more river flow and level information. An advanced flood monitoring program would be developed to predict the river level earlier and more accurately.

- **NS6 Develop Zoning and Planning Along Cedar Rapids Corridor.**
    - A set of zoning and planning restrictions would be developed along Cedar Rapids corridor that restricts building structures in hazardous areas.
    - Increasing the height requirement (freeboard) above the base flood elevation for new or substantially damaged structures would be considered.

- **NS7 Develop New Building Codes Along Cedar Rapids Corridor.** Building codes would be changed to make buildings more flood resistant by requiring building materials below the base flood elevation (BFE) to be flood damage resistant. Flood damage

resistant materials are building products capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage.

- **NS8 Develop Evacuation Plans Along Cedar Rapids Corridor.** A comprehensive staged evacuation plan would be developed for areas along the floodplain in Cedar Rapids. City's 2009 update of Flood Response Plan will include an evacuation map.

- **NS9 Elevate Structures.** Structures would be raised in-place so the lowest floor is above the expected level of floodwaters. After the building is raised, existing foundation walls can be extended vertically using materials such as masonry block or poured concrete. The foundation must have openings to allow floodwaters to pass under the building. Utility lines are extended and reconnected.

- **NS10 Relocate Structures.** Structures would be moved to another location away from flood hazards. Procedure involves raising the structure and placing it on beams, axles, and wheels. The structure is then transported to a new location and placed on a new foundation.

Screening of Floodproofing structures, dry floodproofing NS1, and wet floodproofing NS2. For lack of evaluation information, these measures must be carried on for further analysis.

Screening of Nonstructural Policies NS3, NS4, NS5, NS6, NS7, and NS8: For lack of evaluation information, these measures must be carried on for further analysis.

Screening of Elevate Structures (NS9) and Relocation of Structures (NS10). For lack of evaluation information, these measures must be carried on for further analysis.

For more details on further nonstructural analysis please see Nonstructural Measures Appendix O.

C. Iteration Two: The majority of the process outlined in this phase is in the main report. The additional information is background measure development and analysis.

Damage Reach Descriptions. Table O-2 gives the boundaries of these reaches. The red outlines show the individual reaches with the landward sides showing the farthest extent of the June 13, 2008 flood event.

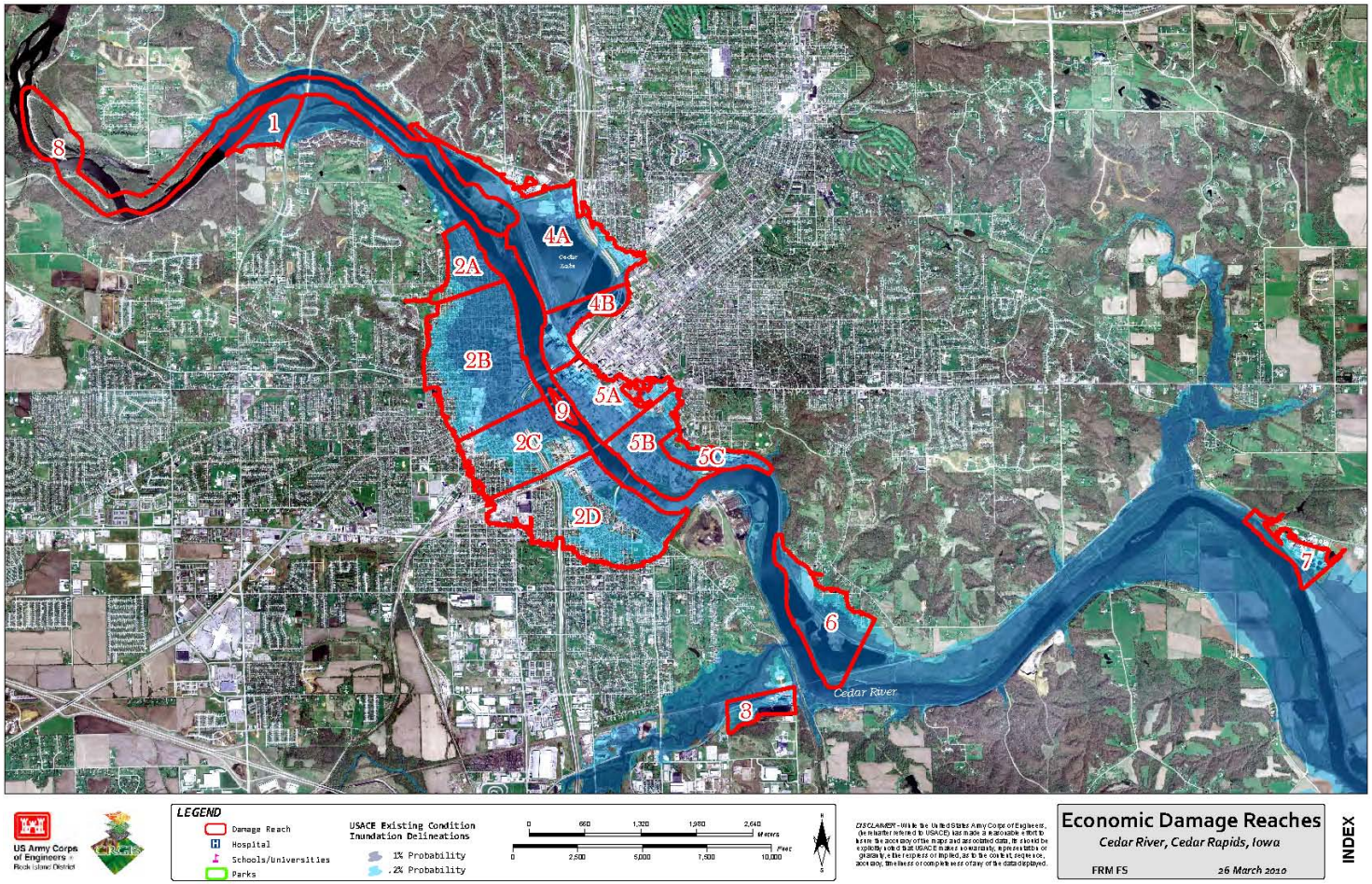

Figure O-6. Study Reaches

Table O-2. Boundaries of Reaches

Study Damage Reaches		Description	Downstream X-section	Index X-section	Upstream X-section
1	Right	Area upstream of Edgewood Dr.	71,108.29	73,295.84	75,651.64
2A	Right	Ellis Lane to O Avenue	59,539.50	61,371.18	62,789.52
2B	Right	O Avenue to 1st Avenue	54,547.42	56,909.09	59,539.50
2C	Right	1st Avenue to 8th Avenue	51,667.35	53,297.19	54,547.42
2D	Right	8th Avenue to Skejskal Park	47,445.66	50,037.51	51,667.35
3	Right	Area at mouth of Prairie Creek	34,185.03	35,451.68	35,451.68
4A	Left	Long Bluff Rd. to Southern edge of Cedar Lake	57813.87	59,539.50	66,550.02
4B	Left	Southern edge Cedar Lake to I-380	55,278.83	56177.15	57,813.87
5A	Left	I-380 to 8th Avenue	51,667.35	53,297.19	55,278.83
5B	Left	8th Avenue to 12th Ave. SE	48,339.74	50,219.63	51,667.35
5C	Left	12th Ave. SE to Van Vechten Park	43,800.70	45228.10	48,339.74
6	Left	Otis Road to Otis Avenue	34,185.03	37,573.16	41,572.89
7	Left	Bertram Rd. Water Pollution Control Facility	12,161.44	13,835.67	15,530.17
9		Mays Island similar to 5A	51,667.35	53,297.19	55,278.83

[1] Right - Right Bank; Left - Left Bank



Figure O-3. Damage Reach 1-Edgewood Neighborhood

1. Damage Reach 1-Edgewood Neighborhood. The Edgewood neighborhood is a small residential neighborhood consisting of eight residential properties, three commercial/industrial properties, a public school bus parking lot, sanitary sewer lift station, and the Edgewood Bridge/Approach, which is a main traffic arterial in the western part of Cedar Rapids.

- **Residential Area:** The City has determined to offer a voluntary property acquisition program to remove properties from future flood hazards. The Study investigated structural protection in the form of levees and floodwalls as shown in figure O-4.

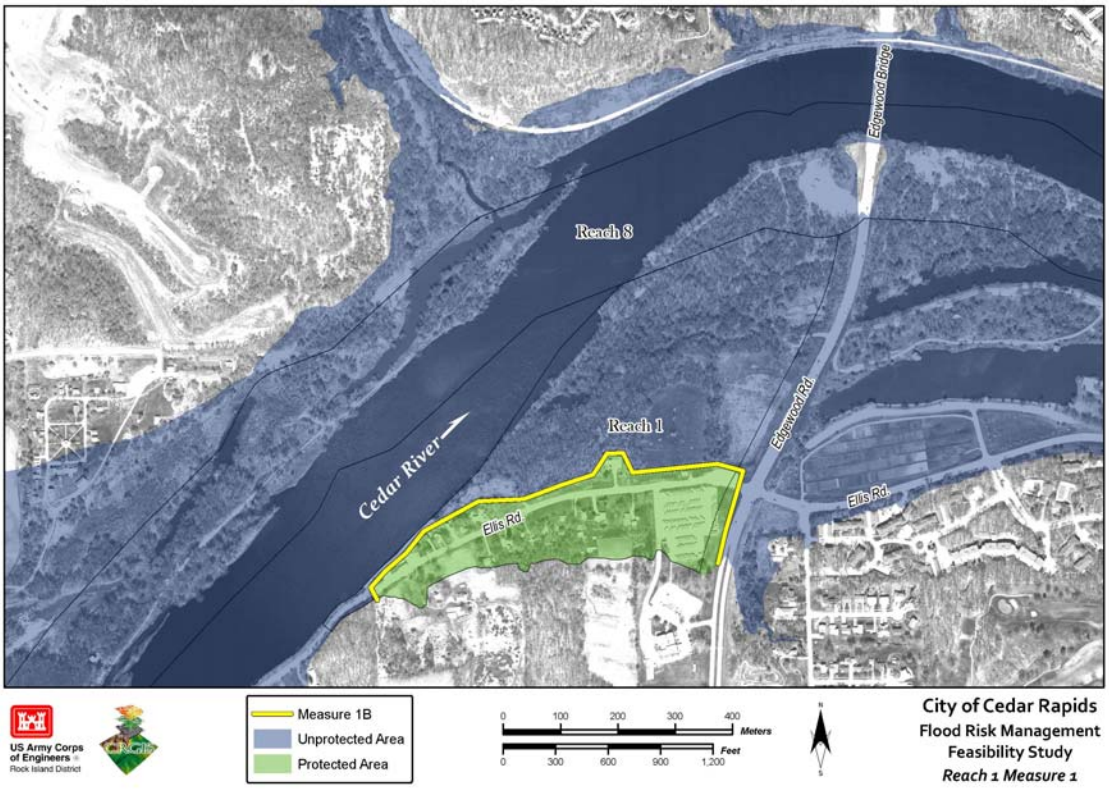

Figure O-4. Reach 1: Measures Map

- **School Bus Parking Lot:** The parking lot was empty when flooding occurred in June 2008 and there was little damage. As of April 6, 2010 the Cedar Rapids School District had voted to place their administration facilities on the SW corner of the intersection of Ellis and Edgewood along with the bus facility. We have no additional information on the details of this construction at this time.

- **Morgan Creek Lift Station:** The facility was inundated by the flood and was lost from service. The effect of the inundation was the release of raw sewage from much of Northwest and some of the Northeast sections of the city into the flood flow upstream of downtown Cedar Rapids. Mitigation efforts include raising the access road to the existing FEMA 1% chance flood event, improving the sump pump and flood doors, and putting an emergency generator upslope to prevent future flood damages.

- **Edgewood Bridge Approach:** This is the only major traffic bridge in the western portion of Cedar Rapids. Flooding and ice jams on the 2 to 5 yr. event level typically close the road for 1 to 5 days.

a. Measures Developed for Reach 1

- **No Action (1A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (1B).** This measure combines the levee and floodwalls and would provide flood protection by installing levees and floodwalls along the alignment shown in figure O-4.

- **Nonstructural Protection (1C).** Since the recon level economic assessment has been completed the City has focused efforts on buyouts for this neighborhood. Other nonstructural measures will be considered if all properties are not included in the buyout programs.

- **Edgewood Bridge Approach (1D).** The Edgewood Bridge Approach (upper right of figure O-4) which is the only major traffic bridge connection in the western portion of Cedar Rapids, all other access across the Cedar River within City limits is in the downtown area. During the record flood of 2008 the only access from one side of the river to the other was the I-380 Bridge. The raising of the Edgewood Bridge Approach is a priority of the City's as it could provide emergency traffic access during times of flood events similar in nature to the 2008 flood event. Flooding and ice jams on the 2 to 5 year event level typically close the road for one to five days.

b. Screening Analysis for Measure 1

- **No Action (1A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 1B:** Under guidance from MVD and the City of Cedar Rapids (from the November 20, 2008 In-Progress-Review Meeting), MVR conducted a reconnaissance level study using existing economic information and GIS inputs. The results of the reconnaissance level study to determine if structural measures such as levee and floodwalls would have a Federal interest resulted in Benefit-Cost-Ratios of 0.01 (for the 1%, 0.02%, and 2008 chance flood events). Due to the low BCR values no further structural analysis was conducted for this study reach.

- **Measure 1C:** Since the Study began the neighborhood has been a focus in City planning efforts to remove properties from lower lying floodplain areas. The City has purchased and removed 3 properties in the neighborhood. No further analysis will be completed on this measure.
- **Measure 1D:** Under guidance from MVD and the City of Cedar Rapids (from the November 20, 2008 In-Progress-Review Meeting), MVR conducted a reconnaissance level study using existing economic information and cost estimates provided by Anderson-Bogart Engineering. The results of the reconnaissance study to determine if a road raise would have a Federal interest resulted in Benefit-Cost-Ratio of less than 0.2 (2008 chance flood events). Due to the low BCR values no further analysis was conducted for this study.

2. Damage Reach 2

2A-Ellis Park and North Time Check Neighborhoods

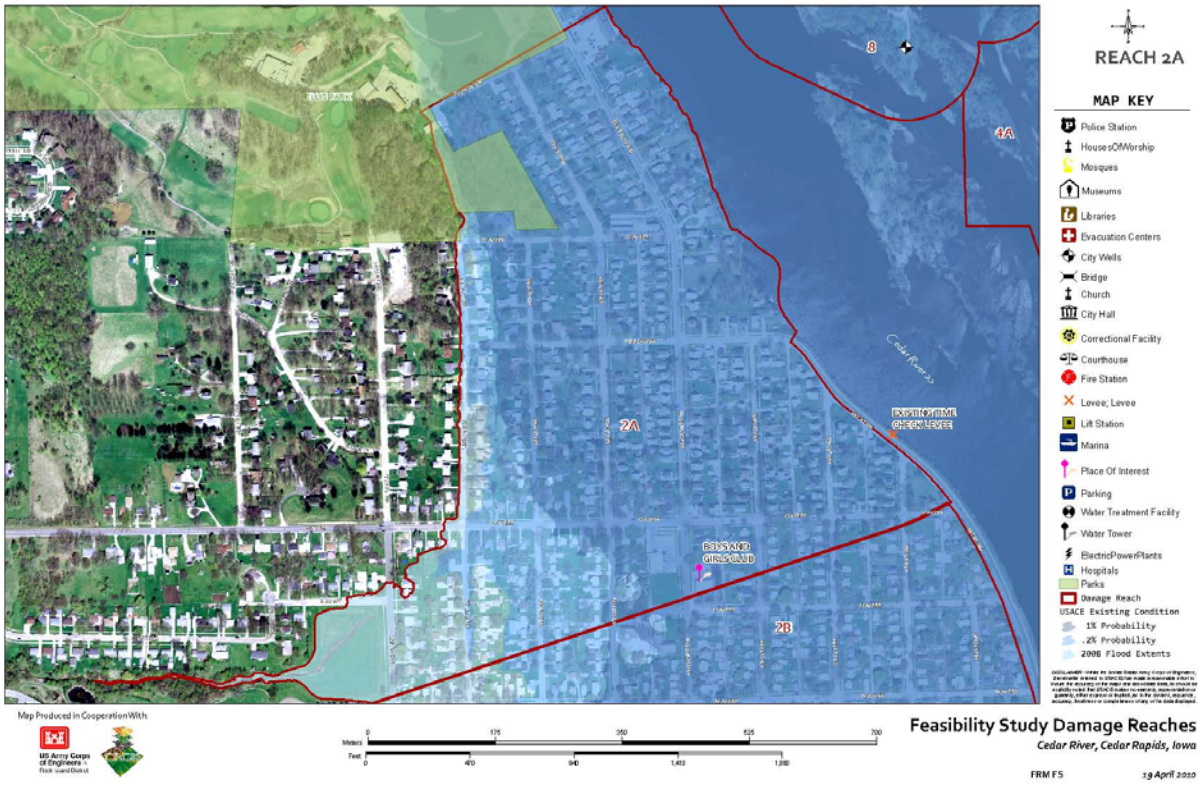

Figure O-5. Damage Reach 2A

Reach 2A is the northwestern most reach in the downtown Cedar River corridor and consists largely of residential properties. For the Study analysis, 4 commercial/industrial properties, 2 public, and 303 residential properties were identified within this reach. The existing Time Check Levee starts in this

section at Penn Avenue NW. Flood fighting efforts start here first with an existing levee in Ellis Park (northern boundary) tying into existing high ground two blocks south to Penn Ave NW. The City has in the past protected the neighborhood to approximately the 722 to 724 river stages.

Damage Reach 2B-Time Check Neighborhood

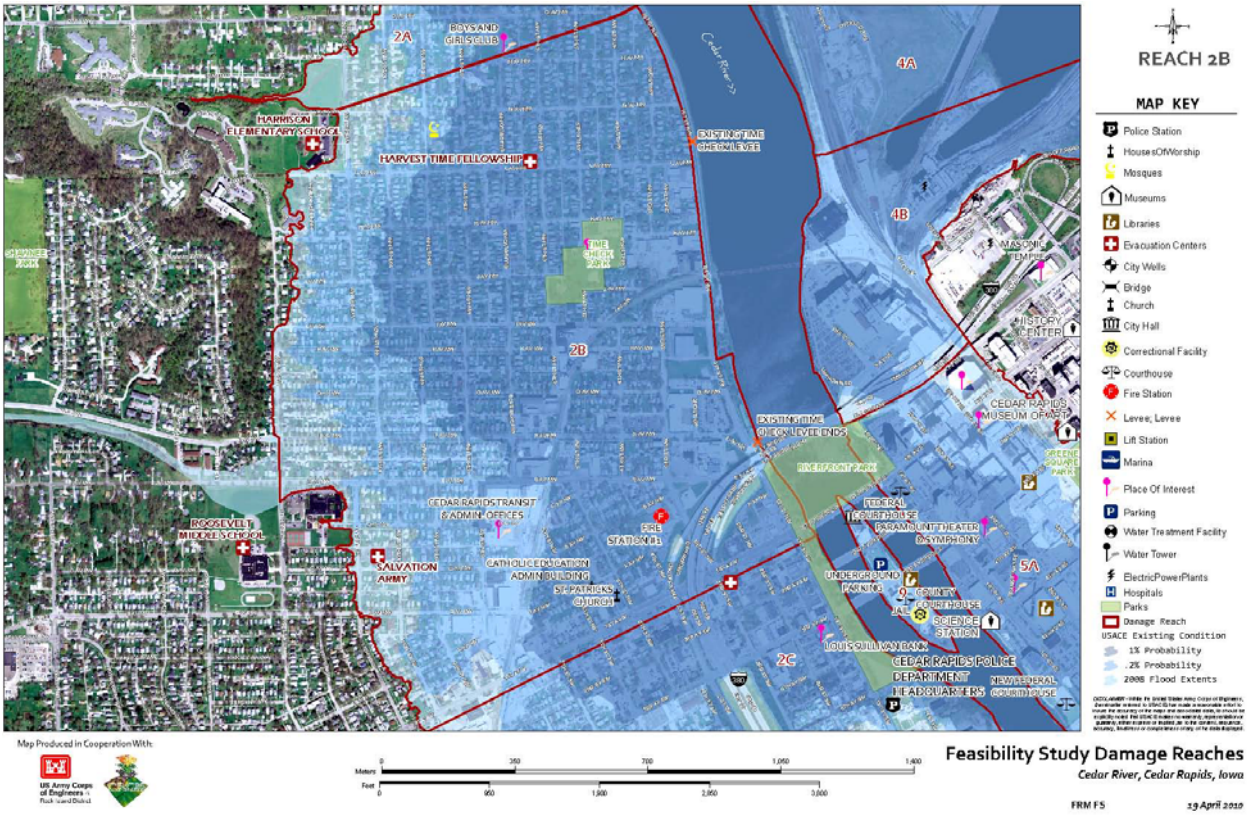

Figure O-6. Damage Reach 2B

Reach 2B is the north-central reach on the west side of downtown Cedar Rapids and has a mix of residential, commercial, and public properties. The properties in this reach identified in our analysis include 84 commercial/industrial properties, 31 public facilities, and 1,277 residential. The existing Time Check Levee continues through this reach and ties into high ground in the I-380 area.

Damage Reach 2C-Taylor Neighborhood

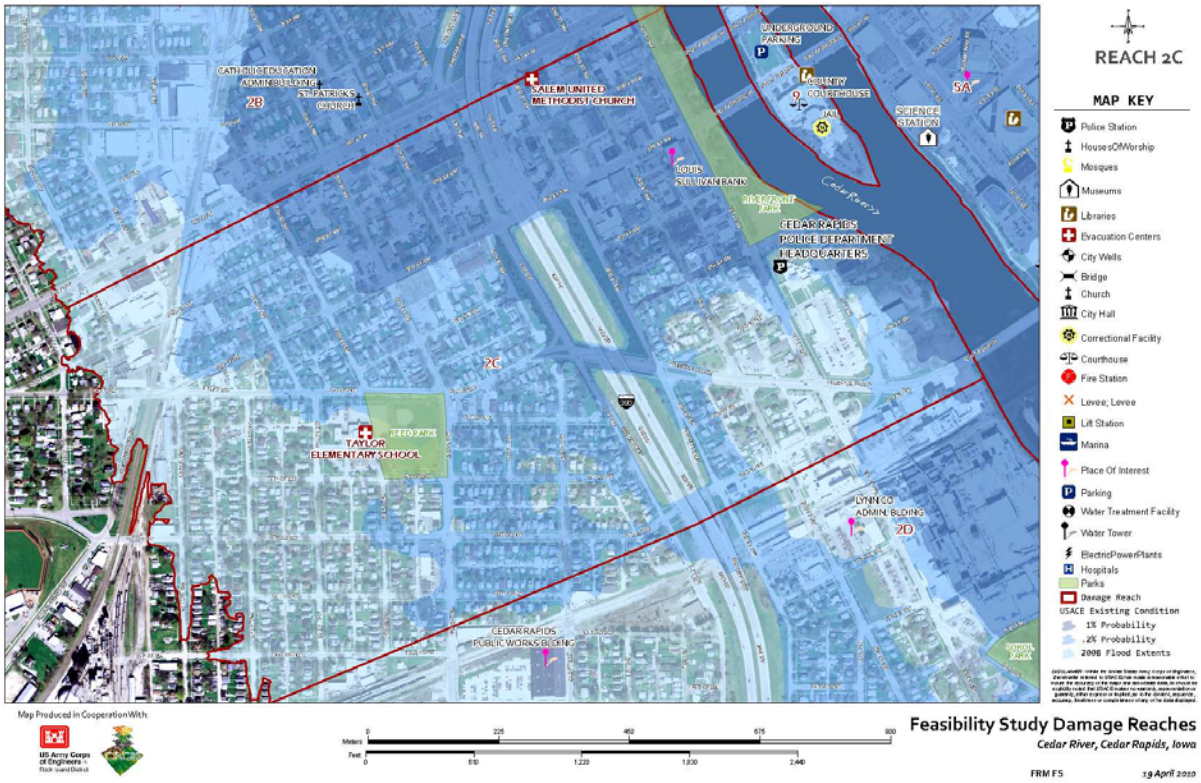

Figure O-7. Damage Reach 2C

Reach 2C is the south-central reach on the west side of downtown Cedar Rapids and includes 96 commercial/industrial properties, 18 public (including the Cedar Rapids Police Department Headquarters) and 616 residential properties.

Damage Reach 2D-Czech Village Neighborhood

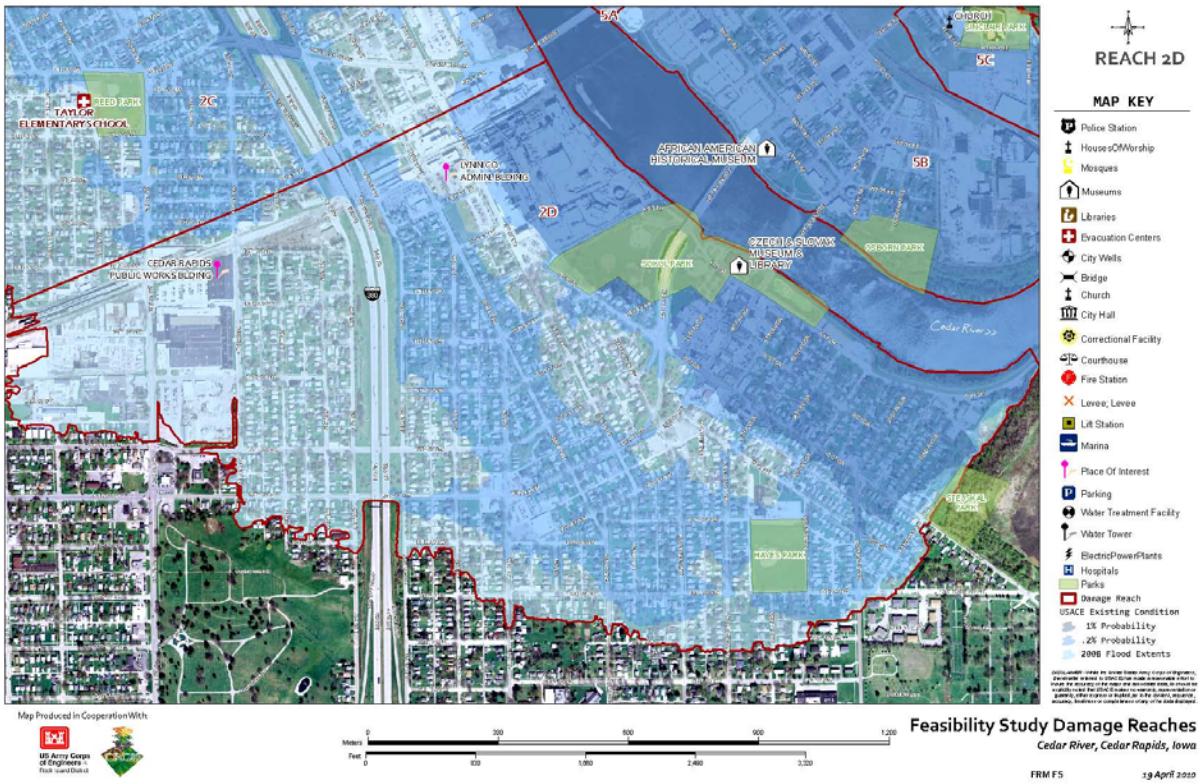

Figure O-8. Damage Reach 2D

Reach 2D is the southern reach on the west side of downtown Cedar Rapids. The reach includes 88 commercial/industrial, 23 public, and 1,065 residential properties.

a. Measures Developed for Reach 2 (2A thru 2D)

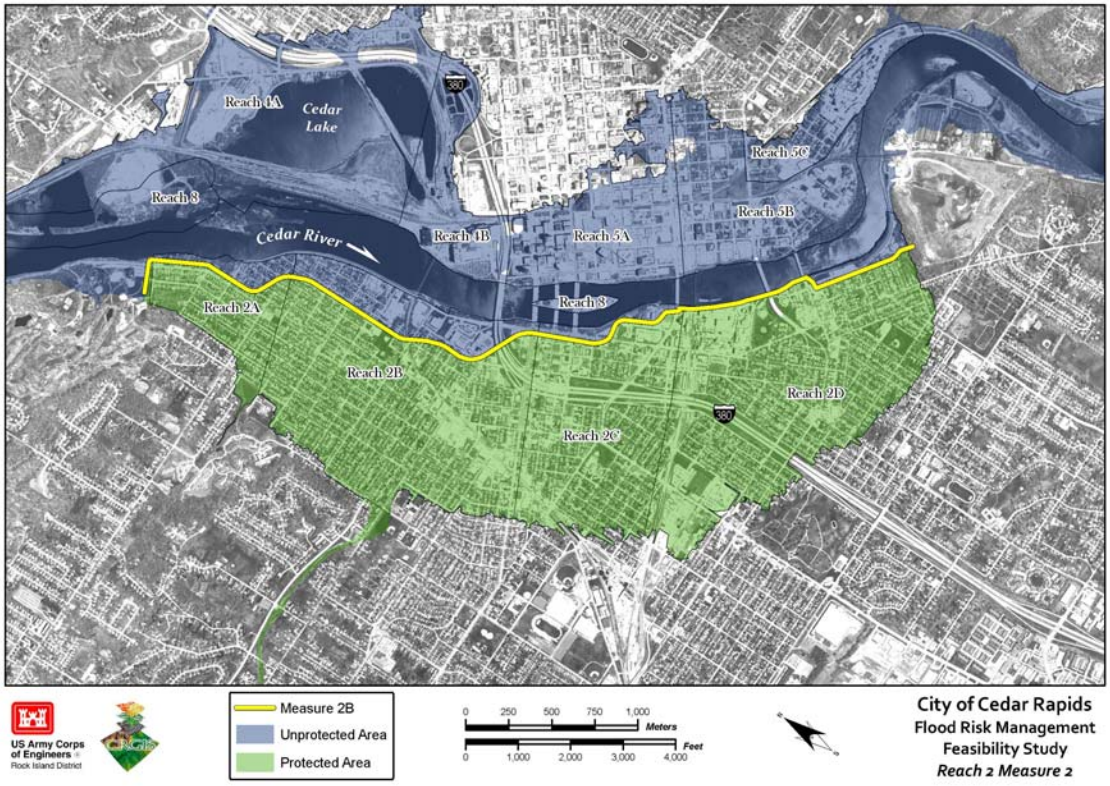

Figure O-9. Measure 2 (Reach 2A thru 2D)

This measure has a greenway setback in Reaches 2A and 2B. The setback levee has been formulated to account for the potential FEMA buyout plans that are associated with the higher flood risk properties the City has identified closest to the Cedar River. The alignment is similar to the City of Cedar Rapids Framework Plan for Reinvestment and Revitalization.

- **No-Action (2A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (2B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids. Throughout the screening process various alignments for the west side have been developed taking into consideration City planning efforts.

- **Nonstructural Protection (2C).** This measure provides nonstructural measures for the Damage Reaches identified.

b. Screening Analysis for Measure 2

- **No Action (2A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 2B.** This measure follows the same alignment as the City's Preferred Plan on the west side of the Cedar River. This measure will be carried forward.

- **Measure 2C.** For Study purposes, representative properties were chosen and analyzed to determine Federal interest in providing nonstructural flood mitigation options such as property buyouts, flood-proofing, ring levees, etc. No nonstructural measures were found to be justified. The complete nonstructural analysis is in Appendix P.

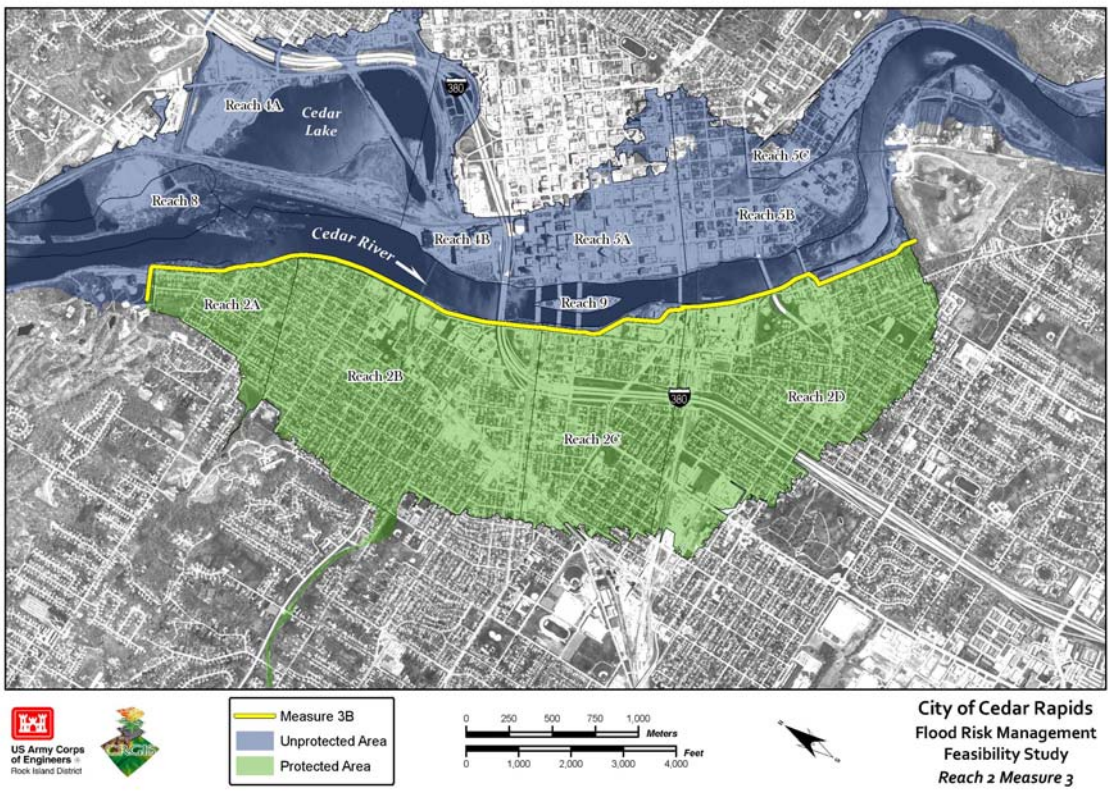

Figure O-10. Measure 3 (Reach 2A thru 2D)

This measure represents the expansion of the Time Check Reconnaissance Report (May 2004) to provide flood protection to include the entire west side of downtown Cedar Rapids.

- **No-Action (3A).** This measure would result in no additional management efforts beyond the existing practices.
- **Levee/Floodwall Protection (3B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (3C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 3

- **No Action (3A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 3B.** Since the Study began the City has focused planning efforts to remove properties from lower lying floodplain areas specifically in Reaches 2A and 2B. The City using FEMA (HGMP), HUD (CDBG), and local taxing initiatives (LOST) has purchased through the voluntary property acquisition programs 137 properties. The City identified properties in the low lying 1 percent chance floodplain for the FEMA buyout program. Since the City's Preferred Plan has identified a FEMA buyout zone along the Cedar River this measure is no longer being considered.

- **Measure 3C.** Same as Measure 2C.

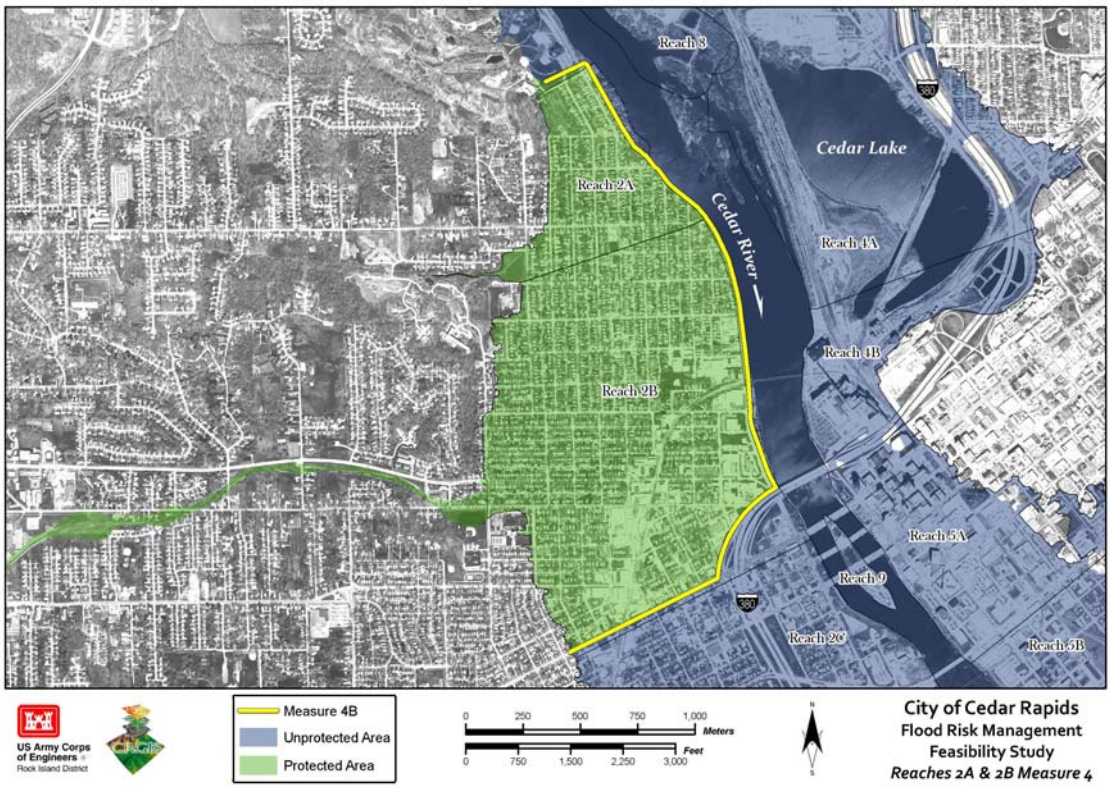

Figure O-11. Measure 4 (Reach 2A & 2B)

This measure follows the river edge in the Ellis Park and Time Check Neighborhoods and has a tie-back levee at 1st Avenue NW.

- **No-Action (4A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (4B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (4C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 4

- **No Action (4A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 4B.** Same as Measure 2B, removed from further consideration.
- **Measure 4C.** Same as Measure 2C, removed from further consideration.

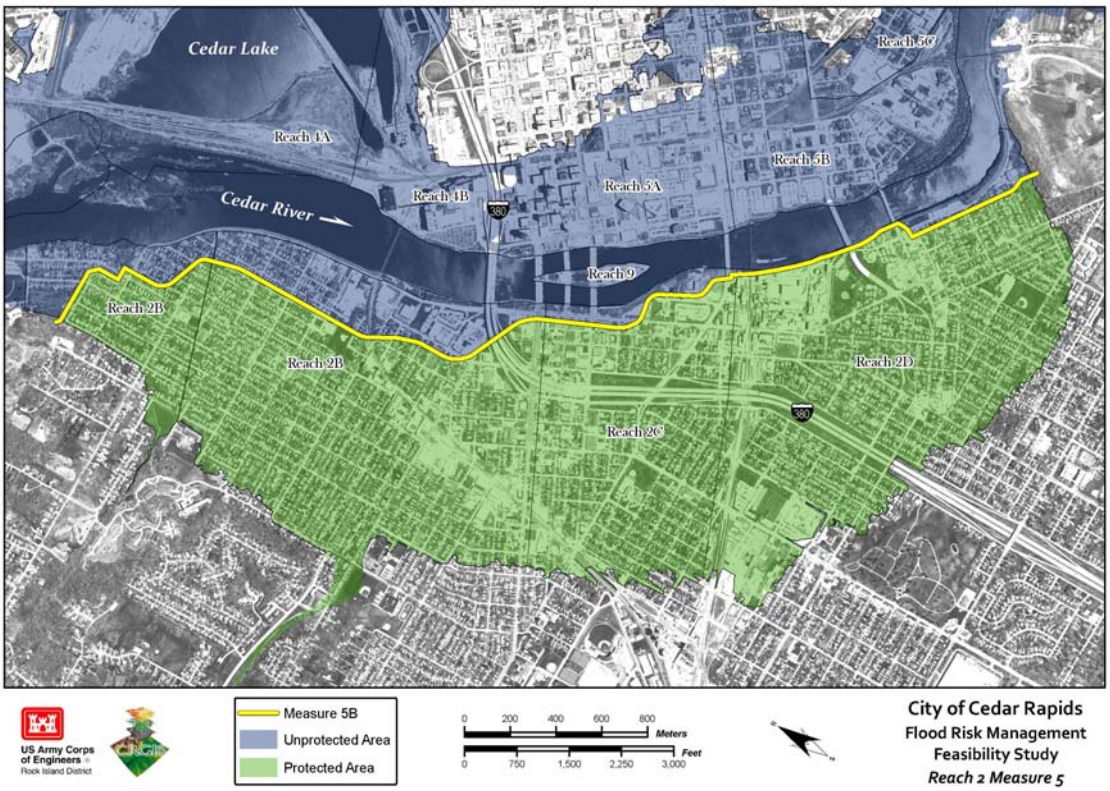

Figure O-12. Measure 5 (Reach 2)

This alignment has a slightly different configuration than Measure 2 in the Reach 2A. It also incorporates a greenway setback along the river in Reaches 2C and 2D.

- **No-Action (5A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (5B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (5C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 5

- **No Action (5A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 5B.** Same as Measure 2B, removed from further consideration.

- **Measure 5C.** Same as Measure 2C, removed from further consideration.

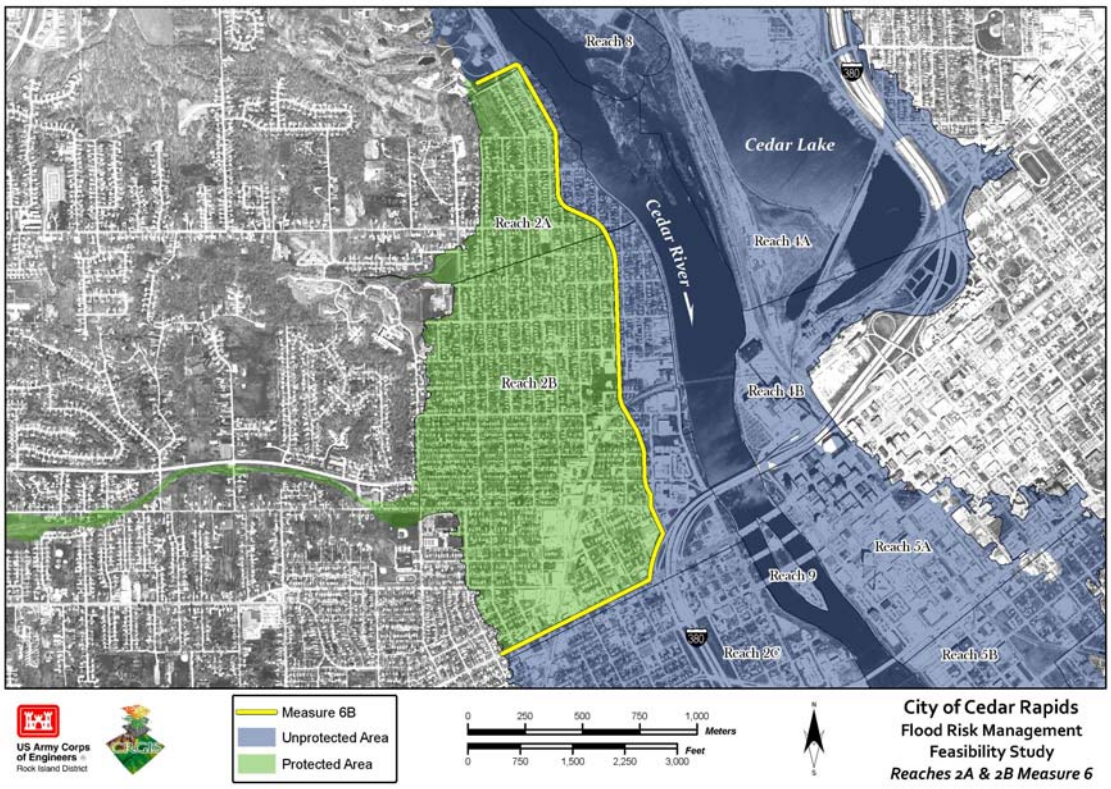

Figure O-13. Measure 6 (Reach 2A & 2B)

This measure incorporates a greenway setback along the river in the Ellis Park and Time Check Neighborhoods and has a tie-back levee at 1st Avenue NW.

- **No-Action (6A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (6B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (6C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 6

- **No Action (6A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 6B.** This alignment does take into consideration the FEMA buyout area but is being screened out because the original Time Check Levee tied into higher ground downstream along the river protecting more area (Reach 2C and 2D) downstream. Also the tie-back levee would have significant impacts to a busy commercial corridor (25,000 plus vehicles a day).

- **Measure 6C.** Same as Measure 2C, removed from further consideration.

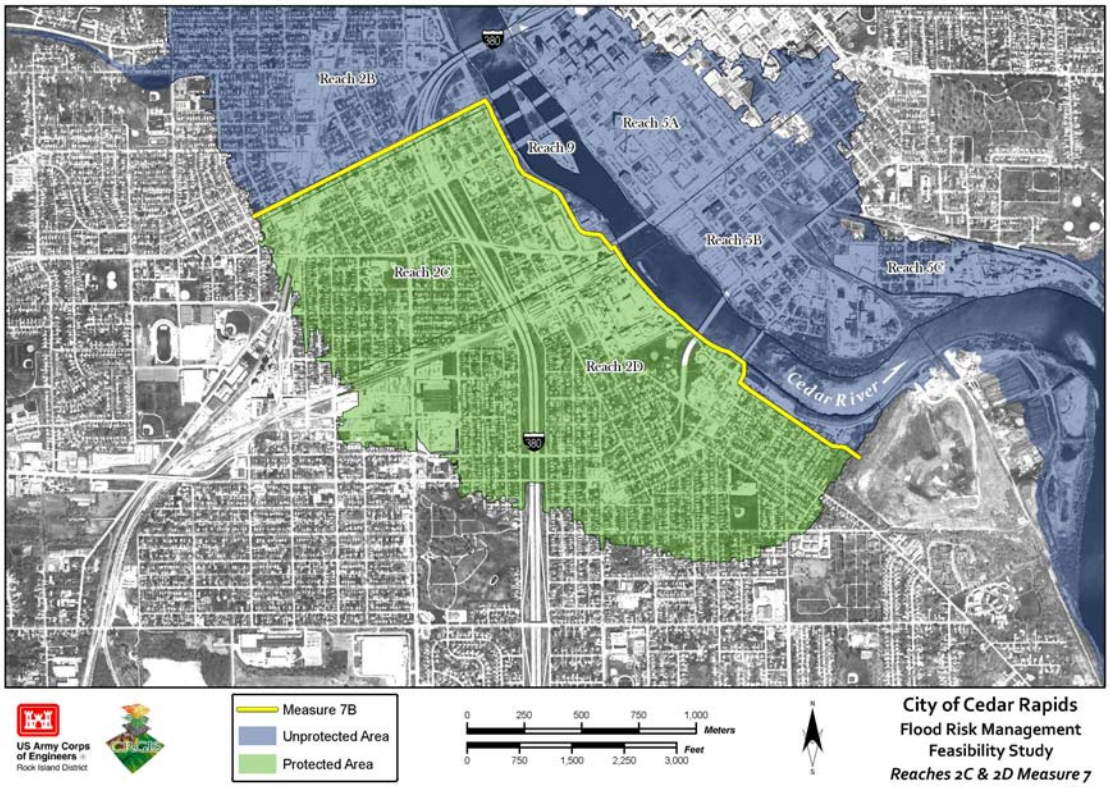

Figure O-14. Measure 7 (Reach 2C & 2D)

This measure incorporates two small greenway setbacks along the river in the vicinity of the Police Station (north) and Czech Village Neighborhood (south) and has a tie-back levee on 1st Avenue NW.

- **No-Action (7A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (7B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (7C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 7

- **No Action (7A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 7B.** This measure has been screened out due to the impact to local business, transportation networks, and neighborhoods. The alignment would also induce flooding north of the protected reaches.

- **Measure 7C.** Same as Measure 2C, removed from further consideration.

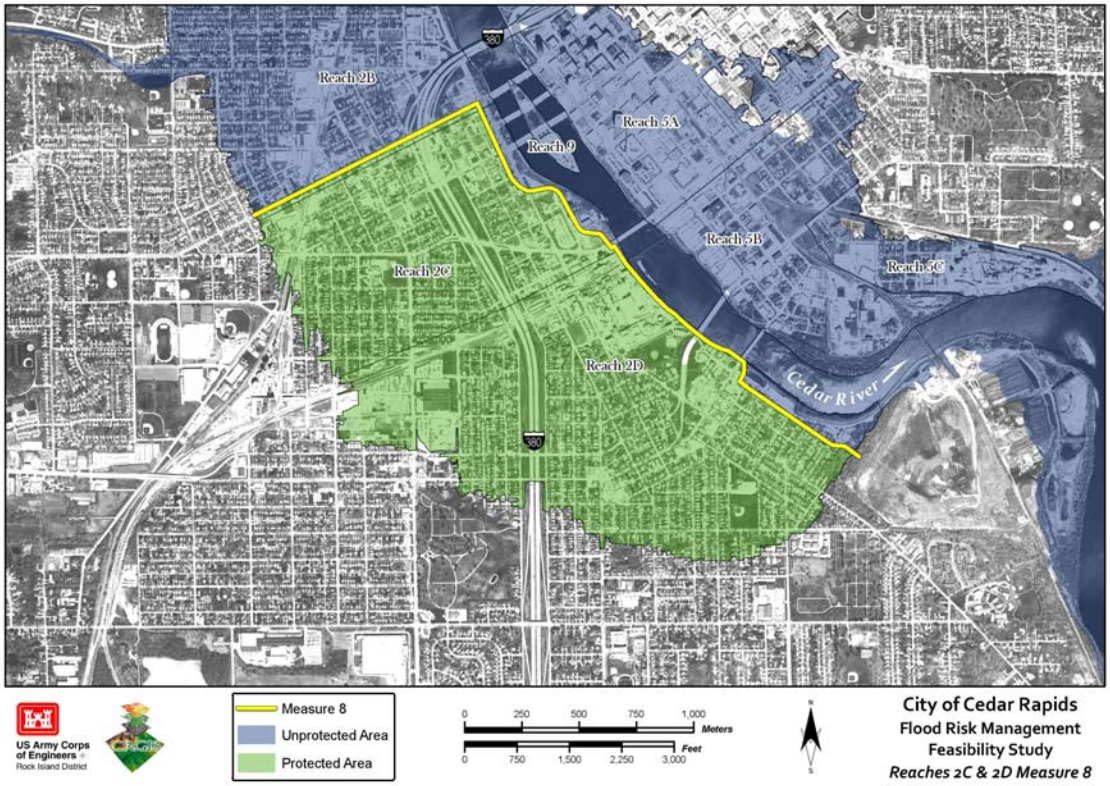

Figure O-15. Measure 8 (Reach 2C & 2D)

This measure incorporates two greenway setbacks starting on 1st Avenue NW continuing to the Police Station (north) and Czech Village Neighborhood (south) and has a tie-back levee on 1st Avenue NW.

- **No-Action (8A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (8B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (8C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 8

- **No Action (8A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 8B.** This measure has been screened out due to the impact to local business, transportation networks, and neighborhoods. The alignment would also induce flooding north of the protected reaches.

- **Measure 8C.** Same as Measure 2C, removed from further consideration.

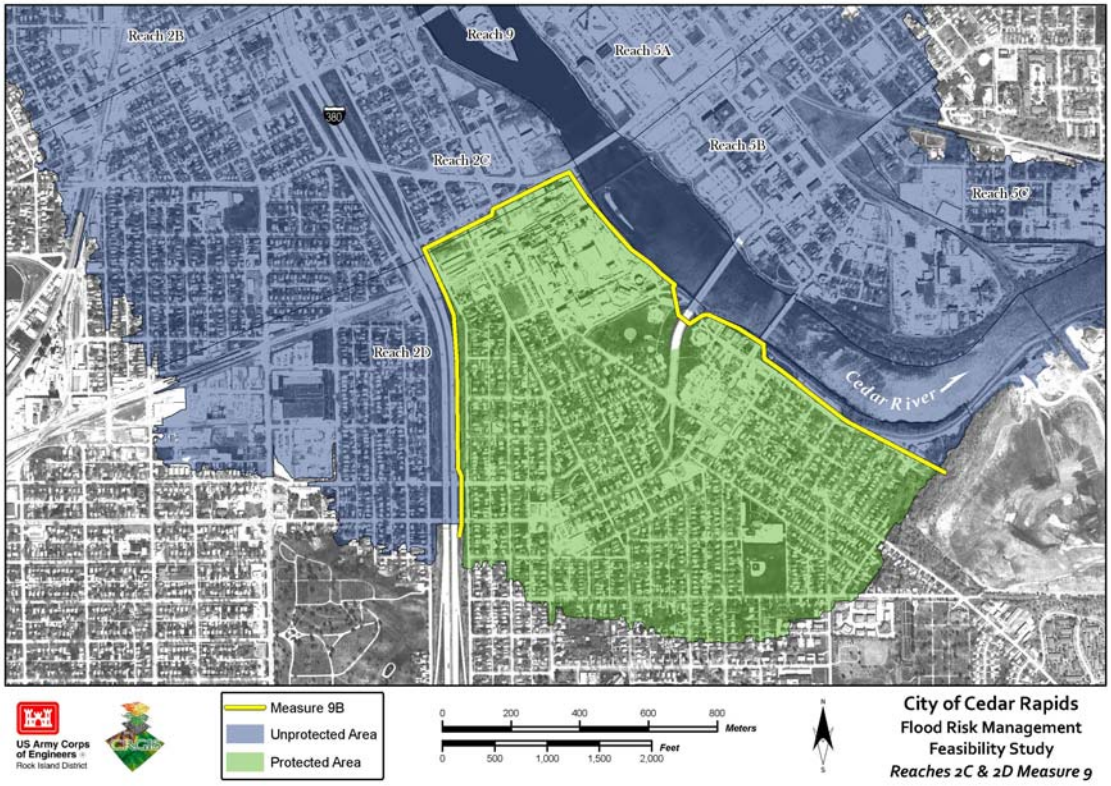

Figure O-16. Measure 9 (Reach 2C & 2D)

This measure incorporates two greenway setbacks starting on 1st Avenue NW continuing to the Police Station (north) and Czech Village Neighborhood (south) and has a tie-back levee on 1st Avenue NW.

- **No-Action (9A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (9B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (9C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 9

- **No Action (9A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 9B.** This alignment provides protection to a high value damage area that includes industrial/commercial and culturally significant properties. This measure will be analyzed further.

- **Measure 9C.** Same as Measure 2C, removed from further consideration.

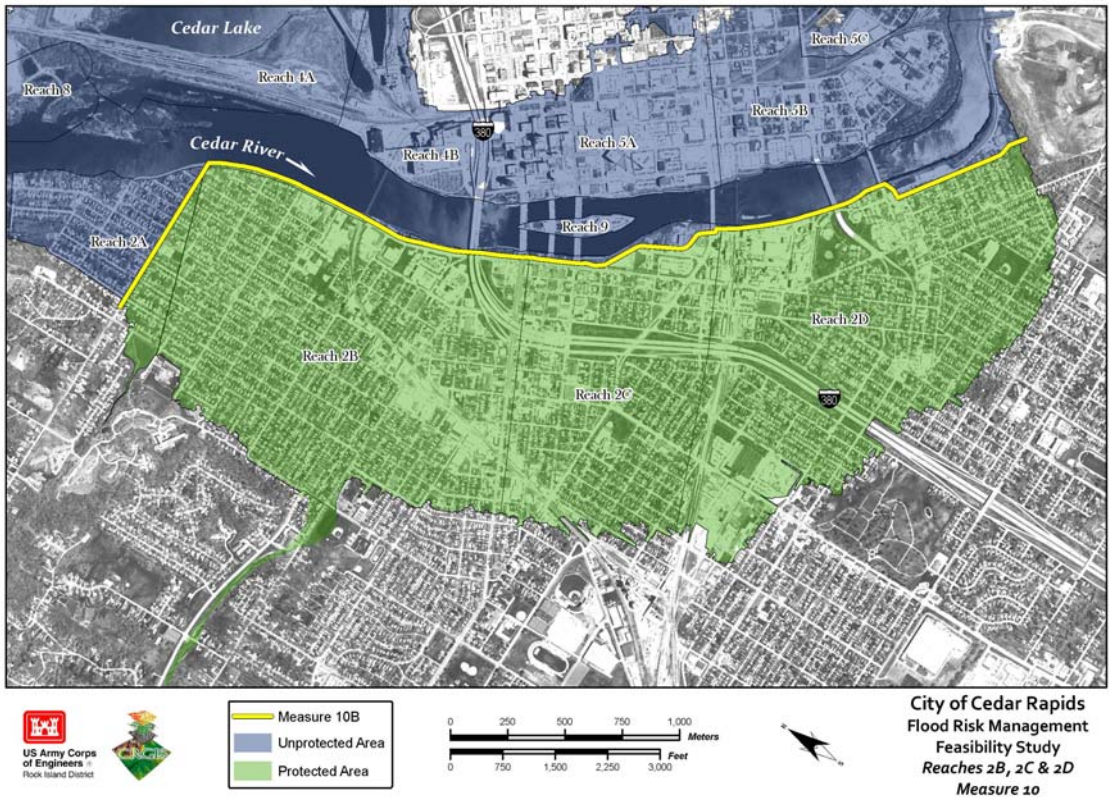

Figure O-17. Measure 10 (Reach 2B, 2C & 2D)

This measure has a tie-back levee in the north starting on O Avenue NW and proceeding downstream to the landfill. This measure also incorporates two greenway setbacks at the Police Station (north) and Czech Village Neighborhood (south)

- **No-Action (10A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (10B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (10C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 10

- **No Action (10A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 10B.** Same as Measure 2B, removed from further consideration.

- **Measure 10C.** Same as Measure 2C, removed from further consideration.

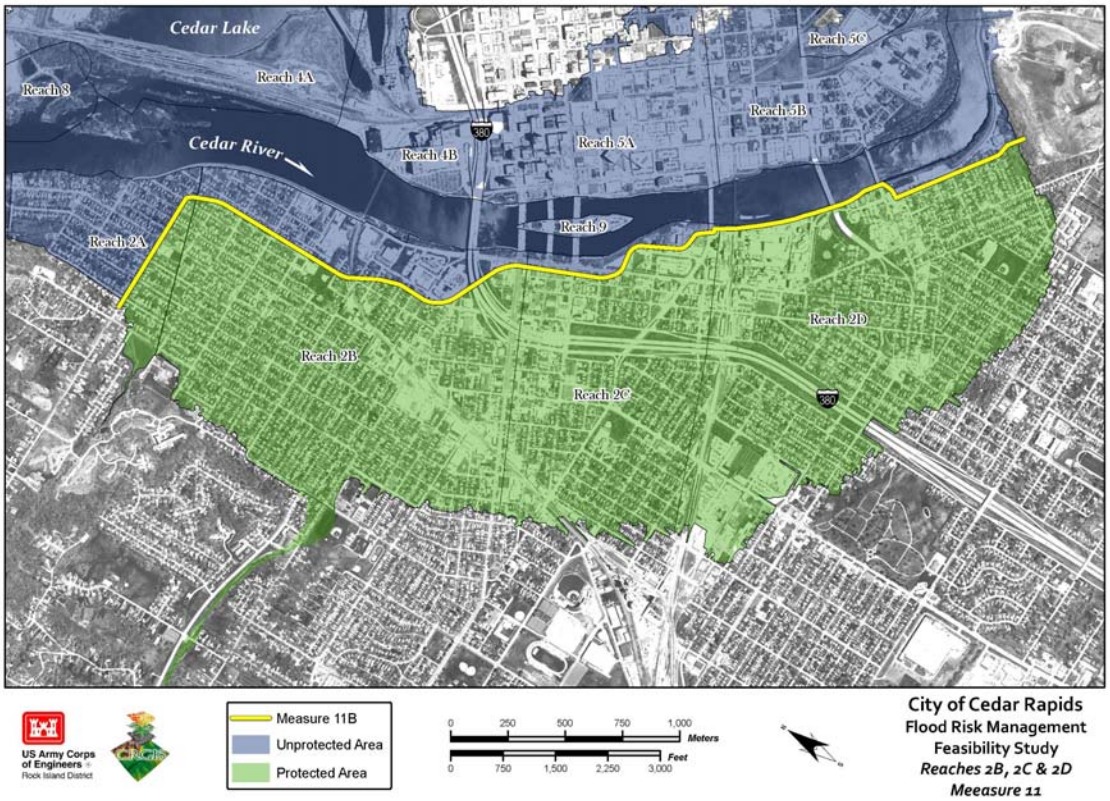

Figure O-18. Measure 11 (Reach 2B, 2C & 2D)

This measure incorporates greenspace in the Time Check Neighborhood and has a tie-back levee on O Avenue NW. This measure has been screened out due to separation of the Time Check Neighborhood as well as impacts to utilities and traffic. There may also be issues with mitigation from increased flood levels upstream in the areas unprotected.

- **No-Action (11A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (11B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (11C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 11

- **No Action (11A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 11B.** This alignment does take into consideration the FEMA buyout area but is being screened out due to the separation of the Time Check Neighborhood as well as impacts to utilities and major traffic corridor.

- **Measure 11C.** Same as Measure 2C, removed from further consideration.

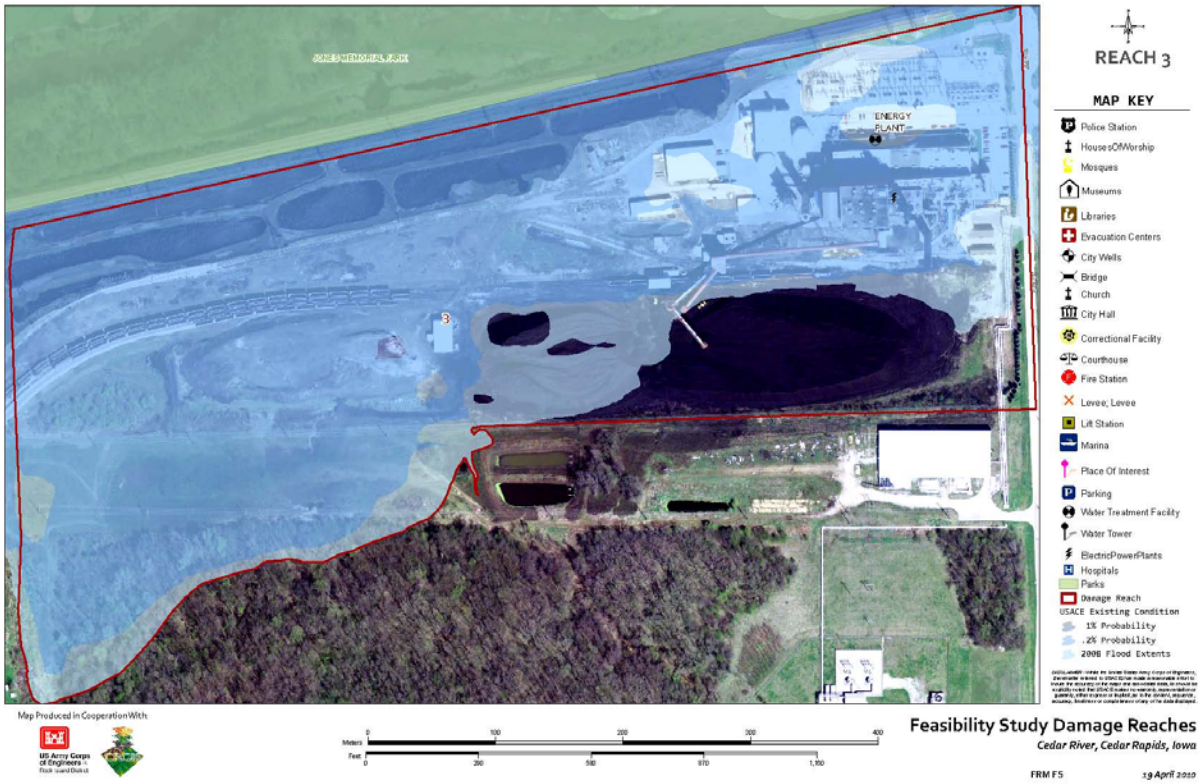

Figure O-19. Prairie Creek Generation Station

Damage Reach 3 - Prairie Creek Generation Station

This damage reach is comprised of one main industry that supplies electricity and steam power to residential and commercial consumers. The Study team used information gathered from a current investigation to formulate measures for this reach. The URS completed analysis on providing structural protection to the Prairie Creek Generation Station (PCGS) facilities. The summary is in the following section for measures development.

Summary of the URS Report

Flood Abatement Study
Prairie Creek Generation Station
Cedar Rapids, IA

The Study proposes two main alternatives for flood protection at the Prairie Creek Generation Station to allow for an option of minimum or maximum containment area, with a possibility of choosing something in between.

Alternative One: The maximum containment alternative is a system of walls/levees that surrounds the entire general operations facility, excluding lagoons. This would have 6 access openings that could be closed with flood gates and 1 gravel ramp for access over the levee. The flood protection system would have a mixture of 1) earthen levee, 2) Dual Wall Gabion Structure, and 3) Cast-in-place Concrete Wall depending on space and economic allowances. Estimated cost: $3,894,731

Alternative Two: This minimum containment alternative is a cast-in-place wall surrounding only the Turbine/Boiler Building with a serious of nine access points protected by flood gates. Estimated cost: $1,575,175

General Considerations: Regardless of what alternative is selected, there are several general considerations to be made, including;

- Closing the gates on the water intake and discharge tunnel during a flooding event,
- Replacing the grated top of the discharge tunnel junction box with a reinforced concrete top to prevent overtopping,
- Installing valves on the two pipes from the blow-off tank, which would be closed off in a flood event,
- Placing storm water pipes with gates under the flood wall system,
- Installing valves on the sanitary sewer line that runs under C Street,
- Installing valves on the six existing pipes discharging into the west lagoon,
- Plugging void space around the electrical cables where they enter the buildings.

Measures Developed for Reach 3:

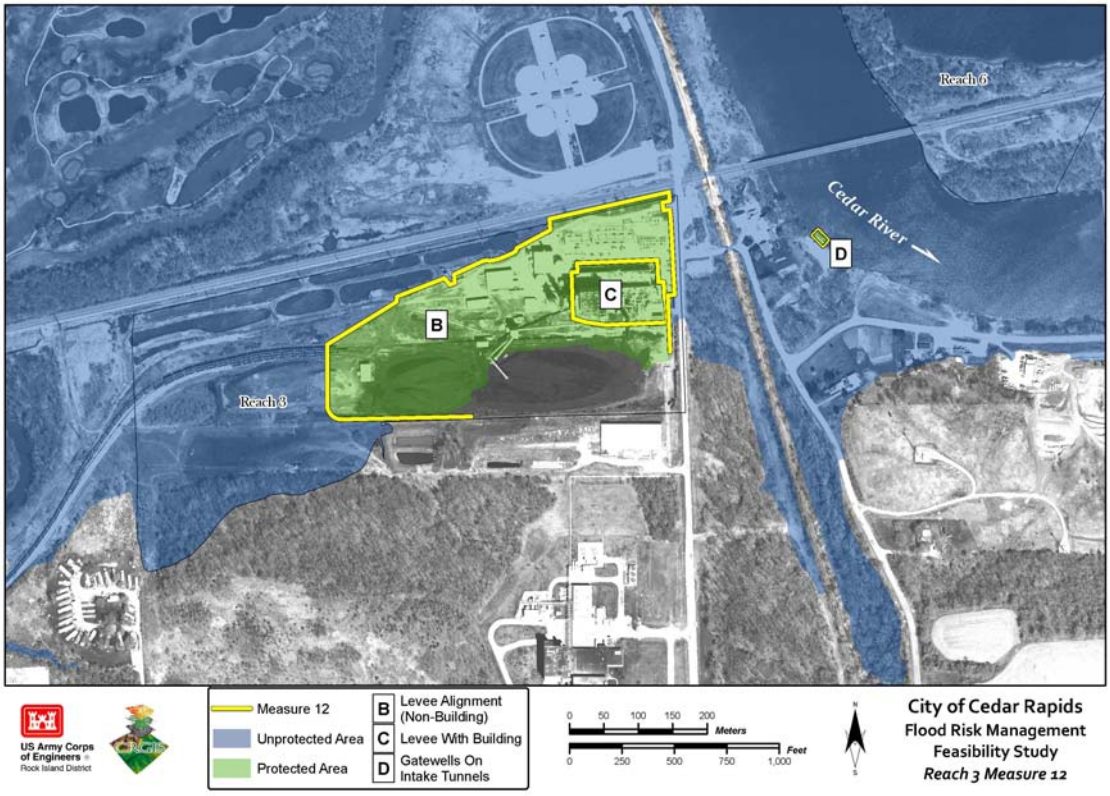

Figure O-20. Measure 12 (Reach 3) Alliant Energy–Prairie Creek Generation Station

This reach has three separate measures associated with it.

- **No-Action (12A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (12B) (labeled as "A" in figure O-20):** This measure provides structural flood protection in the form of levees and floodwalls around the entire facility. This measure is similar to Alternative 1 from the ***URS Report:*** Flood Abatement Study.

- **Floodwall Protection (12C) (labeled as "B" in figure O-20):** The measure provides protection for the main generating building only.

- **Gatewell Protection (12D) (labeled as "C" in figure O-20):** The protection for this measure would include installing gatewells for the cooling water intakes from the Cedar River.

- **Nonstructural Protection (12E).** Since the Study began the PCGS has implemented flood damage reduction measures that have greatly reduced the need for protection.

Screening Analysis for Measure 12

- All Measure 12 options will be considered with further analysis.

Damage Reaches 4 and 5 – Cedar Rapids Eastside:

Damage Reach 4A - Cedar Lake North

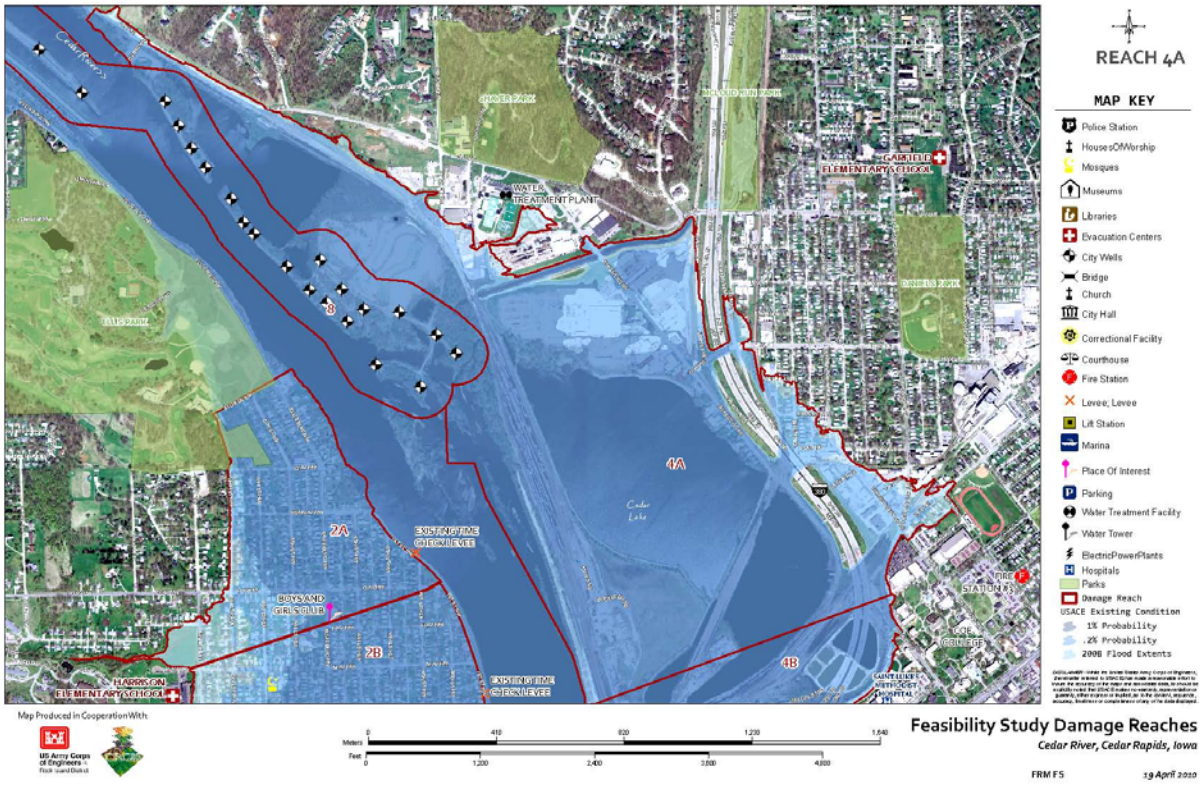

Figure O-21. Damage Reach 4A

Reach 4A is the northern reach on the east side of downtown Cedar Rapids. The reach includes 41 commercial/industrial, 7 public, and 44 residential properties.

Damage Reach 4B - Cedar Lake South

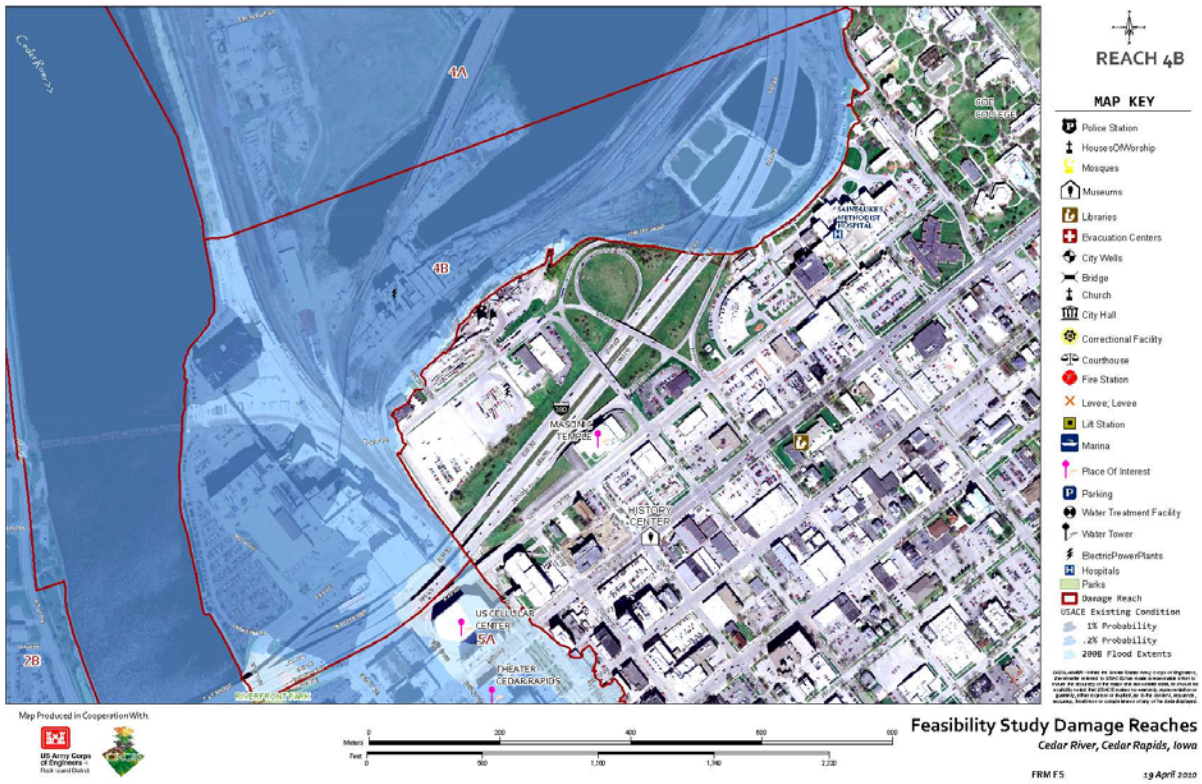

Figure O-22. Damage Reach 4B

Reach 4B is the on the east side of downtown Cedar Rapids and includes 3 commercial/industrial properties.

Measures Developed for Reach 4:

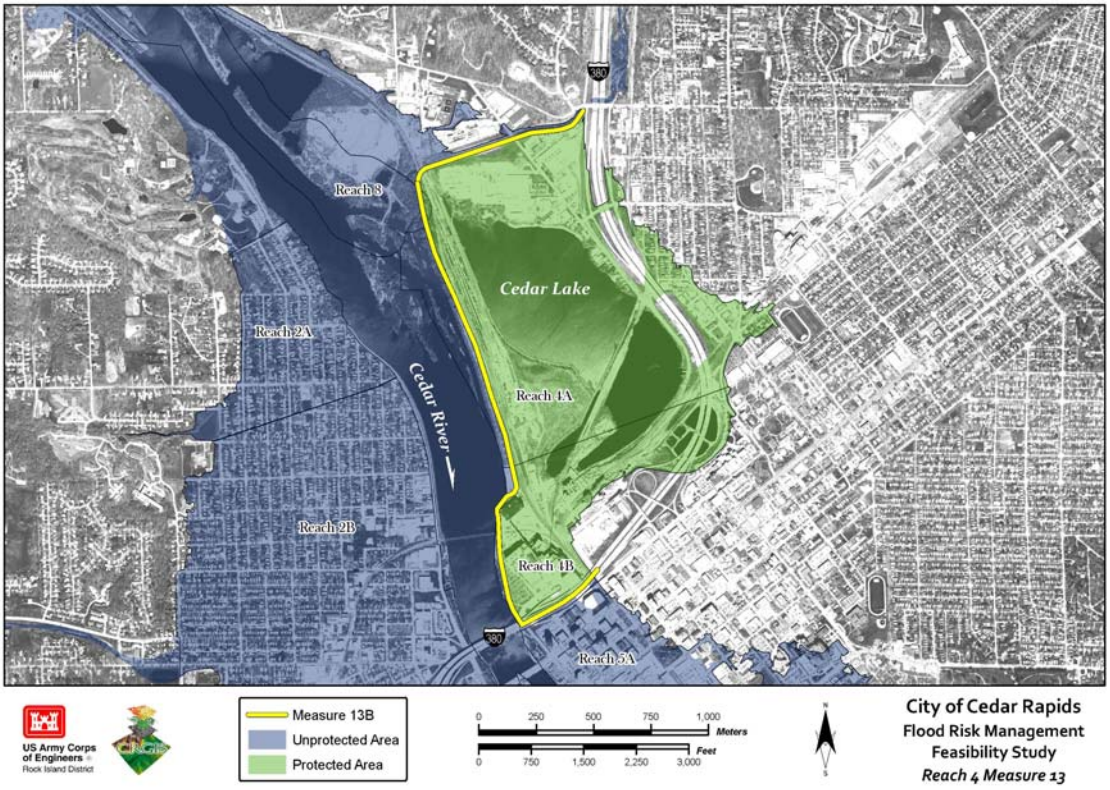

Figure O-23. Measure 13 (Reach 4)

The measure is the northern portion that starts north at J Ave NE and has a downstream tieback levee adjacent to I-380. The alignment protects the eastside neighborhoods around Cedar Lake.

- **No-Action (13A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (13B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.

- **Nonstructural Protection (13C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 13

- **No Action (13A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.
- **Measure 13B.** This measure protects the Cedar Lake Area and will be further analyzed.
- **Measure 13C.** Same as Measure 2C, removed from further consideration.

Measures Developed for Reach 4B:

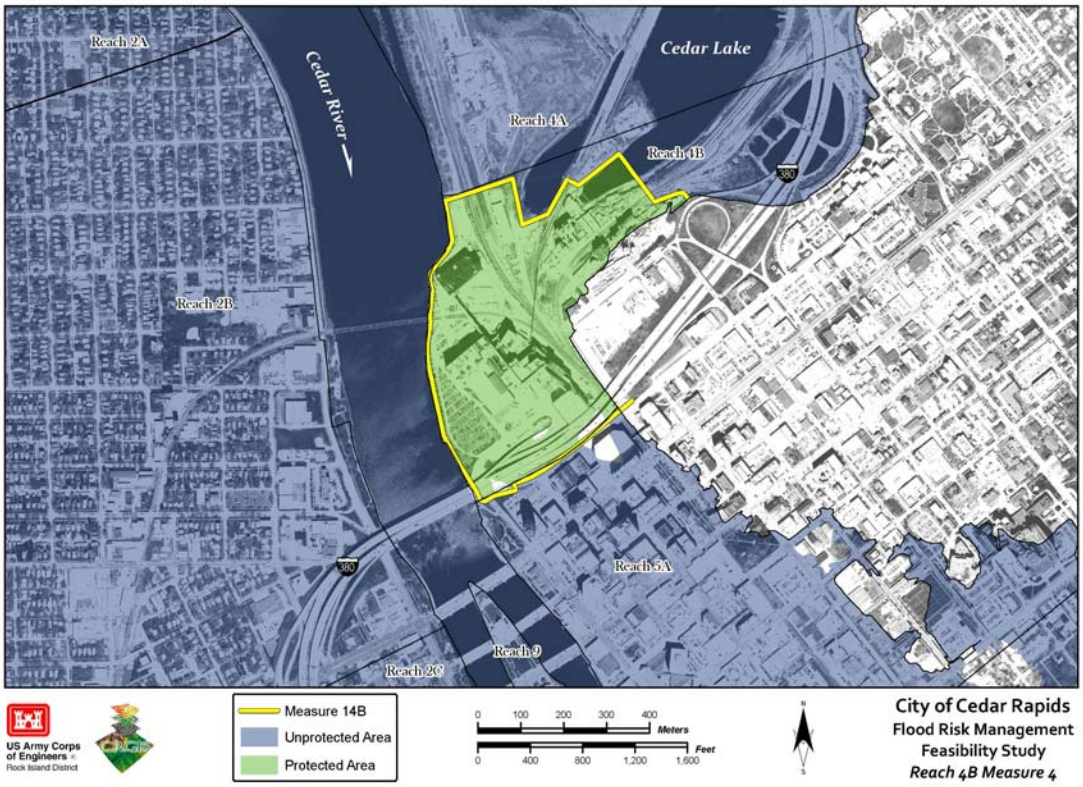

Figure O-24. Measure 14 (Reach 4B)

This alignment starts in the north running southwest of three commercial/industrial buildings then generally runs east to west along the Cedar River. The final tie-back portion of the levee to the south is under Interstate 380.

- **No-Action (14A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (14B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.
- **Nonstructural Protection (14C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 14

- **No Action (14A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.
- **Measure 14B.** This alignment includes protection of Reach 4B which is one of the major industrial damage centers in the Study. It will be analyzed further.
- **Measure 14C.** Same as Measure 2C, removed from further consideration.

Damage Reach 5A – Downtown Cedar Rapids

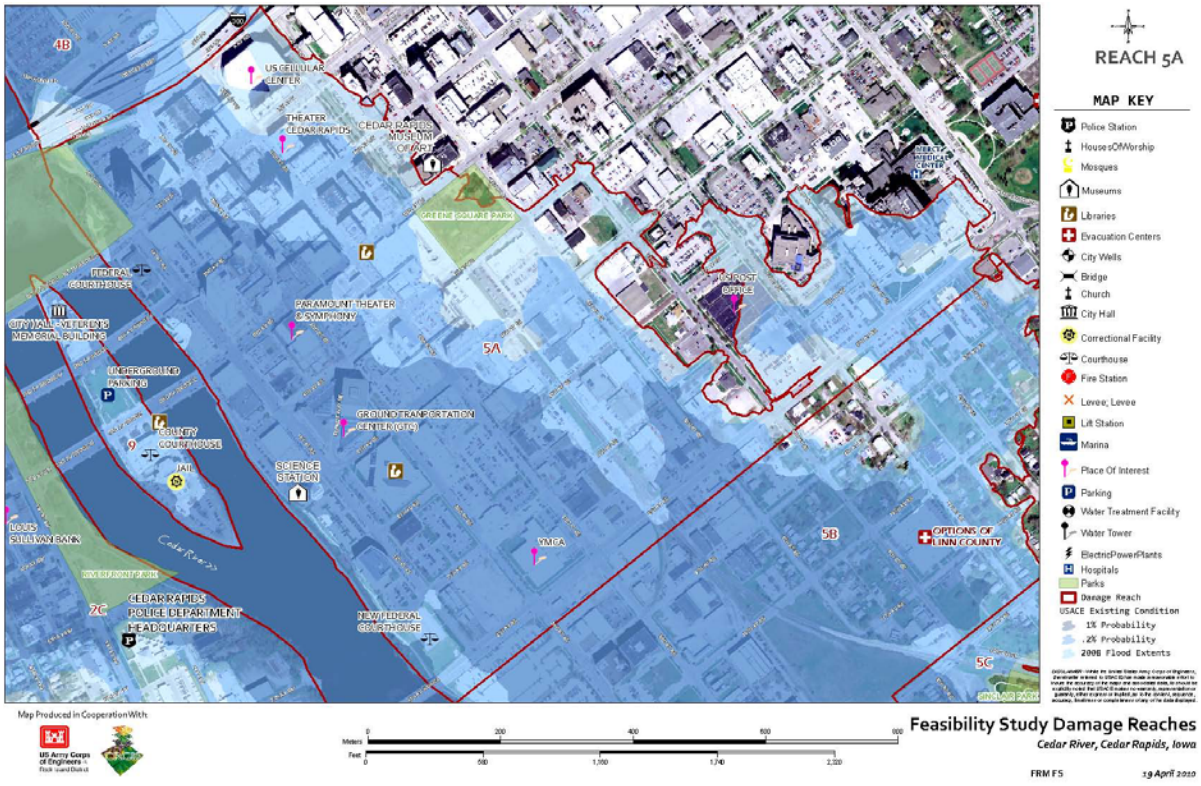

Figure O-25. Damage Reach 5A

Reach 5A is the northern reach on the east side of downtown Cedar Rapids. The reach includes 89 commercial/industrial and 27 public properties.

Damage Reach 5B – Oakhill Jackson Neighborhood

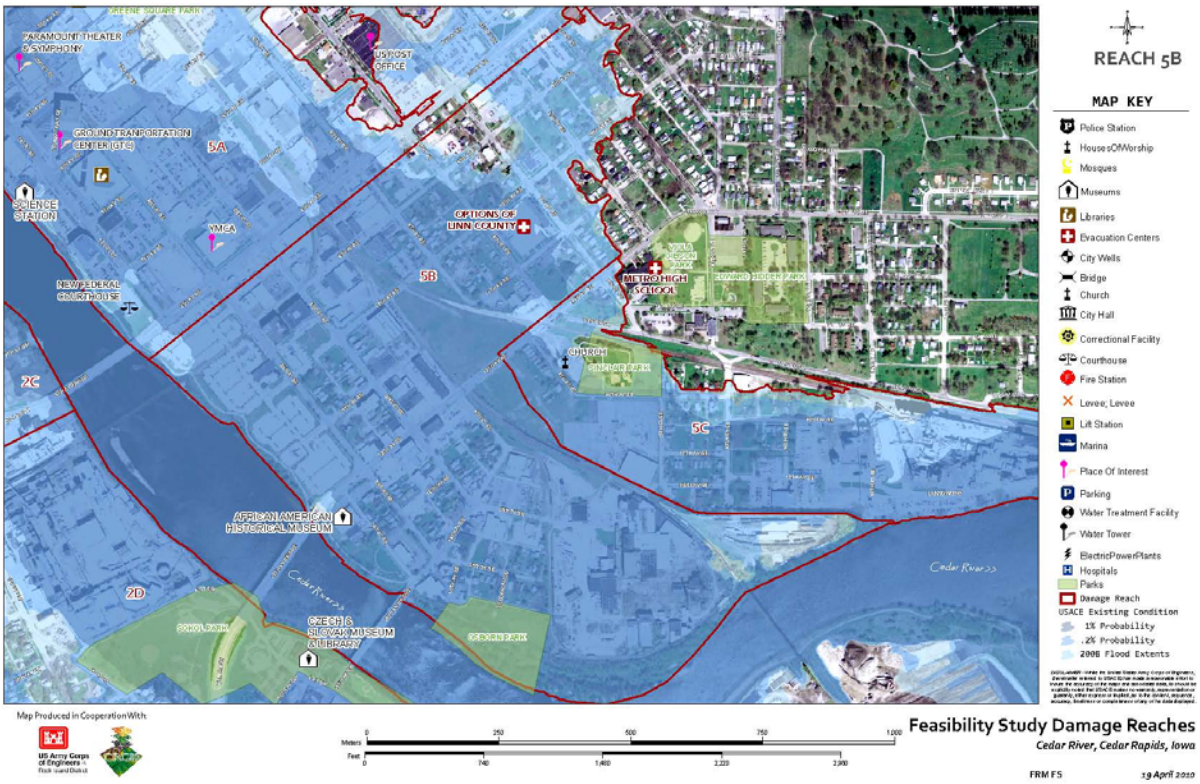

Figure O-26. Damage Reach 5B

Reach 5B is on the east side of downtown Cedar Rapids and includes 61 commercial/industrial, 14 public, and 110 residential properties.

Damage Reach 5C – Otis Road East

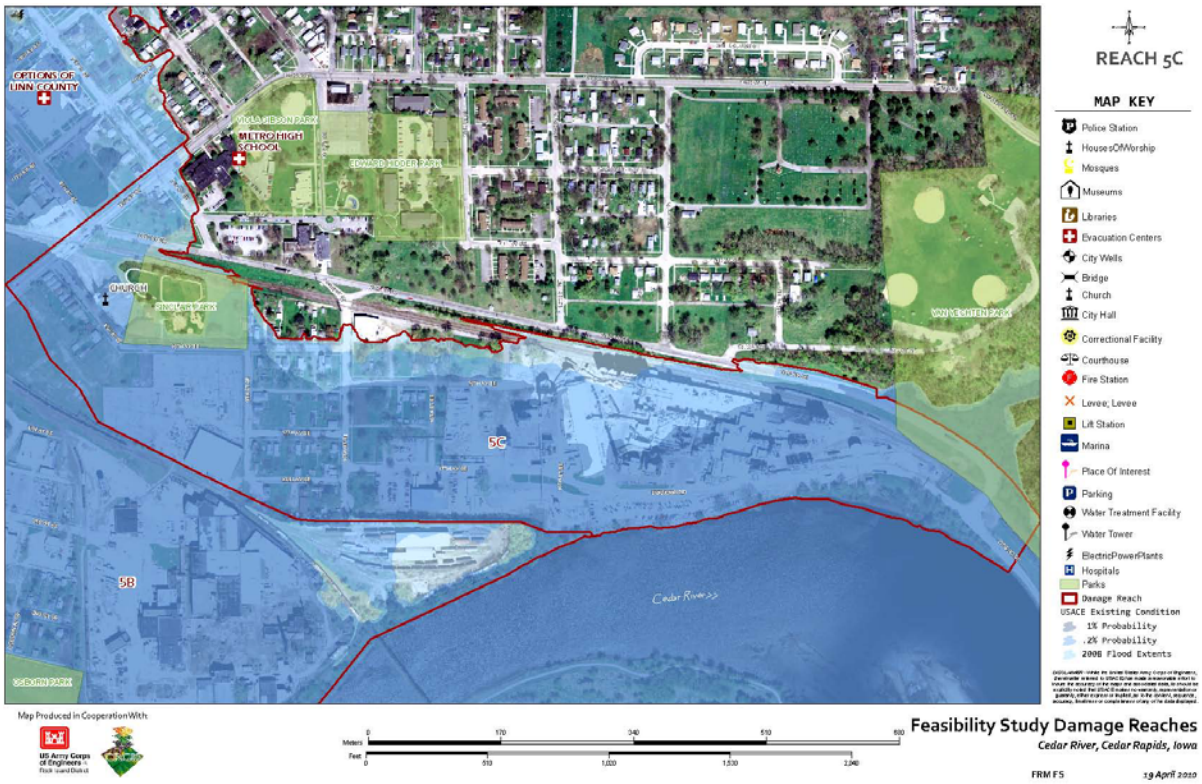

Figure O-27. Damage Reach 5C

Reach 5C is on the east side of downtown Cedar Rapids and includes 2 commercial/industrial, 4 public, and 35 residential properties.

Measures Developed for Reaches 4 and 5

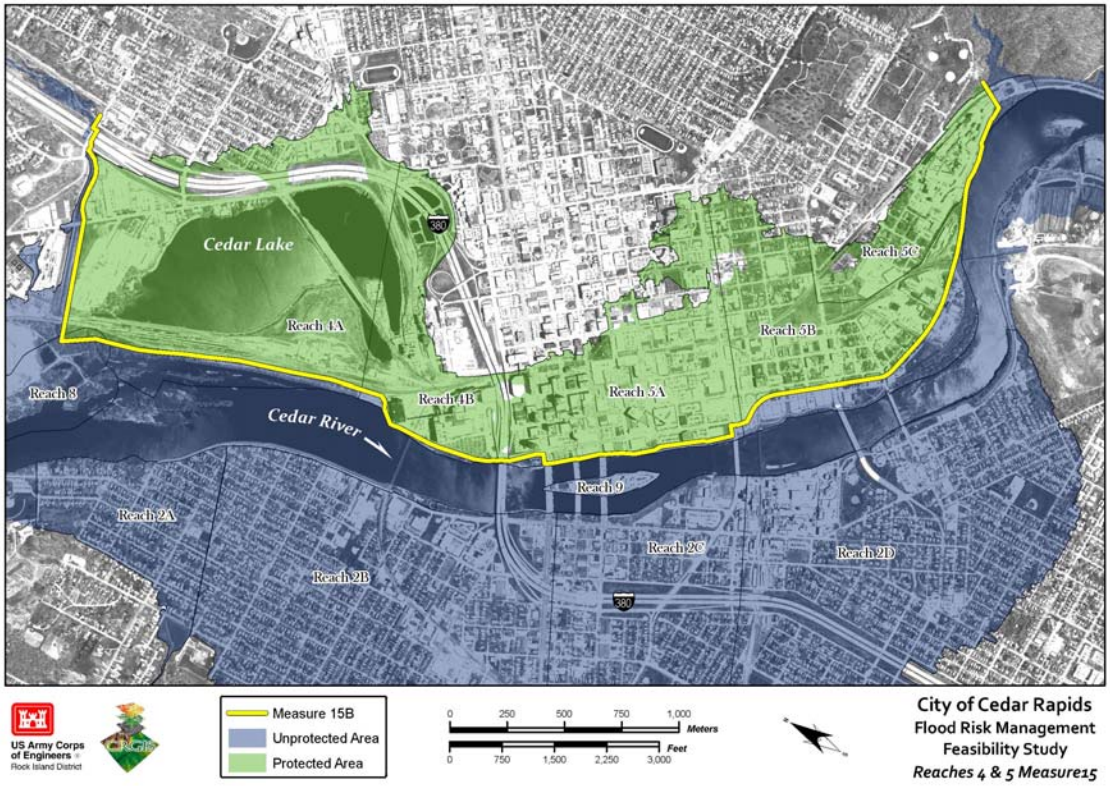

Figure O-28. Measure 15 (Reaches 4 & 5)

This measure has a setback for additional greenspace (south of 8th Ave) and protects the eastside of downtown Cedar Rapids. The measure follows closely the line of protection developed and outlined in the City of Cedar Rapids Framework Plan for Reinvestment and Revitalization.

- **No-Action (15A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (15B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids. It also has a greenway setback in Reach 5B.

- **Nonstructural Protection (15C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 15

- **No Action (15A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.
- **Measure 15B.** This alignment is very similar to other East side alignments and will be analyzed further.
- **Measure 15C.** Same as Measure 2C, removed from further consideration.

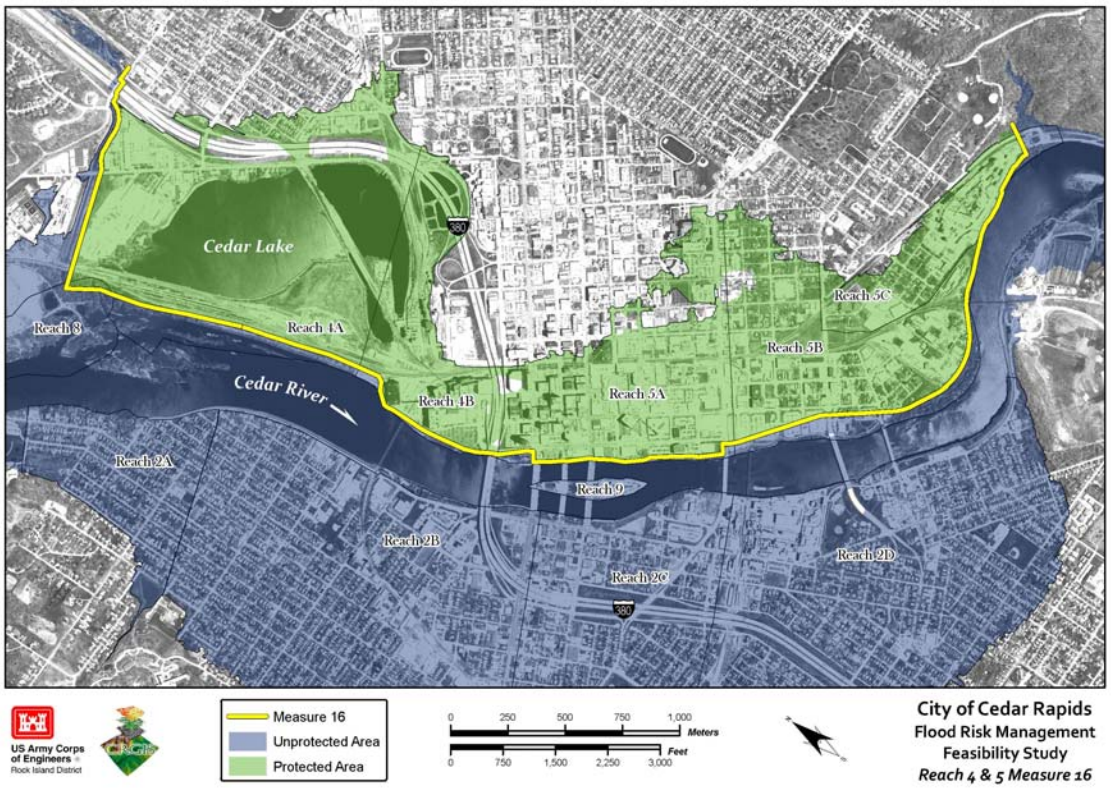

Figure O-29. Measure 16 (Reaches 4 & 5)

This measure has less of a setback than Measure 11 (south of 8th Ave) and protects the eastside of downtown Cedar Rapids. The measure also follows closely the line of protection developed and outlined in the City of Cedar Rapids Framework Plan for Reinvestment and Revitalization.

- **No-Action (16A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (16B).** This measure provides structural flood protection in the form of levees and floodwalls for the west side of downtown Cedar Rapids.
- **Nonstructural Protection (16C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 16

- **No Action (16A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.
- **Measure 16B.** This alignment is very similar to other East side alignments and will be analyzed further.
- **Measure 16C.** Same as Measure 2C, removed from further consideration.

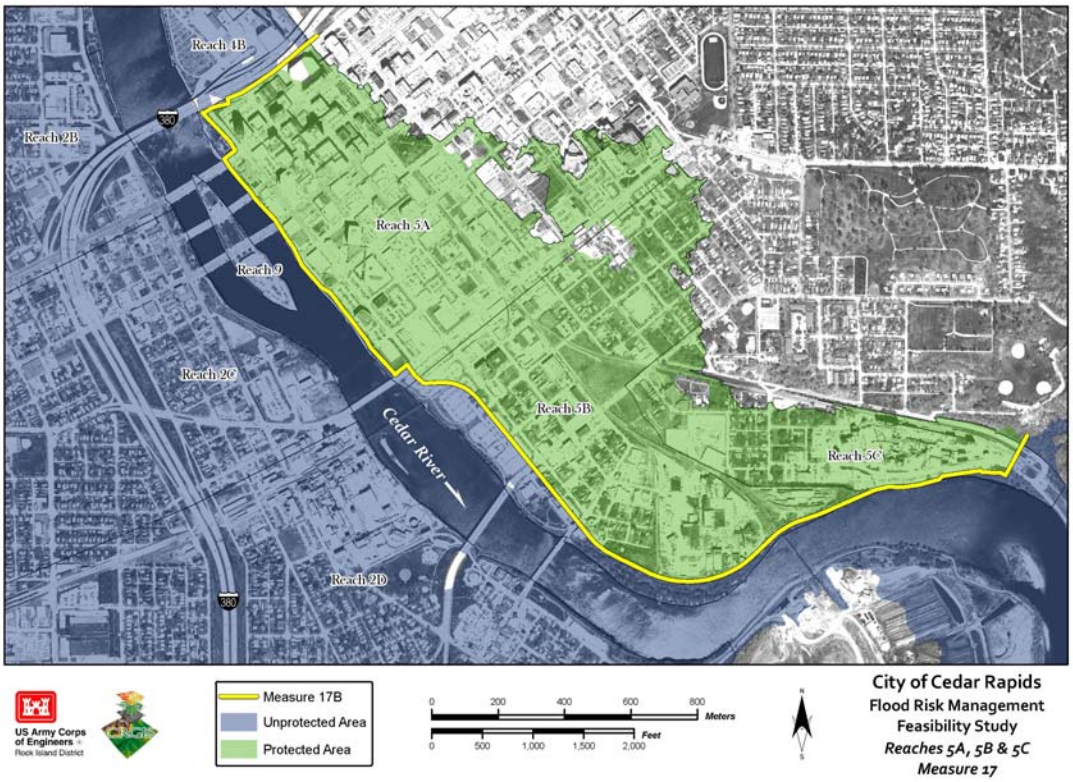

Figure O-30. Measure 17 (Reach 5A, 5B, 5C)

The measure is the southern portion of the East side alignment with an upstream tieback levee in the north adjacent to I-380. This measure has a setback for additional greenspace (south of 8th Ave) and protects the eastside of downtown Cedar Rapids.

- **No-Action (17A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (17B).** This measure provides structural flood protection in the form of levees and floodwalls for the east side of downtown Cedar Rapids.

- **Nonstructural Protection (17C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 17

- **No Action (17A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 17B.** This alignment separates one of the major damage areas in the north (Reach 4B) from the rest of the East side. This alignment will not be analyzed further.

- **Measure 17C.** Same as Measure 2C, removed from further consideration.

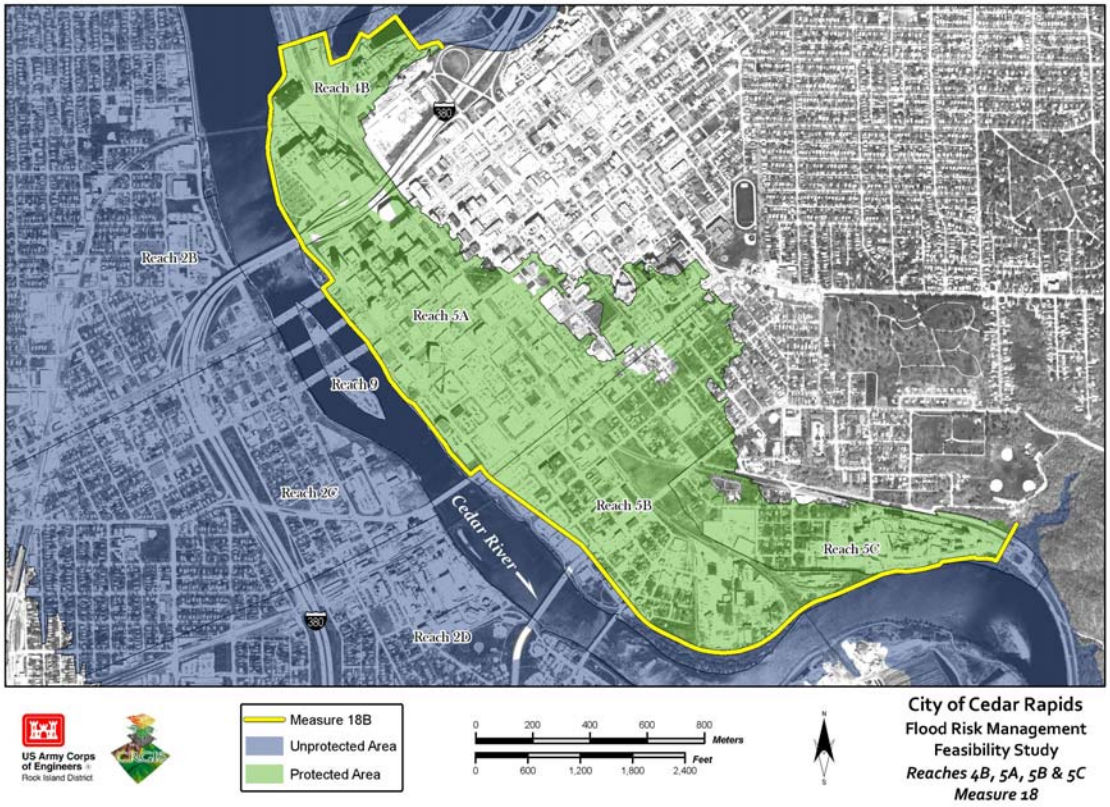

Figure O-31. Measure 18 (Reach 4B and 5)

This alignment starts in the north running southwest of three commercial/industrial buildings (4B) then generally runs east to west along the Cedar River with a tie-back levee in Reach 5C. This measure has a setback for additional greenspace (south of 8th Ave) and protects the eastside of downtown Cedar Rapids.

- **No-Action (18A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (18B).** This measure provides structural flood protection in the form of levees and floodwalls for the east side of downtown Cedar Rapids.

- **Nonstructural Protection (18C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 18

- **No Action (18A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 18B.** This alignment is very similar to other East side alignments and it links the major East side damage reaches. It will be analyzed further.

- **Measure 18C.** Same as Measure 2C, removed from further consideration.

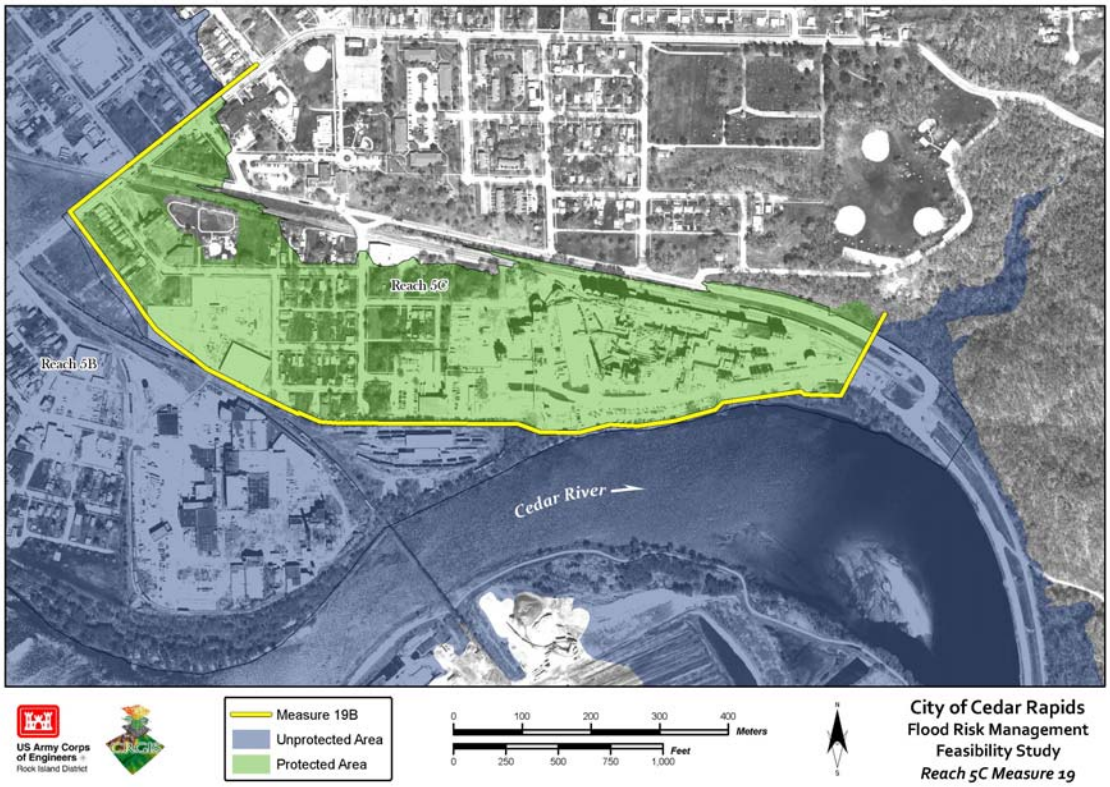

Figure O-32. Measure 19 (Reach 5C)

The measure is the south portion of the East side alignment with a upstream tieback levee at 12th Avenue SE. The alignment protects the southeastern portion of downtown Cedar Rapids.

- **No-Action (19A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (19B).** This measure provides structural flood protection in the form of levees and floodwalls for the east side of downtown Cedar Rapids.

- **Nonstructural Protection (19C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 19

- **No Action (19A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 19B.** This alignment provides protection for one of the major damage reaches (Damage Reach 5C) on the East side. It will be analyzed further.

- **Measure 19C.** Same as Measure 2C, removed from further consideration.

Damage Reach 6 - Cedar Valley (Rompot) Neighborhood

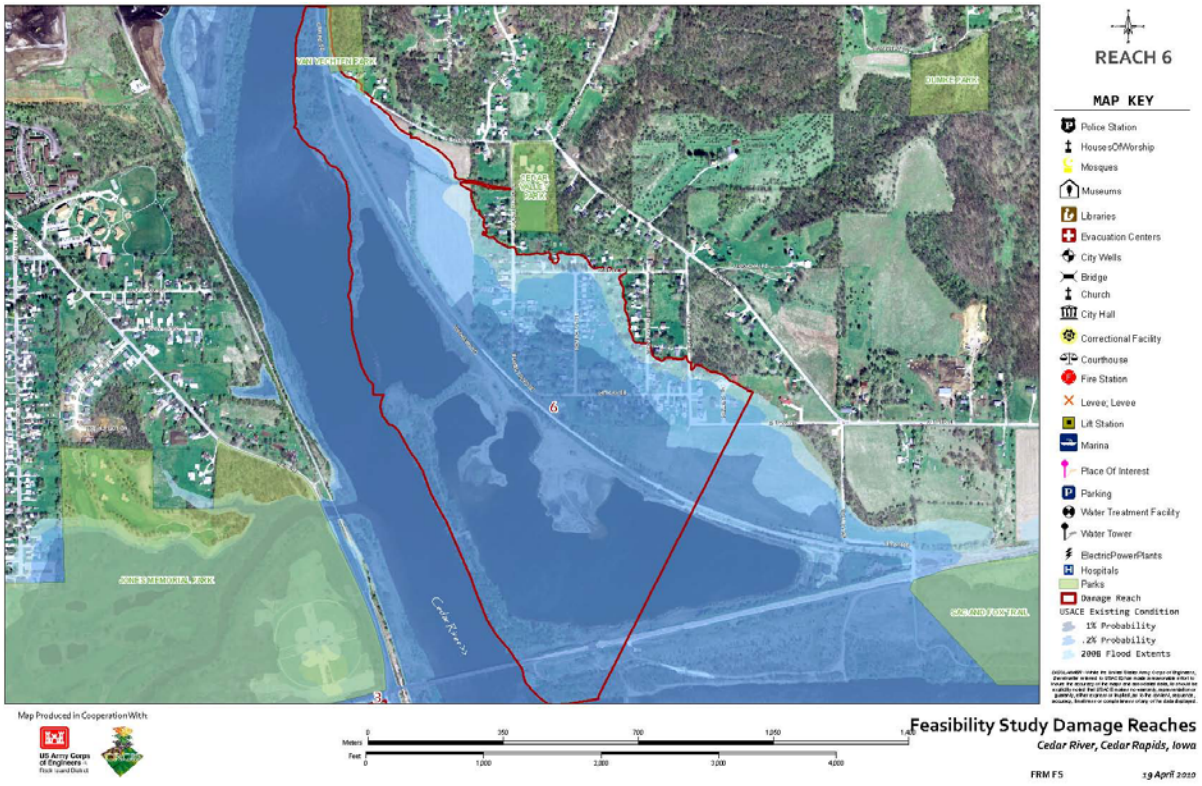

Figure P-33. Damage Reach 6

The Cedar Valley Neighborhood consists of 1 public and 78 residential properties.

Measures Developed for Reach 6:

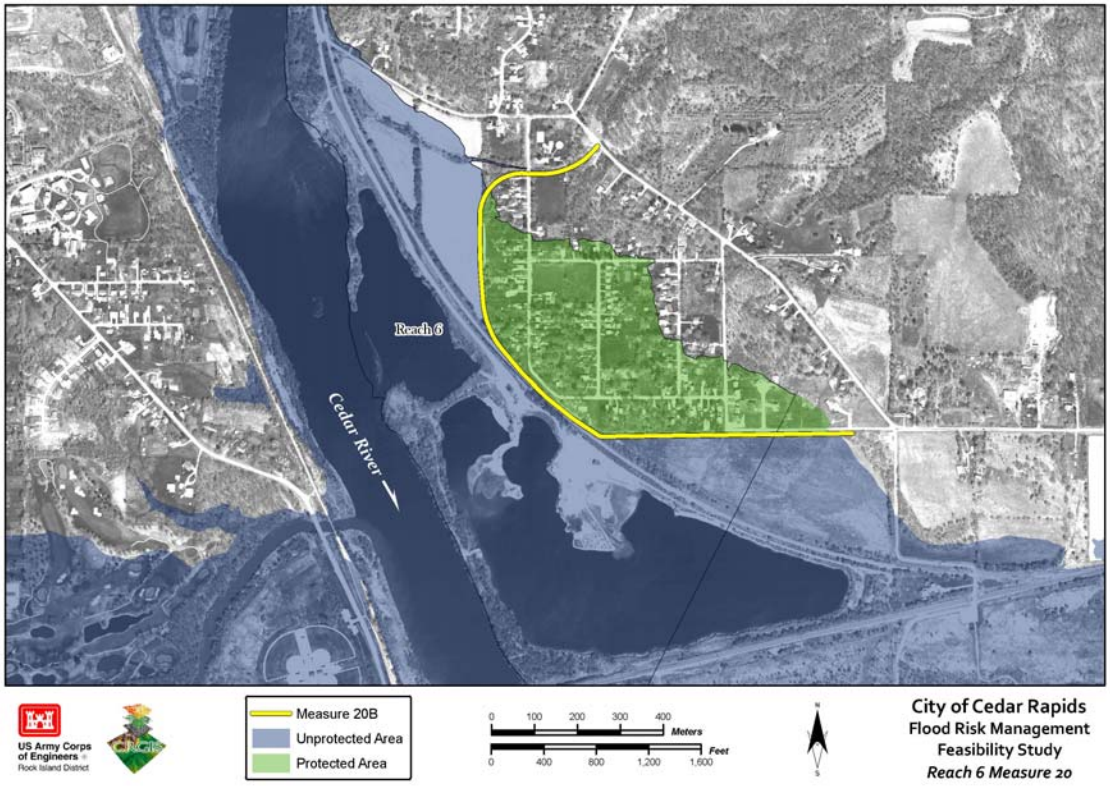

Figure O-34. Measure 20 (Reach 6)

This measure was developed for the Cedar Valley Neighborhood.

- **No Action (20A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (20B).** This measure combines the levee and floodwalls and would provide flood protection by installing levees and floodwalls along the alignment shown in Measures 1 Map.

- **Nonstructural Protection (20C).** Since the recon level economic assessment has been completed the City has focused efforts on buyouts for this neighborhood. Other nonstructural measures will be considered if all properties are not included in the buyout programs.

Screening Analysis-Measure 20

- **No Action (20A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 20B.** Under guidance from MVD and the City of Cedar Rapids (from the November 20, 2008 In-Progress-Review Meeting), MVR conducted a reconnaissance level study using existing economic information and GIS inputs. The results of the reconnaissance study to determine if structural measures such as levee and floodwalls would have a Federal interest resulted in Benefit-Cost-Ratios of approximately 0.28 (for the 1%, 0.02%, and 2008 chance flood events). Due to the low BCR values no further structural analysis was conducted for this study reach.

- **Measure 20C.** Same as Measure 2C, removed from further consideration.

Damage Reach 7 – Water Pollution Control Facilities:



Figure O-35. Reach 7 – Water Pollution Control Facilities

Water Pollution Control Facilities: The WPCF provides wastewater treatment for the City. The WPCF was inundated to a water elevation of 720 ft USGS. The "wet side" and solids handling

aspects of the plant facilities were lost for weeks. During this time the city's wastewater was discharged directly to the Cedar River.

The main lift facility was lost for about 10 days. The primary settlers (first physical treatment process) and the roughing filters (the first biological treatment) were out of service for about one month. The first stage of activated sludge treatment was out of service about two months. The second stage of activated sludge treatment was out of service about three months. The incineration facility for destroying primary and biological treatment solids is still out of service. While it is, solids are being trucked to landfills or for field application at a cost to the city of $5,000 to $10,000 per day.

The emergency repairs to the facility are estimated to cost about $8.5 million. Permanent repairs to the wet side processes are estimated at about $10 million. Permanent repairs to the solids processing facilities, principally the incinerator, are estimated to be $20 million.

Measures Developed for Reach 7

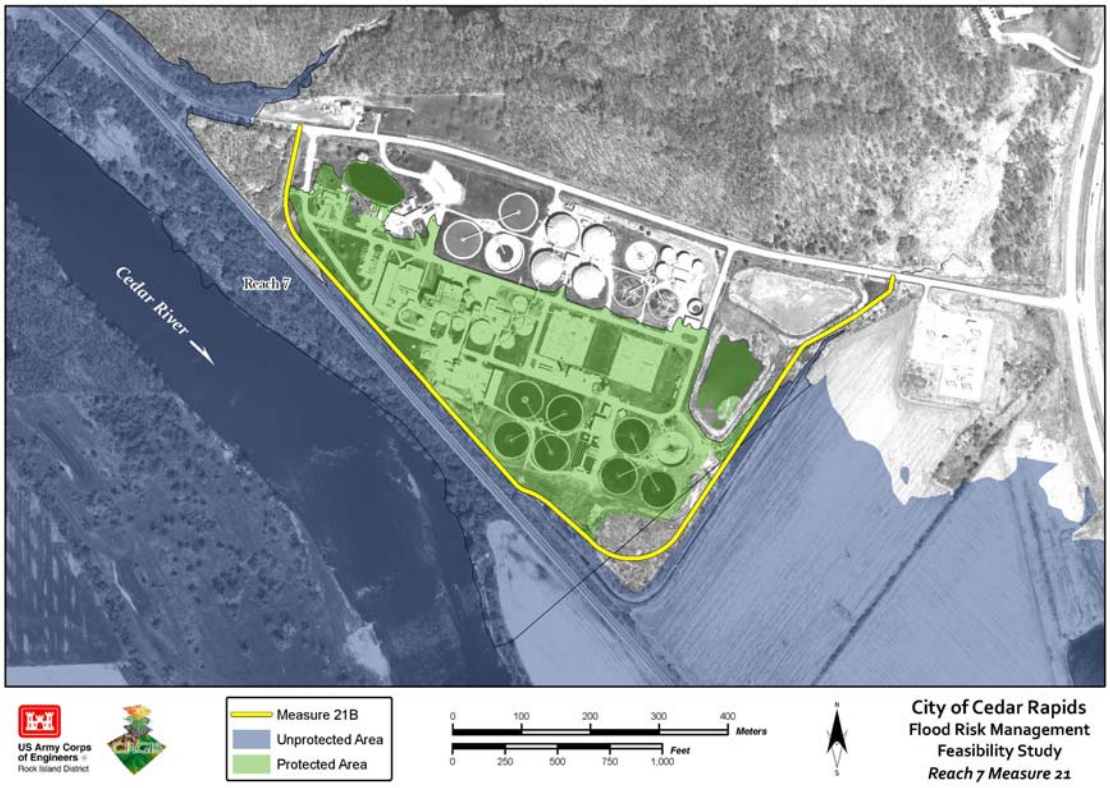

Figure O-36. Measure 21 (Reach 7)

HDR Engineering completed a study on the WPCF in February 2009. INSERT SUMMARY

- **No Action (21A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection (21B).** This measure combines the levee and floodwalls and would provide flood protection by installing levees and floodwalls along the alignment shown in Measures 1 Map.

- **Nonstructural Protection (21C).** This measure provides nonstructural measures for the Damage Reaches identified.

Screening Analysis for Measure 21

- **No Action (21A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 21B.** This alignment provides protection for a major Public facility. It will be analyzed further.

- **Measure 21C.** Same as Measure 2C, removed from further consideration.

Damage Reach 8 – Fresh Water Intake Wells

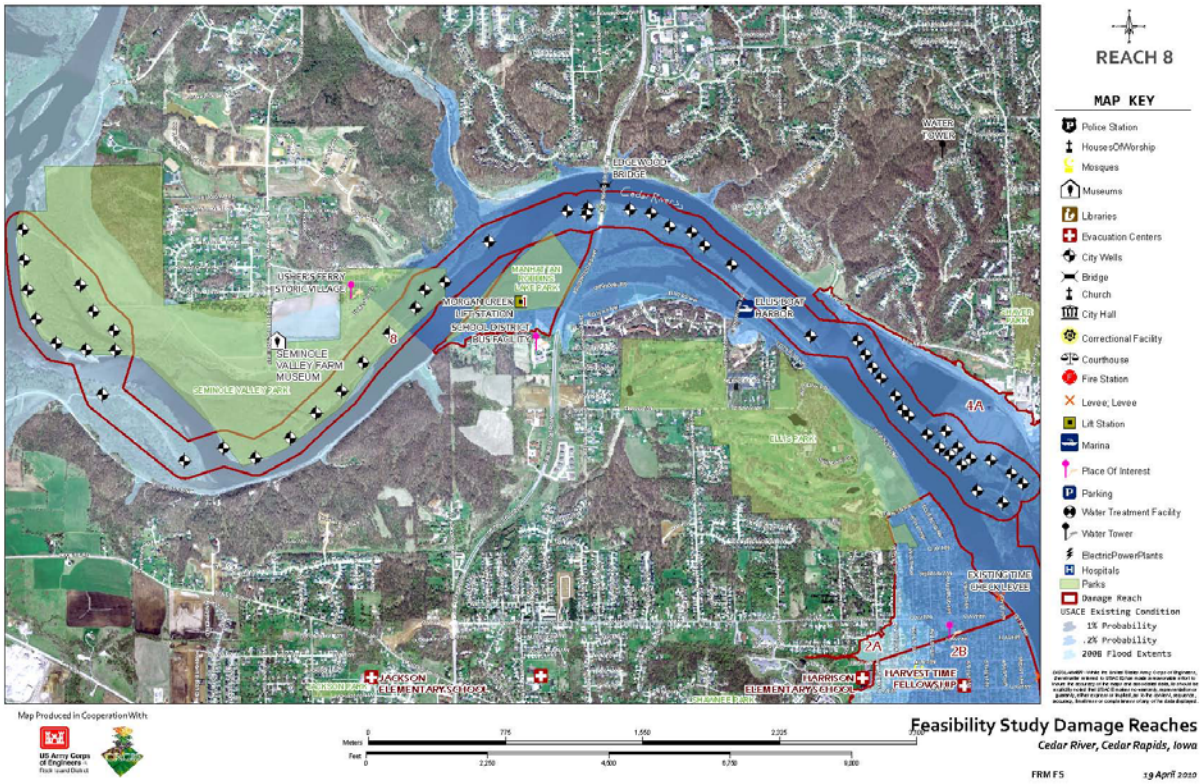

Figure O-37. Damage Reach 8

This reach is defined by the fresh water well field which includes 46 vertical and 4 collector wells. The well field provides potable water to the City of Cedar Rapids.

- **2008 Flood Impacts**
  The well field supplies raw water to the two potable water treatment plants. All of the 46 vertical wells were lost from service when the flood waters inundated the motors, and 3 of the 4 horizontal collector wells were lost from service when the flood waters inundated the transformers (at HCW 1 and 2) and/or suffered flood water intrusion of the motor control gear inside the collector well buildings (HCW 1, 2 and 4).

  Supply from the well field was limited to about 12 million gallons daily to only the J Avenue plant during the flood. As average water demand in the city is around 38 million gallons daily, all of the wet industry customers of the water system had to be shut down, and water usage restrictions imposed on the city's civilian population to forestall draining the system's storage and de-pressurizing most of the water system. Only the fortunate return to service of collector well 4 two days after the flood crest prevented having to shut off water to large segments of the residential service areas of the city.

The Northwest plant was out of service until nearly a week after the flood while certain well field motors were repaired. Only collector well 3 was kept in service through extraordinary sand bagging efforts by staff and members of the community, and further efforts to keep the portable generator at the facility fueled and in service. Two of the three damaged collector wells had replacement motor control gear installed within five weeks of the flood. It took about two months to address repairs to all of the vertical well motors. One of the three damaged collector wells is still awaiting repairs.

Measures Developed for Reach 8:

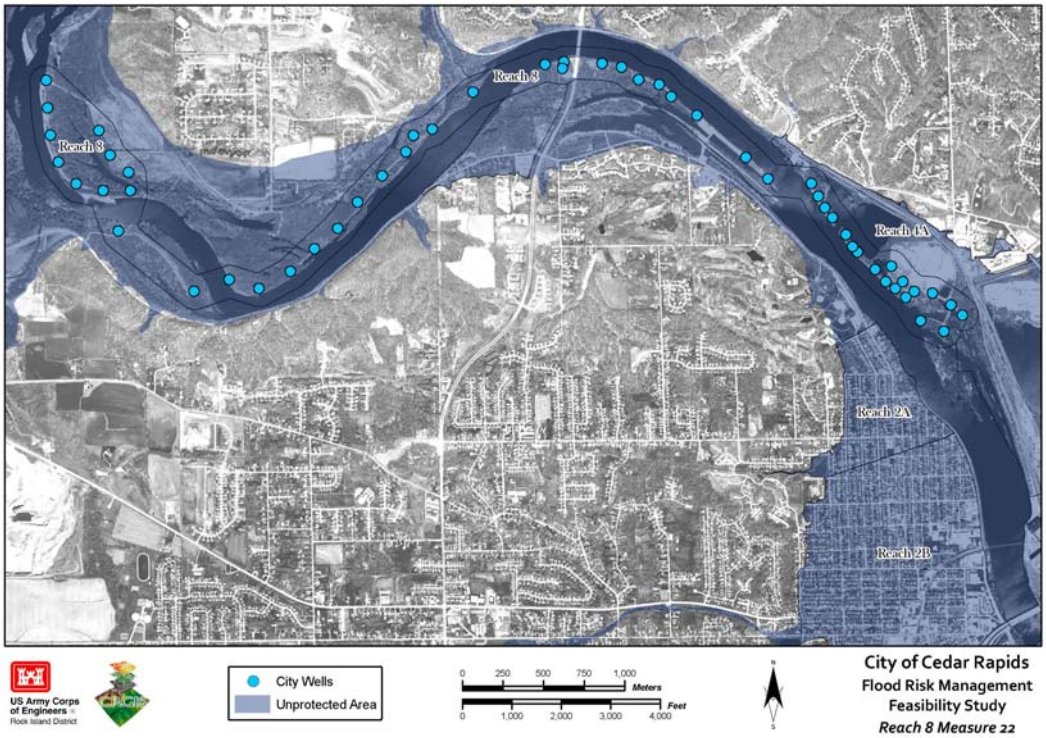

Figure O-38. Measure 22 (Reach 8)

This measure is based on providing protection for the well field that provides drinking water for Cedar Rapids.

- **No Action (22A).** This measure would result in no additional management efforts beyond the existing practices.
- **Levee/Floodwall Protection (22B).** This measure combines a series of ring levees or floodwalls to protect the individual well sites.

- **Nonstructural Protection (22C).** The nonstructural measures considered for this measure include flood-proofing, raising well casings, and other methods that would provide protection from future flood events.

Screening Analysis for Measure 22

- **No Action (22A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.
- **Measure 22B.** This alignment provides protection for a major Public facility. Structural flood protection measures to protect each individual well are not considered to be a viable option, especially considering the mitigation efforts that have taken place since the June 2008 flood event. This measure will not be considered further.
- **Measure 22C.** This measure has been screened out due to the City's planning efforts and the use of FEMA funding which has supported the raising of 10 vertical wells (to date) as well as the additional funding to protect the rest of the well field. This measure will not be considered further.

Damage Reach 9 – Mays Island:

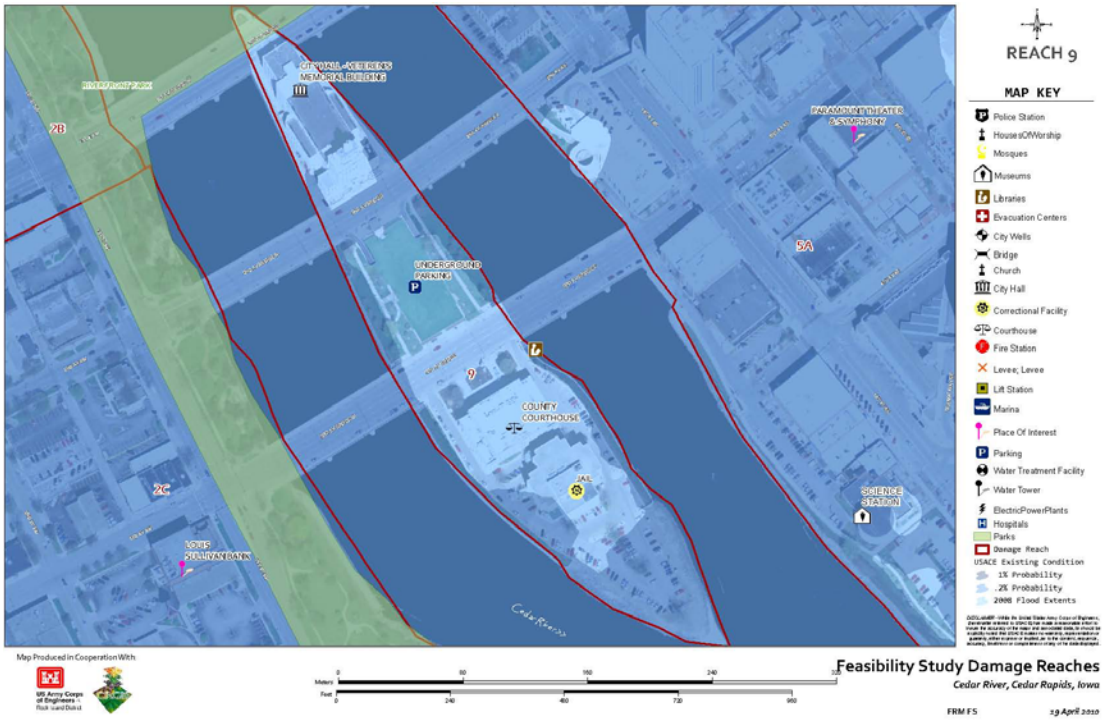

Figure O-39. Damage Reach 9 – Mays Island

This measure is based on providing protection for Mays Island: Located in the center of downtown Cedar Rapids, it has four main facilities from north to south – Veteran's Memorial Building (Cedar Rapids City Hall), a City owned underground parking garage, the Linn County Courthouse, and the Linn County Corrections Facility.

- Veteran's Memorial Building (City Hall): Prior to the flood event in June 2008, the main City Hall offices and functioning City government were located in the building. Since the flood the City has decided to bring some City government functions back to the building and the Federal Courthouse located on 1st Street NE.
- City Parking Garage: It has not been determined at the time of the Study from a structural analysis standpoint whether the parking garage will used in the future.
- Linn County Courthouse: The County has plans and funding in place to flood proof the building to a level above the 2008 flood event (approximately 4 ft). The general plan is to restrict use on the lower levels and to raise the utilities on platforms.
- Linn County Corrections Facility: The County has plans and funding in place similar to the courthouse.

Measures Developed for Reach 9

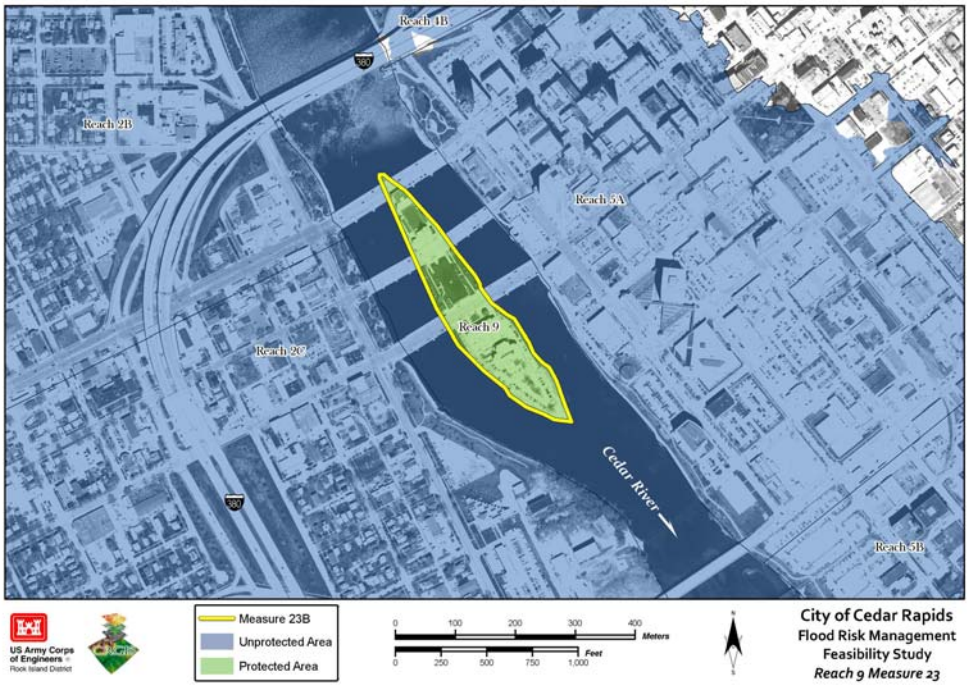

Figure O-40. Measure 23 (Reach 9)

This measure would provide protection for Mays Island.

- **No Action (23A).** This measure would result in no additional management efforts beyond the existing practices.

- **Levee/Floodwall Protection Measures (23B).** The properties on the island; the Linn County Courthouse and Corrections Facilities are completing implementation plans to elevate utilities and services to levels above the 2008 flood event. The City is also planning on removing all important infrastructure and services from the first floor of City Hall located at the north end of the island.

- **Nonstructural Protection Measure (23C)**. The measure will include nonstructural measures and will likely be combined with other levee alignment measures as part of a comprehensive flood control system.

Screening Analysis for Measure 23

- **No Action (23A).** This measure would result in no additional management efforts beyond the existing practices. This measure will be carried forward.

- **Measure 23B.** This alignment provides protection for major Public facilities. This measure is not being considered for further analysis due to the mitigation the City and County has completed.

- **Measure 23C.** This measure has been screened out due to the planning efforts of the City and County as well as the use of FEMA funding which has supported the raising of utilities and other important infrastructure that service the County buildings. The City and County also have flood mitigation plans to restrict 1st floor usage for the buildings.

D. Iteration Three: The majority of the process outlined in this phase is in the main report. The Total Project Costs and Annual Costs to Implement tables are included for additional background information.

Alternative 1 - Total Project Costs - Dollars Shown In ($000)

Last Updated: 2010-02-25

Alternative	1-Z	1-A	1-B	1-C	1-D
Construction Cost - Measure 2B [1]	$42,973	$55,671	$62,929	$71,608	$81,485
Construction Cost - Measure 18B [1]	$43,960	$57,204	$66,716	$76,431	$89,529
Total Construction Costs	**$86,933**	**$112,875**	**$129,645**	**$148,039**	**$171,014**
PE&D (18%)	$15,648	$20,318	$23,336	$26,647	$30,783
S&A (10%)	$8,693	$11,288	$12,965	$14,804	$17,101
Subtotal	**$111,274**	**$144,480**	**$165,946**	**$189,490**	**$218,898**
Real Estate [3,4,5]	$52,600	$52,600	$52,600	$52,600	$52,600
Envir Mitig	$681	$681	$793	$908	$1,034
Cultural Mitigation (1%)	$869	$1,129	$1,296	$1,480	$1,710
Total	**$165,425**	**$198,890**	**$220,635**	**$244,478**	**$274,242**
Annual O&M costs	**$80**	**$80**	**$80**	**$80**	**$80**

1) Project Costs based on estimates from Stanley Consultants dated Feb 08, 2010 and Feb 02, 2010

2) 75-year level is a rough estimate based on reduced cost on levees, floodwalls and interior storm water systems

3) HTRW cleanup costs are not included (city responsibility)

4) Costs to mitigate for induced damages are not included

5) Real Estate estimates are based solely on the 2008 project footprint for each level of protection.

Alternative 1 - Annual Costs to Implement - Dollars Shown In ($000)
Assumes 5-year construction duration

Last Updated: 2010-02-25

Alternative	1-Z	1-A	1-B	1-C	1-D
Construction Cost	$86,933	$112,875	$129,645	$148,039	$171,014
PE&D	$15,648	$20,318	$23,336	$26,647	$30,783
S&A	$8,693	$11,288	$12,965	$14,804	$17,101
Year 1					
PE&D (30%)	$4,694	$6,095	$7,001	$7,994	$9,235
Construction (10%)	$8,693	$11,288	$12,965	$14,804	$17,101
S&A (10%)	$869	$1,129	$1,296	$1,480	$1,710
Year 2					
PE&D (30%)	$4,694	$6,095	$7,001	$7,994	$9,235
Construction (25%)	$21,733	$28,219	$32,411	$37,010	$42,754
S&A (25%)	$2,173	$2,822	$3,241	$3,701	$4,275
Year 3					
PE&D (15%)	$2,347	$3,048	$3,500	$3,997	$4,617
Construction (30%)	$26,080	$33,863	$38,894	$44,412	$51,304
S&A (30%)	$2,608	$3,386	$3,889	$4,441	$5,130
Year 4					
PE&D (15%)	$2,347	$3,048	$3,500	$3,997	$4,617
Construction (20%)	$17,387	$22,575	$25,929	$29,608	$34,203
S&A (20%)	$1,739	$2,258	$2,593	$2,961	$3,420
Year 5					
PE&D (10%)	$1,565	$2,032	$2,334	$2,665	$3,078
Construction (15%)	$13,040	$16,931	$19,447	$22,206	$25,652
S&A (15%)	$1,304	$1,693	$1,945	$2,221	$2,565

Alternative 1A - Total Project Costs - Dollars Shown In ($000)

Last Updated: 2010-02-25

Alternative	1A-Z	1A-A	1A-B	1A-C	1A-D
Construction Cost - Measure 2B [1]	$42,973	$55,671	$62,929	$71,608	$81,485
Construction Cost - Measure 27B [1]	$46,379	$56,297	$63,844	$70,896	$80,307
Total Construction Costs	**$89,352**	**$111,968**	**$126,773**	**$142,504**	**$161,792**
PE&D (18%)	$16,083	$20,154	$22,819	$25,651	$29,123
S&A (10%)	$8,935	$11,197	$12,677	$14,250	$16,179
Subtotal	**$114,371**	**$143,319**	**$162,269**	**$182,405**	**$207,094**
Real Estate [3,4,5]	$49,800	$49,800	$49,800	$49,800	$49,800
Envir Mitig	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$894	$1,120	$1,268	$1,425	$1,618
Total	**$165,065**	**$194,239**	**$213,337**	**$233,630**	**$258,512**
Annual O&M Costs	**$75**	**$75**	**$75**	**$75**	**$75**

1) Project Costs based on Estimates from Stanley Consultants dated Feb 08, 2010 and Feb 11, 2010
2) 75-year level is a rough estimate based on reduced cost on levees, floodwalls and interior storm water systems
3) HTRW cleanup costs are not included (city responsibility)
4) Costs to mitigate for induced damages are not included
5) Real Estate estimates are based on the 2008 project footprint for each level of protection.

Alternative 1A - Annual Costs to Implement - Dollars Shown In ($000)
Assumes 5-year construction duration.

Last Updated: 2010-02-25

Alternative	1A-Z	1A-A	1A-B	1A-C	1A-D
Construction Cost	$89,352	$111,968	$126,773	$142,504	$161,792
PE&D	$16,083	$20,154	$22,819	$25,651	$29,123
S&A	$8,935	$11,197	$12,677	$14,250	$16,179
Year 1					
PE&D (30%)	$4,825	$6,046	$6,846	$7,695	$8,737
Construction (10%)	$8,935	$11,197	$12,677	$14,250	$16,179
S&A (10%)	$894	$1,120	$1,268	$1,425	$1,618
Year 2					
PE&D (30%)	$4,825	$6,046	$6,846	$7,695	$8,737
Construction (25%)	$22,338	$27,992	$31,693	$35,626	$40,448
S&A (25%)	$2,234	$2,799	$3,169	$3,563	$4,045
Year 3					
PE&D (15%)	$2,413	$3,023	$3,423	$3,848	$4,368
Construction (30%)	$26,806	$33,590	$38,032	$42,751	$48,538
S&A (30%)	$2,681	$3,359	$3,803	$4,275	$4,854
Year 4					
PE&D (15%)	$2,413	$3,023	$3,423	$3,848	$4,368
Construction (20%)	$17,870	$22,394	$25,355	$28,501	$32,358
S&A (20%)	$1,787	$2,239	$2,535	$2,850	$3,236
Year 5					
PE&D (10%)	$1,608	$2,015	$2,282	$2,565	$2,912
Construction (15%)	$13,403	$16,795	$19,016	$21,376	$24,269
S&A (15%)	$1,340	$1,680	$1,902	$2,138	$2,427

Alternative 4 - Total Project Costs - Dollars Shown In ($000)

Last Updated: 2010-02-25

Alternative	4-Z	4-A	4-B	4-C	4-D
Construction Cost [1]	$46,379	$56,297	$63,844	$70,896	$80,307
PE&D (18%)	$8,348	$10,133	$11,492	$12,761	$14,455
S&A (10%)	$4,638	$5,630	$6,384	$7,090	$8,031
Subtotal	**$59,365**	**$72,060**	**$81,720**	**$90,747**	**$102,793**
Real Estate [3,4,5]	$11,100	$11,100	$11,100	$11,100	$11,100
Envir Mitig	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$464	$563	$638	$709	$803
Total	**$70,929**	**$83,723**	**$93,459**	**$102,556**	**$114,696**
Annual O&M Costs	**$35**	**$35**	**$35**	**$35**	**$35**

1) Project Costs based on Estimates from Stanley Consultants dated Feb 02, 2010

2) 75-year level is a rough estimate based on reduced cost on levees, floodwalls and interior storm water systems

3) HTRW cleanup costs are not included (city responsibility)

4) Costs to mitigate for induced damages are not included

5) Real Estate estimates are based on the 2008 project footprint for each level of protection.

Alternative 4 - Annual Costs to Implement - Dollars Shown In ($000)
Assumes 5-year construction duration.

Last Updated: 2010-02-25

Alternative	4-Z	4-A	4-B	4-C	4-D
Construction Cost	$46,379	$56,297	$63,844	$70,896	$80,307
PE&D	$8,348	$10,133	$11,492	$12,761	$14,455
S&A	$4,638	$5,630	$6,384	$7,090	$8,031
Year 1					
PE&D (30%)	$2,504	$3,040	$3,448	$3,828	$4,337
Construction (10%)	$4,638	$5,630	$6,384	$7,090	$8,031
S&A (10%)	$464	$563	$638	$709	$803
Year 2					
PE&D (30%)	$2,504	$3,040	$3,448	$3,828	$4,337
Construction (25%)	$11,595	$14,074	$15,961	$17,724	$20,077
S&A (25%)	$1,159	$1,407	$1,596	$1,772	$2,008
Year 3					
PE&D (15%)	$1,252	$1,520	$1,724	$1,914	$2,168
Construction (30%)	$13,914	$16,889	$19,153	$21,269	$24,092
S&A (30%)	$1,391	$1,689	$1,915	$2,127	$2,409
Year 4					
PE&D (15%)	$1,252	$1,520	$1,724	$1,914	$2,168
Construction (20%)	$9,276	$11,259	$12,769	$14,179	$16,061
S&A (20%)	$928	$1,126	$1,277	$1,418	$1,606
Year 5					
PE&D (10%)	$835	$1,013	$1,149	$1,276	$1,446
Construction (15%)	$6,957	$8,445	$9,577	$10,634	$12,046
S&A (15%)	$696	$844	$958	$1,063	$1,205

Alternative 10 - Total Project Costs - Dollars Shown In ($000)

Last Updated: 2010-03-24

Alternative	10-Z	10-A	10-B	10-C	10-D	10-E
Construction Cost - Alternative 5 [1]	$9,944	$13,013	$15,482	$17,727	$20,425	$13,013
Construction Cost - Alternative 7 [1]	$18,619	$22,856	$27,308	$31,081	$35,706	$27,308
Total Construction Costs	**$28,563**	**$35,869**	**$42,790**	**$48,808**	**$56,131**	**$40,321**
PE&D (18%)	$5,141	$6,456	$7,702	$8,785	$10,104	$7,258
S&A (10%)	$2,856	$3,587	$4,279	$4,881	$5,613	$4,032
Subtotal	**$36,561**	**$45,912**	**$54,771**	**$62,474**	**$71,848**	**$51,611**
Real Estate [2,3,4]	$4,366	$4,400	$4,433	$4,466	$4,500	$4,400
Envir Mitig	$0	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$286	$359	$428	$488	$561	$403
Total	**$41,212**	**$50,671**	**$59,632**	**$67,428**	**$76,909**	**$56,414**
Annual O&M costs	**$17**	**$17**	**$17**	**$17**	**$17**	**$17**

1) Project Costs based on estimates from Stanley Consultants dated Feb 02, Feb 11, and Mar 24, 2010.

2) HTRW cleanup costs are not included (City responsibility).

3) Costs to mitigate for induced damages are not included.

4) Real Estate estimates are based on the 2008 project footprint for each level of protection for Measure 28B. Real Estate estimates for Measure 19B are based on the 100-year and 2008 events. Straight line spread applied to the rest.

Alternative 10 - Annual Costs to Implement - Dollars Shown In ($000)
Assumes 3-year construction duration.

Last Updated: 2010-03-24

Alternative	10-Z	10-A	10-B	10-C	10-D	10-E
Construction Cost	$28,563	$35,869	$42,790	$48,808	$56,131	$40,321
PE&D	$5,141	$6,456	$7,702	$8,785	$10,104	$7,258
S&A	$2,856	$3,587	$4,279	$4,881	$5,613	$4,032
Year 1						
PE&D (50%)	$2,571	$3,228	$3,851	$4,393	$5,052	$3,629
Construction (20%)	$5,713	$7,174	$8,558	$9,762	$11,226	$8,064
S&A (20%)	$571	$717	$856	$976	$1,123	$806
Year 2						
PE&D (30%)	$1,542	$1,937	$2,311	$2,636	$3,031	$2,177
Construction (50%)	$14,282	$17,935	$21,395	$24,404	$28,066	$20,161
S&A (50%)	$1,428	$1,793	$2,140	$2,440	$2,807	$2,016
Year 3						
PE&D (20%)	$1,028	$1,291	$1,540	$1,757	$2,021	$1,452
Construction (30%)	$8,569	$10,761	$12,837	$14,642	$16,839	$12,096
S&A (30%)	$857	$1,076	$1,284	$1,464	$1,684	$1,210

Alternative 5 - Total Project Costs
Last Updated: 2010-03-24

	Dollars Shown In ($000)				
Alternative	**5-Z**	**5-A**	**5-B**	**5-C**	**5-D**
Construction Cost [1]	$11,740	$13,013	$15,482	$17,727	$20,425
PE&D (18%)	$2,113	$2,342	$2,787	$3,191	$3,677
S&A (10%)	$1,174	$1,301	$1,548	$1,773	$2,043
Subtotal	**$15,027**	**$16,657**	**$19,817**	**$22,691**	**$26,144**
Real Estate 2,[3,4]	$2,266	$2,300	$2,333	$2,366	$2,400
Envir Mitig	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$117	$130	$155	$177	$204
Total	**$17,411**	**$19,087**	**$22,305**	**$25,234**	**$28,748**
Annual O&M Costs	**$2**	**$2**	**$2**	**$2**	**$2**

1) Project Costs based on Estimates from Stanley Consultants dated Feb 02 & Mar 24, 2010.

2) 75-year level is a rough estimate based on reduced cost on levees, floodwalls and interior storm water systems

3) HTRW cleanup costs are not included (city responsibility)

4) Costs to mitigate for induced damages are not included

5) Real Estate estimates are based on the 2008 project footprint for each level of protection.

Alternative 5 - Annual Costs to Implement
Assumes 3-year construction duration.
Last Updated: 2010-03-24

	Dollars Shown In ($000)				
Alternative	**5-Z**	**5-A**	**5-B**	**5-C**	**5-D**
Construction Cost	$11,740	$13,013	$15,482	$17,727	$20,425
PE&D	$2,113	$2,342	$2,787	$3,191	$3,677
S&A	$1,174	$1,301	$1,548	$1,773	$2,043
Year 1					
PE&D (50%)	$1,057	$1,171	$1,393	$1,595	$1,838
Construction (20%)	$2,348	$2,603	$3,096	$3,545	$4,085
S&A (20%)	$235	$260	$310	$355	$409
Year 2					
PE&D (30%)	$634	$703	$836	$957	$1,103
Construction (50%)	$5,870	$6,507	$7,741	$8,864	$10,213
S&A (50%)	$587	$651	$774	$886	$1,021
Year 3					
PE&D (20%)	$423	$468	$557	$638	$735
Construction (30%)	$3,522	$3,904	$4,645	$5,318	$6,128
S&A (30%)	$352	$390	$464	$532	$613

Alternative 7 - Total Project Costs
Last Updated: 2010-02-25

	Dollars Shown In ($000)				
Alternative	**7-Z**	**7-A**	**7-B**	**7-C**	**7-D**
Construction Cost [1]	$18,619	$22,856	$27,308	$31,081	$35,706
PE&D (18%)	$3,351	$4,114	$4,915	$5,595	$6,427
S&A (10%)	$1,862	$2,286	$2,731	$3,108	$3,571
Subtotal	**$23,832**	**$29,256**	**$34,954**	**$39,784**	**$45,704**
Real Estate [3,4,5]	$2,100	$2,100	$2,100	$2,100	$2,100
Envir Mitig	$0	$0	$0	$0	$0
Cultural Mitigation (1%)	$186	$229	$273	$311	$357
Total	**$26,119**	**$31,584**	**$37,327**	**$42,194**	**$48,161**
Annual O&M Costs	**$15**	**$15**	**$15**	**$15**	**$15**

1) Project Costs based on Estimates from Stanley Consultants dated Feb 11, 2010
2) 75-year level is a rough estimate based on reduced cost on levees, floodwalls and interior storm water systems
3) HTRW cleanup costs are not included (city responsibility)
4) Costs to mitigate for induced damages are not included
5) Real Estate estimates are based solely on the 2008 project footprint for each level of protection.

Alternative 7 - Annual Costs to Implement
Assumes 3-year construction duration.
Last Updated: 2010-02-25

	Dollars Shown In ($000)				
Construction Cost	$18,619	$22,856	$27,308	$31,081	$35,706
PE&D	$3,351	$4,114	$4,915	$5,595	$6,427
S&A	$1,862	$2,286	$2,731	$3,108	$3,571
Year 1					
PE&D (50%)	$1,676	$2,057	$2,458	$2,797	$3,214
Construction (20%)	$3,724	$4,571	$5,462	$6,216	$7,141
S&A (20%)	$372	$457	$546	$622	$714
Year 2					
PE&D (30%)	$1,005	$1,234	$1,475	$1,678	$1,928
Construction (50%)	$9,310	$11,428	$13,654	$15,541	$17,853
S&A (50%)	$931	$1,143	$1,365	$1,554	$1,785
Year 3					
PE&D (20%)	$670	$823	$983	$1,119	$1,285
Construction (30%)	$5,586	$6,857	$8,192	$9,324	$10,712
S&A (30%)	$559	$686	$819	$932	$1,071

E. Iteration Four and Final Iteration: All of the plan formulation processes outlined in this phase are found in the main report.

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX P
NONSTRUCTURAL MEASURES

CEDAR RIVER
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FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX P NONSTRUCTURAL MEASURES

I. BACKGROUND OF NONSTRUCTURAL IMPLEMENTATION IN FLOOD RISK MANAGEMENT

Flood risk is defined as the product of the frequency of flooding and the consequences of flooding. Flood risk in the United States continues to increase despite many efforts during the past several decades to reduce and eliminate that risk. Early efforts to reduce flood risk were focused on controlling floods by reducing the frequency of flooding with the use of structural alternatives such as dams, levees, channels, and diversions. These structural alternatives modified the characteristics of floods. This concept began to fade in the 1960s as it became apparent that structural means alone could not reliably control nature and contain flooding. The focus then evolved to flood damage reduction. The concept of flood damage reduction is that, from an economic perspective, in order to reduce flood damage, the focus had to be not only on reducing the frequency to flooding but also on the consequences of flooding. The flooding could be made less damaging through modifying the characteristics of floods (structural alternatives) and also modifying the characteristics of development in the floodplain and the behavior of people living within the floodplain (nonstructural alternatives).

In the past several years, the nation has shifted its thinking to overall flood risk reduction and flood risk management (FRM), because flood damage reduction focused primarily on damages and their effects on the economy. The nation has recognized that the adverse affects of flooding were manifested comprehensively across many categories including loss of life, rather than simply economic damages. In the flood risk reduction/flood risk management environment, floodplain managers realize that to effectively reduce flood risk, all "tools" in the flood risk reduction "tool box" must be used. These tools include both structural and nonstructural measures. These measures, when considered in the context of reducing flood risk, become alternatives that can be compared with other alternatives.

Executive Order 11988. This Executive Order (EO) was issued by President Jimmy Carter on 24 May 1977 and is entitled "Floodplain Management." In issuing the EO the President stated, "in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative, it is hereby ordered that each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities…". The nonstructural analysis was done in complete compliance with the EO such that any nonstructural measures that are incorporated into alternatives recommended for implementation support the vision of the EO.

II. INTRODUCTION TO NONSTRUCTURAL MEASURES

Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding, either by changing the use of the floodplains or by adapting the existing uses in the floodplain to the flood hazard. The application of nonstructural measures, which are directly associated with modifying the location, construction or operation of property, structures, and facilities located in hazard area, is one method of reducing flood damages and saving lives that are at-risk. Some examples of nonstructural measures include; flood proofing structures, permanent relocation of structures, flood warning/preparedness systems, and regulation of floodplain uses.

In general, nonstructural measures can be applied as a single measure or in combination with other nonstructural or structural measures to reduce or eliminate flood risk. The range of benefits, costs, and residual damages associated with the application of each measure is broad. The extent and severity of social and economic impacts associated with the various measures can be likewise broad and must be identified for any plan. Depending upon the nonstructural measures selected for application and the relative percentage of each applied to the city, the future land use pattern of the area could look considerably different in specific areas and the aesthetics and livability experience of the city enhanced while the flood risk is reduced.

Actions to modify or remove development in the at-risk areas in order to reduce damages can generally be applied in two ways: 1) take direct actions towards the at-risk building or facility so as to modify its structural characteristics or location such that damages are reduced, or 2) apply incentives and/or disincentives through regulatory or economic processes that cause landowners to re-evaluate the costs and benefits of living in a hazardous location more carefully. Many existing regulatory and land valuation techniques exist that can influence individuals' choice of a building location. Both techniques need to be considered as part of the nonstructural analysis within this study.

Nonstructural measures that take direct action towards the at-risk building or facility are obviously very building/structure specific. Each structure may require a different nonstructural measure tailored to suit the individual structure, the method under which it was constructed, the nature of its use, its location within the floodplain, and other variables related to the flood hazard. In order to achieve this level of specificity, each structure would have to be individually inspected by a nonstructural team consisting of a floodplain engineer, structural engineer, cost engineer, civil engineer, and real estate specialist in order to determine, prior to implementation, the specifics relative to each type of measure to be employed. Because of the level of investigation within this phase of the study, such a high degree of specificity was not possible. In addition, because each structure is potentially owned and occupied individually, nonstructural measures require different implementation activities as compared to structural measures, and agreements for nonstructural implementation must be entered into with individual owners.

Structure owners would need to participate in any potential project incorporating nonstructural measures into a flood risk/flood damage reduction plan. This can be either voluntary or mandatory depending upon the needs of the project and the desires of the community. Voluntary is always the preferred method of implementation, but could result in a patchwork effect due to some owners refusing to participate in the project.

Development of Nonstructural Measures. The Rock Island District (District) consulted with the Corps of Engineers (Corps)' National Nonstructural / Flood Proofing Committee (NFPC) early in the Study. Conference calls were held with Mr. Larry Buss, P.E., former committee chairman, and Carol Hollaway, committee advisor, in August of 2009. On the basis of recommendations and other information provided by the NFPC, a variety of nonstructural measures were further investigated in this Study. Figure P-1 displays a matrix that was developed and published by the NFPC to serve as a tool for evaluating flood damage reduction measures including 15 nonstructural measures. This matrix served the Project Delivery Team (PDT) as the starting point for the nonstructural evaluation.

This appendix identifies and describes in detail the various types of nonstructural measures that could be applied to the project area for the purpose of reducing loss of life and flood damages. It also makes a preliminary determination as to the applicability of individual measures to all, or portions of, the project area based upon the existing conditions, expected effectiveness of the measure, and potential social, economic and environmental impacts. Based upon that determination, table P-1 provides an overview of the potential nonstructural measures that could be formulated into several alternatives either as single alternatives or as combinations of alternatives for this Study.

It is possible to have nonstructural measures that are dependent upon one another for their effectiveness. Obviously building codes are best when implemented prior to a structure being newly constructed or remodeled. Altering property taxes to discourage development works best when the property is in the ownership of a private individual, rather than the county or municipal government. Also, many measures are not effective in the absence or presence of a structure on the particular tract of land.

The concept of combinability addresses whether measures may or may not be mutually exclusive of one another. Obviously in the nonstructural arena, one cannot both purchase and demolish a structure and then elevate that same structure as a floodproofed structure on the same lot. Once acquired and demolished, no structure is left on the site to elevate. In that same way, application of building codes on property where structures are acquired and reserved for ecosystem restoration is impractical. Of particular note is the combinability of some of the measures that work in a symbiotic relationship. Such a relationship exists between the flood warning system and the emergency evacuation measures.

Nonstructural measures can be divided into two groups for the purposes of combinability. First are those measures that concern modification of private and public structures and associated facilities or the ownership of the land upon which they are located; second are those measures that concern regulation, taxation, fees and assessments and enforcement of regulations and codes that apply to the land. By Congressional action, the Corps can be authorized to implement certain nonstructural measures that result in modification of buildings and facilities through contractual arrangements with the landowners to reduce damages and loss of life. However, as certain private and public rights and responsibilities have been conferred to the states by the Federal government and then subsequently passed down to local governments as police powers, the Corps is unable to implement or administer some nonstructural measures. These "local measures" can be just as effective in reducing damages although the benefit stream may be more difficult to identify for formulation processes. It is possible to combine both measures implemented by the Corps and measures implemented by local jurisdictions on one parcel of land and realize the full benefit potential of their combination.

US Army Corps
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National Nonstructural/ Flood Proofing Committee

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Nonstructural/ Flood Proofing
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		FLOOD DAMAGE REDUCTION MEASURES																		
		NON-STRUCTURAL MITIGATION MEASURES															STRUCTURAL MITIGATON MEASURES			
														NFIP						
	FLOOD DAMAGE REDUCTION MATRIX	Elevation on Foundation Walls	Elevation on Piers	Elevation on Posts or Columns	Elevation on Piles	Elevation on Fill	Relocation	Buyout/ Acquisition	Floodwalls and Levees	Floodwalls and Levees with Closures	Dry Flood Proofing	Wet Flood Proofing	Flood Warning Preparedness	Flood Plain Regulation	Flood Insurance	Flood Mitigation [1]	Channel	Levee/Wall	Dams	Diversions
Flooding Characteristics	**Flood Depth**																			
	Shallow (<3 ft)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Moderate (3 to 6 ft)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Deep (greater than 6 ft)	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Flood Velocity																			
	Slow (less than 3 fps)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Moderate (3 to 5 fps)	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
	Fast (greater than 5 fps)	N	N	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
	Flash Flooding																			
	Yes (less than 1 hour)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
	No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Ice and Debris Flow																			
	Yes	N	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
	No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Site Characteristics	**Site Location**																			
	Coastal Flood Plain																			
	Beach Front	N	N	N	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	N	[2]	N	N
	Interior (Low Velocity)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
	Riverine Flood Plain	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Soil Type																			
	Permeable	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Impermeable	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Building Characteristics	**Structure Foundation**																			
	Slab on Grade	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Crawl Space	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Basement	Y	N	N	N	N	Y	Y	Y	Y	N	Y	Y	y	Y	Y	Y	Y	Y	Y
	Structure Construction																			
	Concrete or Masonry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Metal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Wood	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Structure Condition																			
	Excellent to Good	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Fair to Poor	N	N	N	N	N	N	Y	Y	Y	N	N	Y	Y	Y	[3]	Y	Y	Y	Y
NED/NER/Recreation/Social Characteristics	**Economic**																			
	Structure Protected	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	[5]	N	Y	Y	Y	Y	Y
	Cost to Implement	M	M	M	M	M	H	H	M	M	L	L	L	L	L	H/M	H	H	H	H
	Potential Flood Insurance Cost Reduction (Residential)	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	Y	-	Y	Y	Y	Y	Y
	Potential Flood Insurance Cost Reduction (Commercial)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	-	Y	Y	Y	Y	Y
	Potential Adverse Flooding Impact on Other Property	N	N	N	N	Y	N	N	Y	Y	N	N	N	Y	N	N	Y	Y	Y	Y
	Reduction in Admin Costs of NFIP	N	N	N	N	Y	Y	Y	N	N	N	N	N	[6]	-	[3]	[7]	[7]	[7]	[7]
	Reduction in Costs of Disaster Relief	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Reduction in Emergency Costs	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	[3]	Y	Y	Y	Y
	Reduction in Damage to Public Infrastructure	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	[3]	Y	Y	Y	Y
	Potential for Catastrophic Damages if Design Elevation Exceeded	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	Y	Y	N
	Promotes Flood Plain Development	N	N	N	N	N	N	N	N	N	N	N	N	N	[8]	N	Y	Y	Y	Y
	Environmental																			
	Ecosystem Restoration Possible	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
	Potential Adverse Environmental Impact	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y
	Recreation																			
	Recreation Potential	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	[3]	N	N	Y	N
	Social																			
	Community Remains Intact	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	[4]	Y	Y	Y	Y
	Population Protected	N	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	[3]	Y	Y	Y	Y
	Potential Structure Marketability Increase	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	[5]	N	Y	Y	Y	Y	Y

[1] NFIP Flood Mitigation may vary but it is usually buyout/acquisitic
[2] Not generally recommended
[3] Buyout/acquisition only
[4] Elevation only
[5] Post FIRM construction only
[6] Post FIRM structures elevation on fill
[7] Yes, if project provides 100 year or greater protection
[8] Yes, if in flood plains less frequent than the 100-year

Y-Yes
N-No
L-Low
M-Medium
H-High

Oct 2004

The US Army Corps of Engineers National Nonstructural/Flood Proofing Committee [NFPC] is available to assist in any aspect of formulating and implementing nonstructural flood damage reduction measures and realizing the opportunities that exist with nonstructural.

For more information, please contact the NFPC Chairman, Mr. Larry Buss at 402-221-4417 / e-mail larry.s.buss@usace.army.mil or contact the NFPC website at www.nwo.usace.army.mil/NFPC.

Figure P-1. Matrix of Nonstructural Measures

Table P-1. Nonstructural Measures

Measure	Description
NS1	Wet Flood Proofing
NS2	Dry Flood Proofing
NS3	Elevating Structures
NS4	Relocation of Structures
NS5	Single Structure Levee / Floodwall
NS6	Buyout / Acquisition of Structures
NS7	Flood Warning System
NS8	Flood Response Plan
NS9	Evacuation Route Mapping and Signage
NS10	Community Flood Response Education
NS11	Floodplain Management Plan
NS12	Flood Insurance
NS13	Community Rating System
NS14	Land Use Regulation and Zoning
NS15	Building Codes
NS16	Purchase of Land Development Rights
NS17	Agricultural Lands Policy (Watershed Management)

Table P-2 lists a variety of nonstructural measures and whether the Corps or another Federal agency, such as FEMA, or state or local government would be the appropriate entity to implement the measure. This table also indicates by this division of responsibility the various combinations of measures that could be instituted as a joint effort by the Federal government and the State and local governments in the project area. Of particular interest is the Flood Warning System which has components that can be implemented by both Federal and non-Federal partners. In addition, although permanent acquisition and floodproofing would normally be Federal roles, local entities could implement these components as local initiatives financed through state resources.

Table P-2. Nonstructural Categories by Responsible Entity

	Responsible Entity	
Measure	**Federal Government**	**State and Local Governments**
Flood Warning System	**X**	**X**
Floodplain Management and Zoning (NFIP)		**X**
Local Land Use Regulation and Zoning		**X**
Building Codes and Enforcement		**X**
Floodproofing	**X**	
Permanent Acquisition	**X**	
Purchase of Development Rights		**X**

Formulation of successful plans requires a cooperative effort between team members, stakeholders and project partners. Although implementation of certain identified measures within plans may be beyond the limits of the Corps' authority to implement, that does not restrict their inclusion in the formulated plans. Every opportunity to engage the abilities and authorities of our local partners and cooperating agencies in meeting project objectives should be explored. Since nonstructural measures normally include actions that can only be implemented within the statutory scope of local governments, the opportunities for formulating innovative plans abound.

Following the system of categorizing measures according to responsible entity, the nonstructural measures evaluated within this Study can be loosely grouped into two categories: those measures that are implementable by the Corps and could potentially be part of the "with project" recommended plan; and those measures that have greater implementation responsibility lying with the local jurisdiction, some of which may have already been, or are currently being, implemented by the City of Cedar Rapids. Those city implementable measures that were put into place prior to this study have also been reviewed for completeness and effectiveness. The nonstructural measures that are potentially implementable by the Corps have been evaluated using a benefit to cost ratio (BCR) in a similar manner as the structural measures. The costs for the nonstructural measures were derived by Stanley Consultants. The estimates provided by Stanley Consultants were then cross checked against historical (actual) costs provided by the Floodplain Manager for Rock Island County, Illinois. The cost estimates provided by Stanley were approximately equal to the historical costs in Rock Island County and were deemed appropriate for use by PDT Study members.

III. NONSTRUCTURAL ASSESSMENT FOR RESIDENTIAL STRUCTURES

As discussed previously, nonstructural measures that take direct action toward a specific structure, such as a residential home, have a high degree of specificity due to variables such as construction method and location within the floodplain. Evaluating individual structures would take a greater level of investigation than is possible within this phase of the Study. Therefore, in order to determine the feasibility of implementing the individual nonstructural measures on residential structures, the PDT selected four representative residential structures on which to perform a benefits cost analysis in four flood plain reaches: Reach 1 – Edgewood Neighborhood; Reach 2D – Czech Village; Reach 2B Time Check; and Reach 6 – Rompot (Cedar Valley).

The representative structures were selected based on the following criteria; elevation and flood frequency, structure value, and whether or not they had a basement. Each of the four, representative residential structures are situated at low elevations and therefore experience the highest frequency of flooding compared to other structures in the neighborhood. The representative structures also have a greater value than neighboring structures meaning that the potential for flood damage is greater, and, therefore, benefits from prevented flood damage are also greater. By choosing structures with a high frequency of flood inundation and high structure value, the worst case scenario in terms of potential flood damage is captured in each of the four reaches. In using representative structures with the highest potential damage, the team was able to analyze the BCR to determine if implementation of nonstructural measures on these structures was feasible. The benefits and costs of protecting to the 1 percent flood event were developed for each of the representative structures. If the BCR for these

representative structures was less than 1, it would be highly unlikely that structures with less potential damage, yet comparable costs for measure implementation, would be feasible either. Additionally, if the BCR for the representative structures was less than 1, than large-scale implementation of the nonstructural measure would also be unjustified using the BCR analysis. Damage information for each of the representative structures was collected from the HEC-FDA model, the same model used for assessment of the structural measures, and used in the Benefit to Cost analysis, resulting in a BCR (as displayed in table P-3). The structure number displayed in table P-3 is the identifier in the HEC-FDA model.

The remaining criterion for selecting the representative structures was whether or not the structure had a basement. An analysis of residential parcels in the Study area determined that 83 percent of the properties have basements. This is a factor in determining the feasibility of nonstructural measures because some nonstructural measures are not implementable on a structure with a basement. Of the four representative structures, three structures have a basement and one structure is on slab.

Single Structure Measures. Floodproofing is a very broad term that describes an array of building construction techniques that can be used to reduce flood damages to structures. These methods of protection can be applied to new building construction or can be applied to existing buildings commonly referred to as retrofitting.

Unlike permanent acquisition and evacuation, floodproofing measures result in the continuation of the structure's functions on-site in some modified condition so that normal functions of that structure or facility can continue (with post-flood cleanup) shortly after the conclusion of a flood event. Although this rebound capability is a plus for families and communities attempting to recover from a major flood event, the risks associated with the determination of appropriate levels of protection and both design and construction parameters are many. Full consideration of risks and uncertainty in establishing the appropriate level of protection and building design parameters is important in the formulation of the floodproofing measures.

Also important to floodproofing is a reliable and timely flood warning and emergency evacuation program so that residents of floodproofed structures can safely evacuate their protected structures. Generally speaking, occupants of floodproofed structures and facilities should not inhabit the building during a flood event.

Structures of different construction types (wood frame, masonry over frame or solid masonry), sizes, uses (residential, commercial, and institutional) and foundation types (slab, crawl space, or basement) can be floodproofed in one of several ways as described in the following paragraphs. Floodproofing is generally divided into two types: 1) wet floodproofing where water (floodwaters or clean water) is allowed to enter some portion of the structure temporarily without damages to the structural components of the building or the contents, and 2) dry floodproofing where no water enters any portion of the structure.

NS1 – Wet Floodproofing. This measure is applicable as either a stand alone measure or as a measure combined with another measure such as the elevation of structures which will be described in detail later in this section. As a stand alone measure, it is applied to a structure and/or its contents to

prevent damage from flooding by modifying the structure, relocating the contents, and allowing flood water to enter the structure with little or no damage. All construction materials and finishing materials need to be water resistant. All utilities must be elevated above the design flood elevation. This measure is generally not applicable to moderate or high velocity flows, i.e. greater than 3 fps. The District team received cost estimates from Stanley Consultants dated November 9, 2009 for wet floodproofing a residential structure with a basement and a residential structure without a basement. The cost estimate for implementing this measure on structures both with and without a basement was $36,000. A further benefit-cost analysis was conducted for this measure, and implementation was not feasible due to a resulting BCR of 0.13. Please see table P-3 for further information.

NS2 – Dry Flood Proofing. This measure is applied to a structure, or adjacent to a structure, to prevent entrance of flood waters by making the walls and floor watertight. This measure achieves flood risk reduction but it is not recognized by the National Floodplain Insurance Program (NFIP) for any flood insurance premium rate reduction if applied to residential structures. Based upon NFPC-sponsored tests at the Engineering Research and Development Center (ERDC), a "conventional" built structure can generally only be dry floodproofed up to 3 feet on the walls. A structural analysis of the wall strength would be required if it was desired to achieve higher protection. A sump pump is required and perhaps a French drain system is installed as part of the project. Closure panels are used at openings. This measure will not work effectively for floods with long durations. Additionally, this concept does not work for structures with basements, which is problematic for widespread implementation in Cedar Rapids because 83 percent of the residential structures have basements. The District received cost estimates from Stanley Consultants dated November 9, 2009 for dry floodproofing a residential structure without a basement (house on slab). The cost estimate was $39,000. A further benefit-cost analysis was not conducted for this measure because it was more costly than the other nonstructural measures which did not have a BCR above 1.0 and this provided no additional benefit. See table P-3 for further information.

NS3 – Elevation of Structures. This measure consists of raising damageable portions of the structure to be above a particular flood event via fill, extended foundation walls, piers, posts, or piles. In the metro area, probably the most acceptable elevation measure would be on extended foundation walls. Since most of the structures to elevate have basements under them, the concept would be to basically elevate the basement out of the ground. If the basement had been fully developed pre-elevation and could not be developed post elevation, compensation for the developed basement space would be in order to the owner. There may also be some limitations in implementing this measure for high velocity flows (those greater than 5 fps). The District received cost estimates from Stanley Consultants dated November 9, 2009 for the five options for raising a structure. The cost estimates per structure ranged from $24,000 to raise a house with a basement on extended foundation walls to $44,000 to raise a house with no basement on posts or columns. A further benefit-cost analysis was conducted for the least expensive measure, which was to raise a structure on extended foundation walls and determined that implementation of this measure was not feasible due to a resulting BCR of 0.37. See table P-3 for further information.

NS4 – Relocation of Structures. This measure entails moving the structure as part of the project and buying the land upon which the structure is located. This measure is most appropriate when structures can be relocated from a high flood hazard area to an area that is completely out of the

floodplain. Development of relocation sites where structures could be moved to achieve the planning objectives and retain such aspects as community tax base, neighborhood cohesion, etc. would be investigated as being part of any relocation project. The land that is vacated after the relocation of the structure can be converted to a new use such as ecosystem restoration and/or recreation that is open-space based, such as trails, canoe access, etc. Conversion of previously developed land to open space means that infrastructure is no longer needed (i.e. utilities, streets, sidewalks, etc.) and can be removed as part of the project. The conversion to a new use such as ecosystem restoration or recreation can also be part of the project. By incorporating new uses of the permanently evacuated floodplains into the nonstructural flood risk reduction project, economic feasibility of the buyout or relocation projects is enhanced due to transfer of some flood risk reduction costs to ecosystem restoration and by adding benefits (and costs) of recreation.

The District received cost estimates from Stanley Consultants dated November 9, 2009 for relocating a residential structure without a basement and a residential structure with a basement. The cost estimate for relocating a residential structure with a basement was $54,000. A further benefit-cost analysis was not conducted for this measure because the associated costs were more than the other nonstructural measures which did not have a BCR above 1.0 and this provided no additional benefit. The cost estimate for relocating a residential structure without a basement was $39,000. A benefit-cost analysis was not conducted for this measure because it was more costly than the other nonstructural measures which did not have a BCR above 1.0 and this provided no additional benefit. See table P-3 for further information.

NS5 – Single Structure Levee / Floodwalls: This measure entails the construction of gravity, cantilever, cellular, flat dam, buttress, and counterfort designs to keep flood water from reaching the single structure. The modeled affects of the erected levee or floodwall must indicate a 0.0 foot difference in the water surface elevation of the 100 year flood event. Generally, these levees or floodwalls do not exceed 5 to 6 feet in height. If the zero rise and height limitation are exceeded, this measure is then considered to be a structural FRM measure. Most often this measure is implemented at critical facilities and/or sites with the potential for a great amount of flood damage (such as a business with costly equipment and supplies), and where more extensive structural measures are not feasible. These nonstructural measures are intended to reduce the frequency of flooding, but not eliminate floodplain management and flood insurance. The District received cost estimates from Stanley Consultants dated November 9, 2009 for a floodwall and levee (both with and without a closure) for a residential structure with a basement and for a residential structure without a basement. The cost of implementation of these measures ranged from $140,000 to $181,000. A further benefit-cost analysis was not conducted for this measure because it was more costly than the other nonstructural measures which did not have a BCR above 1.0 and this provided no additional benefit.

Table P-3. Nonstructural Benefit-Cost Analysis

Structure Number	Structure Type	Estimated Annual Damages w/out Project	Estimated Annual Damages w/Project	Estimated Annual Benefits (w/out-Project – w/Project)	Annual Costs	Net Benefits (Benefits − Costs)	B/C Ratio (Benefits ÷ Costs)	Least Cost Measure
24734	residential w/basement	$667	$224	$443	$1,190	$(747)	0.37	raise structure on foundation
105250	residential w/ basement	$1,849	$340	$1,508	$1,785	$(276)	0.85	raise structure on foundation
27509	residential, no basement	$507	$281	$226	$1,785	$(1,559)	0.13	wet floodproofing
161577	residential w/ basement	$820	$464	$356	$1,190	$(833)	0.30	raise structure on foundation
108199	commercial	$2,959	$286	$2,673	$138,866	$(136,192)	0.02	dry floodproofing
24734	residential w/ basement	$667	$ -	$667	$4,958	$(4,291)	0.13	relocation
105250	residential w/ basement	$1,849	$ -	$1,849	$4,958	$(3,109)	0.37	relocation
27509	residential, no basement	$507	$ -	$507	$4,958	$(4,451)	0.10	relocation
161577	residential w/ basement	$820	$ -	$820	$4,958	$(4,138)	0.17	relocation
108199	commercial	$2,959	$ -	$2,959	$9,915	$(6,956)	0.30	relocation

IV. NONSTRUCTURAL ASSESSMENT OF COMMERCIAL STRUCTURES

The City is in the process of floodproofing the City Hall building on Mays Island. This structure was used as a proxy for floodproofing commercial structures within the floodplain. It was analyzed to determine if there would be a Federal interest in floodproofing commercial structures within the floodplain. This building was chosen because cost data for floodproofing the City Hall had already been developed. A benefit-cost analysis was conducted for this measure and determined that implementation of this measure was not feasible due to a resulting BCR of 0.02. Based on this, it was assumed that floodproofing the commercial structures in the floodplain would be infeasible.

V. NONSTRUCTURAL ASSESSMENT OF CRITICAL FACILITIES

Within the City of Cedar Rapids, there are structures/facilities which should never be flooded due to the nature of their use and/or contents. Executive Order 11988 describes these facilities as critical facilities. There are two types of critical facilities: 1) Those facilities which are essential during a flood to provide for human safety, health and welfare, or 2) facilities that could, if flooded, add to the severity of the disaster such as petroleum terminals, waste water treatment plants, toxic material storage sites. Critical facilities of the first type are generally centers for services that are required during a flood event such as police and fire protection, emergency operations, shelter sites, and medical care. However, facilities that house elderly people or otherwise require extensive evacuation time would also be considered critical. All critical facilities should be located external to the 500-year floodplain. If this is not possible or practicable, the facility must be, at a minimum, protected to the extent that it can function as intended during all floods up to and equal to a 500-year event. Figure P-2 shows critical facilities in the Cedar Rapids area.

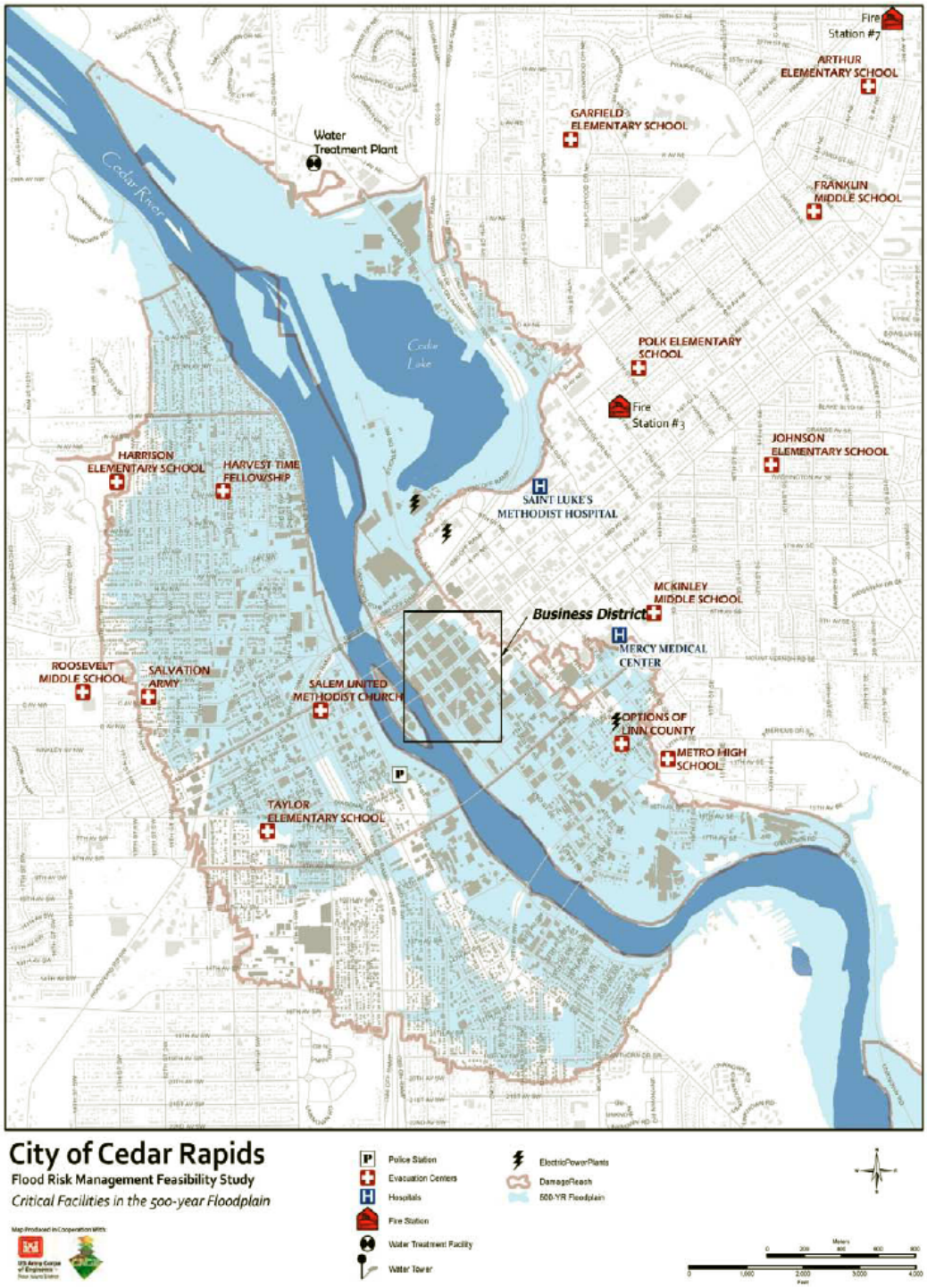

Figure P-2 Critical Facilities in the Cedar Rapids Area

VI. NONSTRUCTURAL ASSESSMENT FOR BROAD BASED IMPLEMENTATION

The ability of a flood risk/flood damage reduction project to achieve the objectives must be considered not just for the short term but also for the long term. Nonstructural measures are most advantageous over structural measures especially for the long term if full unbiased consideration is given to operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) costs not just for the economic life of the project which is normally 50 years, but for the ability of the project to provide the desired level of flood risk reduction for as long as the damage center exists, which is in perpetuity. Within the context of nonstructural measures, measures that can be implemented in the short term by the District in partnership with the City will be considered. However, measures that may require intermediate terms and long terms for implementation should also be identified at least in concept and incorporated into each community's floodplain management plan for development and implementation as opportunities become available.

The ability of nonstructural measures to be implemented in very small increments, each increment producing flood risk reduction benefits, and the ability to initiate and close a nonstructural program with relatively minimal costs are important characteristics of this form of flood risk reduction. Also important is the ability to implement measures over intermediate and long periods such that layering of measures, each one providing a higher degree of risk reduction, is possible and given both Federal and non-Federal funding constraints probable.

A. Flood Warning and Flood Preparedness. Flood preparedness includes a multitude of management activities and features that all contribute to a reduction of flood damages and reduced losses of life due to flood events. These management activities can apply to the emergency operations of Federal, state, and local agencies as well as to the response actions of individual property owners.

Generally speaking, flood warnings and emergency evacuations fall under the purview of the National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA) that includes offices at state and local levels of planning and deployment. Although the Corps of Engineers is not a direct player in these types of flood damage reduction components, the Corps does support these activities as an important part of reducing flood damages and reducing losses of life.

1. NS7 – Flood Warning System. A flood warning system is an emergency alert system whereby local, regional, or national authorities can contact members of the public en masse to warn them of an impending flood event. The system generally includes a means of forecasting river levels and therefore flood events in the near term, which allows the communication component to be implemented in a timely manner as to allow the public additional time to prepare and/or evacuate the area. The development of such plans and the installation of pertinent equipment such as data gathering devices (rain gauges, river gauges), data processing equipment (computer hardware and software), and communication devices (cellular and land lines, public broadcast advisories, siren systems, etc.) can be part of the project. Design of a detailed flood warning system involves an in-depth hydrologic model of the watershed, which determines specific alert stages at various locations.

The Corps evaluates flood warning systems used to operate Federal Projects and operated as independent systems by the local sponsor when no project is justified. Flood warning systems that stand alone do not reduce the risk of damage to structures within the floodplain. But the system can reduce the risk to life and, if property is easily transportable, it can reduce the damage potential.

During periods of raising river stages and frequent rainfall, Cedar Rapids along with other cities on the Cedar River can access forecasts of predicted crests from the National Weather Service (NWS). The city can also monitor the river stage USGS gage at Cedar Rapids and together with a Flood Response Manual initiate various response actions corresponding to various stages. The manual and links to the USGS gage at Cedar Rapids and to the NWS forecasts appear on the city website (http://www.cedar-rapids.org/engineering/).

In 2008 the Waterloo gage (05464000) was the nearest automated gage upstream of Cedar Rapids on the Cedar River. The travel time between these two points is about 2 days. As of March 2009 two automated USGS stream gages have been added in the reach between Waterloo and Cedar Rapids. One gage is located at Vinton (05464315) and the other is at Blairs Ferry Road at Palo (054464420) as shown in figure P-3. These new gages will provide improvements in forecasting flood heights at Cedar Rapids due to flash floods between Waterloo and Cedar Rapids. In view of these additions, relying upon the NWS appears to be the more practical and cost effective than developing and operating an independent network of gauges for a flood warning system.

Following the 2008 flood, the Iowa Flood Center also studied the Cedar River (www.iowafloodcenter.org). One goal of the Iowa Flood Center project is to create a static library of flood inundation maps to more effectively communicate flood impacts to the public. Each map would correspond to a regular stage interval at a nearby stream gage. This would allow the public to visualize the extent and severity of flooding associated with NWS forecasts for that gage. The NWS publishes this information on the Advanced Hydrologic Prediction Service (AHPS) website. Funding for these modeling efforts comes from the Iowa Flood Center. Some of this work may also be beneficial for Cedar Rapids.

Tables P-4 and P-5 provide additional information about the basin. The five NWS rainfall gages listed in table P-4 are in or near the Cedar River Basin between Waterloo and Cedar Rapids.

The drainage area of the Cedar River between Waterloo and Cedar Rapids is 1,364 square miles. The 24 tributaries listed in table P-4 drain about 80 percent of this area. As can be seen, except for Wolf Creek which has a gage, most of the tributaries are small.

One of the most important factors in being able to successfully and safely evacuate a floodplain is allowing sufficient time between flood forecasts and fully disseminating the warning to those in the floodplain. Reverse 911 systems that generate phone calls to homes and businesses in selected areas that are correlated to the current emergency evacuations plans would be an effective way of issuing storm warnings or evacuation orders. In addition, these same systems could use cell phone technology (voicemail, text messaging, paging, etc.) to contact individuals with that service. In either case, such notification systems could be effective in issuing evacuation orders and may decrease the chances for loss of life and property damage. Other warning dissemination methods should be explored that would address physically and mentally disadvantaged populations in the region as well.

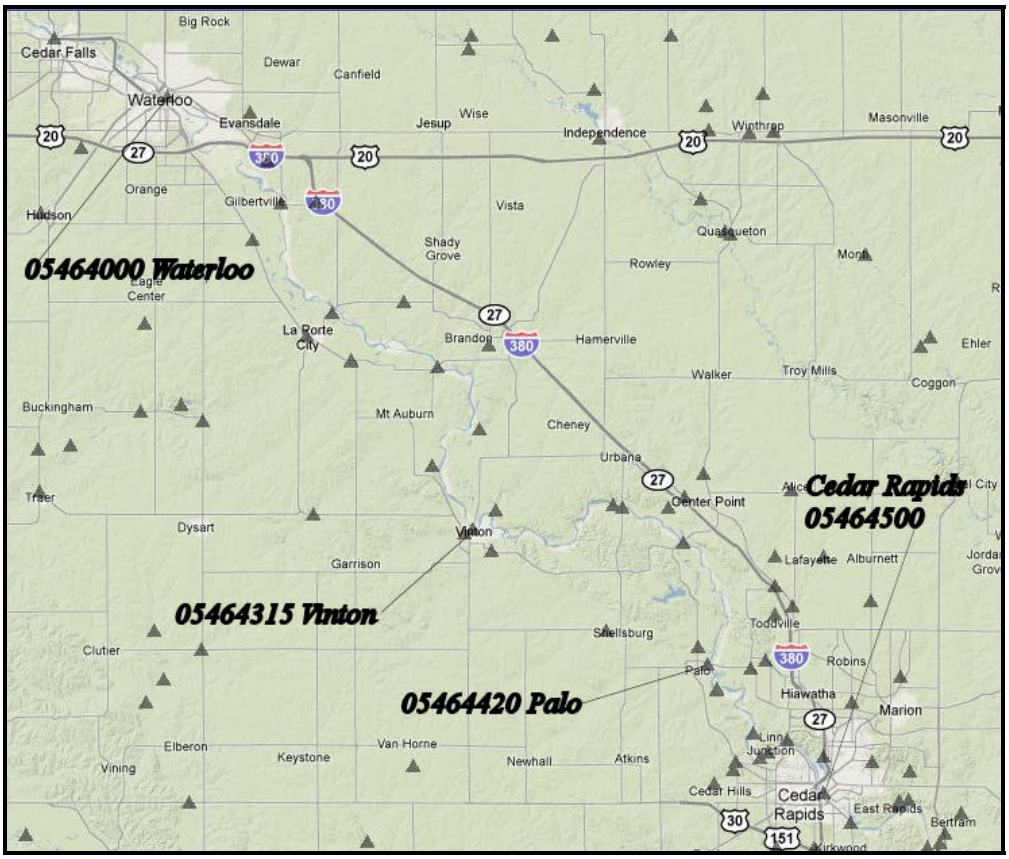

Figure P-3. Cedar River Gages Between Waterloo and Cedar Rapids

Table P-4. NWS Rainfall Gages Upstream of Cedar Rapids

Number	Description	Degree Latitude	Minute Latitude	Degree Longitude	Minute Longitude	Start Year	End Year
131314	Cedar_Rapids_Ap	41	52	91	42	1953	2007
131319	Cedar_Rapids_1	42	2	91	35	1892	2007
131704	Clutier	42	5	92	24	1973	2007
134049	Independence_2nne	42	28	91	52	1955	2007
138706	Waterloo_Municipal_Ap	42	32	92	24	1950	2007

Table P-5. Tributaries Between Waterloo and Cedar Rapids

Tributary Entering	Tributary Drainage Area (sq. miles)	Cedar River Drainage Area (sq. miles)
USGS Waterloo		**5146 *(05464000)***
Elk Run at mouth	37.40	5203
Sink Creek at mouth	8.25	
Poyner Creek at mouth	17.30	
Indian Creek at mouth	23.20	
Millers Creek at mouth	67.20	5327
Mud Creek at mouth	14.10	
Big Slough at mouth	6.94	
Wolf Creek at mouth *(05464220 299 sq mi)*	328.00	5683
Rock Creek at mouth	38.40	
Spring Creek at mouth	60.90	5794
Spring Creek 2 at mouth	14.00	
Black Hawk Co/ Benton Co line		5814
Lime Creek at mouth	41.90	
Bear Creek at mouth	61.30	5940
Pratt Creek at mouth	49.90	
Hinkle Creek at mouth	30.40	
USGS Vinton		**6040 *(05464315)***
Prairie Creek at mouth	20.20	6062
Mud Creek at mouth	45.30	
Blue Creek at mouth	63.00	6206
Spring Creek at mouth	6.65	
Nelson Creek at mouth	7.52	
Opossum Creek at mouth	98.60	6342 (*05464420)*
Dry Creek at mouth	27.30	
Lone Tree Creek at mouth	5.85	
Morgan Creek at mouth	27.00	6486
USGS Cedar Rapids		**6510 *(05464500)***

Despite the various forms of media (i.e. television, radio, internet, cell phones, broadband, etc.) available to the population within the project area, there is no guarantee that individuals would have access to the media, that the media systems would be functional at critical times, or that individuals would be aware of impending flood threats. For this reason, other less sophisticated systems should be in place that would provide unmistakable evidence that there is an impending threat of flooding.

As a nonstructural measure, a system of sirens located across the project area could provide an emergency signal whose message would be unmistakable given sufficient education of the population of the purpose and meaning of the sirens' use. Mounted on wind-resistant poles located at intersections and serviced with underground power, the sirens could be used in conjunction with other media and communication systems to alert the population to the coming threats. For the hearing

impaired, flashing strobe lights could also be installed in neighborhoods so that all segments of the population could be notified of impending danger.

Warning sirens installed on a pole mount range in costs from $15,000 to $25,000 depending upon the anticipated coverage area and required pole height. Battery backup systems are available for a similar price range. Costs include the siren, pole, and wiring plus installation costs. Annual O&M costs are approximately $500 per siren. Flashing strobe lights range in costs from $250 to $500 installed depending upon the wattage and mounting location. Annual O&M costs for the flashing lights would be contingent upon instances of vandalism and theft and would be limited to purchase of a new strobe light and its installation. *(Costs for this measure were taken from the Mississippi Coastal Improvements Program (MsCIP) Appendix D Non Structural Report dated June 2009.)*

The NWS is an agency under the National Oceanic and Atmospheric Administration (NOAA) and the Department of Commerce. The NWS provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. National Weather Service data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community.

There are more than 120 NWS Weather Forecast Offices (WFO) located throughout the United States with a nationwide network of over 900 radio stations broadcasting continuous weather information directly from a nearby NWS office. Each local WFO is responsible for issuing forecasts and warnings 24 hours a day and coordinating with partners and customers within their local service area.

The City of Cedar Rapids is within the WFO Quad Cities' area of responsibility. The WFO Quad Cities Internet page features a wealth of information to provide a quick assessment of current weather at a glance, links to local forecast and hazardous weather information, radar images, and weather headlines. Also accessible are details on NOAA All Hazards Radio.

NOAA Weather Radio All Hazards is the smoke detector of severe weather including flooding events. As the voice of the National Weather Service, it provides continuous broadcasts of the latest weather information. Digitally recorded weather messages are repeated every 3 to 5 minutes and are routinely revised at least every hour to cover changing weather conditions. NOAA All Hazards Radio operates on a 24/7 basis, with the format tailored to the needs of the people within the listening area. During severe weather, the NWS preempts the routine weather broadcast and substitutes warning messages. NOAA Weather Radio All Hazards is the single source for the most comprehensive weather and emergency information available to the public. Commercial radio and TV stations are authorized to rebroadcast all material transmitted over NOAA radio, subject only to minimal restrictions.

Seven frequencies are reserved for NOAA All Hazards Radio. A specially designed radio or scanner is needed to receive the broadcast. The broadcast frequency for the Cedar Rapids area is 162.475MHz. The broadcast can be heard as far away as 40 miles from the antenna site, sometimes more.
The special radio receivers or scanners that pick up the NWR information can be purchased from the NWS or many other commercial outlets. For the hearing or sight impaired population, these alert systems can be connected to other alarm systems (flashing lights, sirens, etc.) in the home or business.

Standard NWS receivers cost approximately $80 and could be purchased in bulk for distribution to identified sectors of the project area population that would be at risk and lacking the resources to purchase the radios. A significant number of those needing these resources could be addressed with a modest project investment at the current unit price. Annual O&M costs would be limited to battery replacements unless rechargeable batteries are chosen (with a slight increase in purchase price).

The City of Cedar Rapids currently operates an NWS radio receiver that picks up all weather alerts being broadcast on the NOAA All Hazards Radio. This receiver is located in the City's Public Works Department. Once the City receives a flood warning alert from the NWS (based upon available forecasting information, including the previously discussed river gauges), the City begins the process of disseminating the alert information to the general public. This process includes public notification via press releases and conferences (disseminated via radio, television, and newspaper media), the City's website, twitter, and door-to-door visits by the police and fire departments.

The ability of emergency services agencies to quickly and decisively issue credible warning is a key element in an effective flood warning system. Because the City currently has an effective flood warning system in place, this measure will not be carried forward into more detailed formulation.

2. NS8 – Flood Response Plan. The Flood Response Plan is a nonstructural approach to reducing flood-related damages and recovering during the aftermath. An action plan is developed identifying steps to be initiated prior to, during, and after a flood event allowing the City to effectively respond to the event. The combination of a Flood Response Plan and a Flood Warning System will not prevent flood disasters; however, it will enable institutional and emergency flood response activities to be conducted efficiently.

The City has prepared a Flood Response Manual (Manual) which was last updated in March 2010. The Manual outlines the appropriate City staff responses to flooding of the Cedar River. City staff personnel are to use the flood response maps and corresponding task lists included in the Manual to complete activities at various flood stage(s) as forecasted by NWS. The City updates its Manual annually and publishes it prior to March 1 of each year. The Manual is updated to incorporate changes in operations and resources and an improved understanding of the flood response system obtained through GIS-based analysis of the system. The Manual provides the following information:

- Activities and tasks including street closings, valve closing, pipe plugging, temporary levee construction, and other tasks to be undertaken at each stage of the City up to the 20-ft flood level
- Contact information for City supervisors and managers with flood-related responsibilities
- Contact information for flood response contractors and suppliers
- Contact information for non-City governmental agencies with potential involvement in flood response
- Contact information for major utility providers and local businesses
- Clear definition of formal lines of communication and responsibility
- Stream monitoring locations and procedures
- Location of the NWS flood forecast information
- Sandbag pump and plug inventory information

- Roadways closures in the event of high water
- Source of roadway barricades and signage
- Areas where sandbag levees may be required
- Traffic control procedures

After reviewing the flood response manual, it is suggested that information on the following topics be gathered and placed in an easily accessible area for flood response, either within the manual itself or in another location that is referenced in the manual:

- Procedures to disseminate flood warnings and updates
- Search and rescue procedures
- All locations requiring evacuation
- Location of the emergency command center with pre-positioned supplies and equipment
- Provisions for fire protection and ambulance services
- Procedures to disconnect utilities
- Identification of mass care centers
- Identification of emergency shelters
- Identification of sources of food, water, and bedding
- Procedures for filling sandbags and safety precautions
- Training programs for emergency responders
- Periodic drills, equipment testing, maintenance, and desktop exercises
- Procedures to reoccupy evacuated areas
- Preparation of an After Action Report and revision of the Flood Response Manual as required

In the event that a FRM project is constructed in the City of Cedar Rapids, the Flood Response Manual will be modified as part of the routine, annual-updating process to include any additional flood response activities that will need to be conducted as a result of the project, i.e. procedures for engaging any closure structures that have been constructed as part of the project. Those flood response activities will be detailed in the Operations & Maintenance manual that will be provided to the City upon project completion and can, therefore, also be incorporated into the City's Flood Response Manual Plan update.

Since a Flood Response Manual is already developed and updated as a routine activity conducted by the City, this nonstructural measure will not be carried into more detailed formulation.

B. Evacuation Planning and Public Education. Once the threat of an approaching storm has been determined by the NWS, specific steps can be taken by local communities and emergency services personnel to begin evacuating those families and individuals and their movable contents to safe areas.

During an emergency evacuation situation, identified evacuation routes are critical to assuring that those families and individuals that are at risk in identified evacuation zones can safely and efficiently leave the danger zone(s) and seek shelter in designated areas. Table P-6 shows a listing of designated shelters in the City of Cedar Rapids along with their capacities, addresses, and phone numbers.

Table P-6. Emergency Shelters in Cedar Rapids, IA

Shelter Name	Evacuation Capacity	Post Impact Capacity	Address	Phone
Polk Elementary School	178	89	1500 B Avenue NE	319-558-2475
Options of Linn County	150	75	1019 7th Street SE	319-892-5800
Prairie High School	1,126	563	401 76th Ave SW	319-848-5200
Prairie Middle School	664	332	401 76th Ave SW	319-848-5200
Prairie View Elementary	328	164	401 76th Ave SW	319-844-5200
Salem United Methodist Church	267	133	225 1st Ave SW	319-362-6178
Hus Memorial Presbyterian Church	147	73	2808 Schaeffer Dr SW	319-363-0067
Metro High School	227	113	1212 7th Street SE	
Christ Episcopal Church	89	44	220 40th St NE	319-365-2029
Prairie Heights Elementary	240	120	401 76th Ave SW	319-848-5200
Arthur Elementary School	150	75	2630 B Avenue NE	319-558-2000
Cleveland Elementary School	283	141	2200 1st Avenue NW	319-558-2463
Coolidge Elementary School	322	161	6225 1st Avenue SW	319-558-2167
Erskine Elementary School	382	191	600 36th Street SE	319-558-2364
Garfield Elementary School	232	116	1201 Maplewood Drive NE	319-558-2169
Viola Gibson Elementary School	225	112	6101 Gibson Drive NE	319-558-2920
Grant Elementary School	190	95	254 Outlook Drive SW	319-558-2020
Grant Wood Elementary School	241	120	645 26th Street SE	319-558-2467
Harrison Elementary School	225	112	1310 11th Street NW	319-558-2269
Hoover Elementary School	264	132	4141 Johnson Avenue NW	319-558-2369
Jackson Elementary School	158	79	1300 38th Street NW	319-558-2471
Johnson Elementary School	99	49	355 18th Street SE	319-558-2174
Kenwood Elementary School	230	115	3700 E Avenue NE	319-558-2273
Madison Elementary School	233	116	1341 Woodside Drive NW	319-558-2473
Monroe Elementary School	120	60	3200 Pioneer Avenue SE	319-558-2176
Hus Memorial Presbyterian Church	251	125	2808 Schaeffer Dr SW	319-558-2373
Taylor Elementary School	237	118	720 7th Avenue SW	319-558-2477
Truman Elementary School	200	100	441 West Post Road NW	319-558-2375
Van Buren Elementary School	242	121	2525 29th Street	319-558-2377
Wright Elementary School	176	88	1524 Hollywood Blvd NE	319-558-2278
Franklin Middle School	694	347	300 20th Street NE	319-558-2278
Harding Middle School	200	100	4801 Golf Street NE	319-558-2254
McKinley Middle School	738	369	620 10th Street SE	319-558-2348
Roosevelt Middle School	408	204	300 13th Street NW	319-558-2153
Taft Middle School	425	212	5200 E Avenue NW	319-558-2243
Wilson School	801	400	2301 J Street	319-558-2156
Jefferson High School	15,634	7,817	1243 20th Street SW	319-558-2435
Kennedy High School	1,323	661	4545 Wenig Road NE	319-558-2251
Washington High School	1,425	712	2205 Forest Drive SE	319-558-2161
Salvation Army	200	100	1000 C Ave NW	319-364-9131
Harvest Time Fellowship	60	30	1300 6th NW	
Cedar Hills Community Church	1,262	631	6455 E Ave. NW	319-396-6608
New Creation Church	0	0	3715 33rd Avenue SW	319-396-4366
Viola Gibson Elementary School	225	112	6101 Gibson Drive NE	319-558-2920

In addition, the evacuation routes should provide efficient routes for evacuation of people by buses or other transit vehicles that may not have access to personal vehicles. Generally the routes are streets, arterial roadways and highways designated by the county emergency services agencies in cooperation with the State Department of Highways, in this case, the Iowa Department of Transportation.

1. NS9 – Evacuation Route Mapping and Signage: As important as selecting safe and efficient evacuation routes is the signage of the selected routes such that citizens can quickly identify the appropriate routes and be assured that they are still on an approved route as they travel away from the floodplain. Costs for the signs range from $250 to $350 installed depending upon the number produces and the installation methods used. Annual O&M costs for the signage are limited to replacement of a percentage of signs due to vandalism or theft.

In addition to the standard metal post signs, other types of signage can be installed that would provide fleeing motorists with information on traffic accidents, available shelters and other important information. Dynamic information signs that flash messages to approaching motorists can be installed along major evacuation routes at strategic locations. Installation options range from smaller pole-mounted roadside signs to multi-lane towers that span 3 to 4 lanes of traffic. Costs for these installations range from $100,000 (roadside) to $400,000 (multi-lane tower) and annual O&M costs range from $4,000 to $7,000 for the messaging board itself. These signs could be located along the main evacuation routes to convey up-to-date emergency information to motorists. *(Costs for this measure were taken from the Mississippi Coastal Improvements Program (MsCIP) Appendix D Non Structural Report dated June 2009.)*

Since all of these measures contribute to that system's effectiveness, all of them are carried forward into more detailed formulation.

2. NS10 – Community Flood Response Education: This measure includes programs, activities, and information dissemination designed to engage residents and raise awareness of potential flood risk to life and property.

One of the most important features of any emergency evacuation plan is the education of both the emergency personnel responsible who will be implementing emergency plan(s) and the citizens who must respond to the emergency evacuation orders posted by local authorities. Regardless of the amount or quality of pre-emergency planning and preparation accomplished prior to a flood event, the consistently unknown element remains the reactions/responses of the at-risk population when mandatory or voluntary evacuation orders are issued. Reducing the potential loss of life and injuries to the evacuees depends largely upon the population's understanding of the threat and what appropriate responses to that threat will be effective for each household or individual. Knowing where evacuation routes and safe evacuation centers are located can make the difference between safety and tragedy.

In order to better equip the at-risk population, a series of training and information seminars, media presentations, and other public forums assisted with easy-to-read and understand materials could be implemented as a nonstructural measure. Information on these emergency subjects can be placed in libraries, community centers, hotels and motels, managed-care facilities, hospitals, banks, credit

unions, and post offices. Applicable web addresses, phone numbers, radio station frequencies, and emergency evacuation routes could be stressed in this public information. The costs of these materials would be minimal since they are already available through Federal and state agencies. Training and information seminars could be hosted by various agencies and organizations at minimal costs.

In addition to educating and training the general population, the most effective education strategy for the area's future would be at the elementary, middle, and high school education levels. Education materials including textbooks, coloring books, workbooks, posters, computer programs, and role-playing games could be distributed throughout the school systems to increase the awareness and understanding of all school-aged children (in a non-threatening way) about flooding and appropriate emergency responses to flood events. Generally, parents of children made aware of threats at school seem to respond in a more affective and positive way out of concern for their children's safety. Additional resources available through FEMA for children can be found at: http://www.fema.gov/kids.

Obviously, this education process cannot be a one-time affair as new residents move into the area over time, and emergency personnel change jobs, retire or move elsewhere. At minimum, annual emergency drills and testing of the warning system(s) are the measures that assure quick and affective response to these flood events. Education at all levels (elementary through elderly) is important to assure public safety.

Each state designates a Severe Weather Awareness Week in March annually to educate the community about severe weather hazards. The week is an opportunity for schools, businesses, individuals, and organizations to review their severe weather action plans. As a partner in the important functions, the NWS broadcasts weather safety information on NOAA All Hazards Radio during March. These practice warnings not only test the technical warning system, but also are an ideal opportunity for people to practice their own severe weather plans, whether at home, at work, or at school.

C. Floodplain Management, Floodplain Zoning, Flood Insurance and CRS. Floodplain management through the auspices of FEMA is one nonstructural measure that has proven to be very effective in reducing damages to structures and losses of life. Generally, floodplain management does little to reduce damages to structures grandfathered in their present at-risk location at the time of enactment of the required ordinance, but the awareness that the delineation of the flood hazard zone has upon at-risk residents may lead to retrofits of the structure under existing programs or other measures that can reduce damages or loss of life.

1. NS11 – Floodplain Management Plan. A Flood Plain Management Plan (FPMP) is required of the Corps' non-Federal project sponsor. If there is a Federal FRM project, the non-Federal sponsor must prepare an FPMP within 1 year of signing the Project Partnership Agreement and the plan must be implemented within 1 year of project completion. The intent of an FPMP is to "protect" the Corps' partnered project from having the frequency of flood risk reduction provided by the project from being diminished. This is a non-Federal sponsor required activity, but, if done during the feasibility phase of the Study, can be cost shared on the same basis as the Study. This makes sense for the local sponsor from not only the cost share perspective, but also from the holistic flood risk reduction perspective. This latter perspective makes sense for the Corps as well. By integrating the FPMP with the Study, both the FPMP and the ultimate project are more effective. An FPMP often contains floodplain

management ordinances, which are laws enacted by a municipal body to regulate land use in the floodplain.

The City of Cedar Rapids has floodplain management ordinance (Chapter 32B) that serves as the floodplain management plan and regulates all lands and uses that have significant flood hazards. The Flood Boundary and Floodway Map and the Flood Insurance Rate Map (FIRM) dated December 15, 1982, are used to identify flood hazard areas which are considered to be the areas within the boundaries of the 100-year flood. The Ordinance states that for all new or substantially improved residential structures, the lowest floor, including the basement, would be elevated a minimum of 1 foot above the 100-year level. For all new or substantially improved non-residential buildings, the first floor, including the basement, would be elevated a minimum of 1 foot above the 100-year flood level, or together with attendant utility and sanitary systems, be floodproofed to such as level. When floodproofing is utilized, a professional engineer registered in the State of Iowa would certify that the floodproofing methods used are adequate to withstand the flood depths, pressures, velocities, impact and uplift forces, and other factors associated with the 100-year flood. Any part of the structure below the 100-year flood level must be watertight with the walls substantially impermeable to the passage of water.

The City is currently undergoing to review of their floodplain management ordinance to determine if modifications to the existing standards should be effected. However, the City does not have a comprehensive floodplain management plan developed at this time. Much of the information necessary to develop a floodplain management plan is readily available, but will need to be compiled in such a way as to meet the current floodplain management plan guidelines. The development of a comprehensive floodplain management plan is part of the tentatively selected plan.

2. NS12 – Flood Insurance. Although not an effective method of reducing flood damages or reducing losses of life, flood insurance is an effective way of reducing the financial impacts of flood damages to landowners and public entities. Uninsured landowners are placed in a difficult financial position regarding repair and re-occupancy of the structure and the community is impacted by loss of property value (reduces property tax revenues over time) and potential loss of business taxes.

In most cases, new home construction and occupancy is financed by a mortgage from one of a number of various financial institutions (banks, credit union, etc.). Under Federal law, new homeowners of structures determined to be within a flood hazard zone are required to secure flood insurance to protect the investment of the financing institution. Failure by the financial institution to assure the purchase of flood insurance for the new structure exposes that company to severe financial penalties. For this reason, most new home and business construction found to be in a flood hazard zone is covered by flood insurance. However, in certain circumstances where a mortgage is not required to construct the building, this flood insurance step may be circumvented by the landowner.

In addition to the financial necessity of acquiring flood insurance, all county and municipal areas that participate in the NFIP would require a floodplain permit for any structure placed or constructed in an identified flood hazard zone. That permitting requirement would normally trigger the requirement for purchasing flood insurance by the building owner.

In some areas, either dated flood hazard mapping or the lack of sufficient mapping results in new structures being placed or constructed in heretofore unidentified flood hazard zones. These structures, located in ignorance of the hazard, remain unprotected by insurance or appropriate building methods commonly used in flood hazard zones. This problem could be reduced by updating the flood insurance rate mapping in previously unmapped areas, but funds for the FEMA-supported process are limited.

Mandating flood insurance for all structures located within an identified flood zone would reduce financial losses to landowners and other charitable organizations that frequently shoulder the financial losses due to flooding. However, merely having flood insurance coverage does not in and of itself reduce flood damages or the chances of loss of life. Since the objectives of the project are to reduce flood damages, not just to recover the financial losses due to flooding, mandating flood insurance coverage on all structures is not carried into the detailed formulation process.

3. NS13 – Community Rating System: The NFIP Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Application of the incentive activities by the community results in discounts on flood insurance premiums for all insurance holders to reflect the reduced flood risk resulting from the community's actions meeting the three goals of the CRS:

- Reduce Flood Losses
- Facilitate Accurate Insurance Rating
- Promote The Awareness of Flood Insurance

The rating system ranges from 10 (lowest ranking and a 0 percent discount on premiums) to 1 (highest ranking a 45 percent discount on premiums). The incentive activities are grouped into four categories including; 1) Public Information; 2) Mapping and Regulation; 3) Flood Damage Reduction; and 4) Flood Preparedness. As a community implements incentive activities from one or more of these categories in their community, all participating landowners receive greater insurance premium discounts.

Besides the benefit of reduced insurance rates, CRS floodplain management activities enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering and protect the environment. Participating in the CRS provides an incentive to maintain and improve a community's floodplain management program over the years.

The City of Cedar Rapids is currently engaged in the application process to qualify as a participant of the CRS. Before Cedar Rapids will be considered as a candidate community for the CRS program, the following specific events must occur;

- Determine that Cedar Rapids has a minimum of 500 credit points, which are awarded based on the amount of community floodplain activity in the City and related to the amount of premium discounts that are gained by the City,
- obtain a letter of compliance from FEMA, and
- meet prerequisite requirements for repetitive flood loss properties.

The City has contracted with Stanley Consultants to gather the information required to begin the CRS Application completion process. Stanley Consultants summarized the CRS, interviewed city staff to determine activities the City is presently conducting, gathered documentation for activity credit and determined/described areas where additional activities may be conducted by the City.

According to Stanley Consultants, the activities in which the City currently shows strength are those that include additional flood studies, city regulations, and ordinances for storm water and land development. At a lower level of potential points gained, the City has a well maintained GIS system and a Flood Response Plan (described above) that will gain points also. The areas where the City will have opportunities to become stronger and gain more credit points are the activities that include converting floodplain parcels into open space. The process of land acquisition after the Flood of 2008 is still being conducted. After the parcels have been acquired, maintaining them in open space through deed restriction or ordinance will gain additional points.

Implementation of several of the identified nonstructural measures would significantly increase Cedar Rapids' ratings and further reduce their insurance premiums. Costs for entering the CRS and complying with the requirements are minimal and local. Because advancement of this nonstructural measure is already being carried out by the City, this measure will not be carried into more detailed formulation.

4. NS14 – Land Use Regulation and Zoning. Land use regulation, more commonly referred to as zoning, is a measure frequently used by local entities to arrange and regulate various uses within their jurisdiction. Enactment and enforcement of land use zoning helps to avoid conflicts between uses (i.e. industrial and residential), reduce traffic congestion, maintain property values, and promotes other social, economic and environmental objectives.

Floodplain zoning, which can be viewed as a distinct overlay zone applied to a standard land use zoning map, was established and is regulated by the NFIP under FEMA. Under the floodplain zoning program, municipal and county governments can establish flood hazard zones along the river according to an analyses of the flood hazard by FEMA. The Flood Insurance Rate Map (FIRM) established for a municipal or county area indicates various levels of flooding, the regulatory floodway, and elevations of the various flood events. The availability and cost of federally-subsidized flood insurance to the landowner are based upon this hydraulic data.

Generally speaking, land use zoning or rezoning as a measure for reducing damages is largely ineffective in many cases because of the amount of existing at-risk development that has been "grandfathered" into the zoning ordinance at the time of its enactment. These "non-conforming uses" cannot be totally removed through the zoning ordinance process unless they are destroyed (declared unsuitable for occupancy or a hazard) and then reconstruction is possible so long as the covenants on the property would constitute a taking and require compensation of its value to the landowner. Only in the application of floodplain zoning and then only in the case of the regulatory floodway can such absolute redevelopment restrictions be upheld in courts.

In areas where no development has taken place (interspersed vacant land) or where development has been largely removed (total loss areas), zoning or rezoning of the property could accomplish several

objectives. Property devoid of structures only retains its basic land value as dictated by market forces. That land value is influenced to some extent by the floods that may endanger any development that would be constructed on the property. In the case of the Study area, there are numbers of privately-owned tracts where the structure has been totally destroyed leaving only a concrete slab or wood pilings from the previous foundation. In these cases, rezoning the property for other land uses more adaptable to and compatible with the flood hazards may indeed accomplish several program objectives.

Costs for changes to zoning ordinances are local, administrative and minimal in nature compared to other alternative measures. Normally, municipal or county planning or engineering staff personnel, or planning commission or zoning board members administer zoning action reviews (variances, meetings, reviews, etc.).

The City currently utilizes land use zoning to regulate uses of the floodplain. If a FRM project is constructed by the Corps, the City is required to develop a Floodplain Management Plan (as described under NS11 – Floodplain Management Plan). Any necessary changes to the currently utilized land use zoning regulations would be further evaluated as part of the FPMP development, which is part of the tentatively selected plan.

5. NS15 – Building Codes. Like land use zoning, the adoption and enforcement of building codes is a police power of local governments enabled by state legislation. Building codes normally are limited to structure design, construction methods, and materials selection to meet building use requirements and both environmental and weather conditions at the building site. Structure foundations, structural integrity, site grading to promote positive drainage, and utilities are all part of a comprehensive building code. Provisions for addressing flood-prone locations in the design and construction of structure foundations are an important feature of a well-prepared code and make its use in the floodplain imperative.

The City has adopted the International Building Code (IBC), 2006 Edition and the International Residential Building Code (IRC), 2006 Edition as published by the International Code Council, Inc. However, the City has elected to modify the IBC by adding, deleting, modifying, or amending various sections of the standardized code (Municipal Code, Chapter 33). One such section that has been deleted pertains to Flood Resistant Construction. Municipal Code Chapter 33.25 states:

> *"The Cedar Rapids Building Code is hereby amended by modifying Section R323 of the IRC by deleting the section as follows: Section R323: Delete in its entirety."*

The costs for upgrading building codes are confined to purchasing the new codes from the International Code Council or other sources and administrative and legal costs for incorporating the codes into the existing municipal ordinances. Annual O&M costs for this measure are administrative (enforcement and variances) and local. Since local jurisdictions can charge fees for building permits, their costs to update and maintain the IBC and perform inspections of construction can be recovered.

The revision of existing building codes is a relatively inexpensive method of assuring that new construction, building additions or rehabilitation will be constructed in such a manner as to significantly reduce flood and wind damages to structures in the project area. Because the City

currently utilizes internationally recognized building code standards, this measure will not be carried forward into more detailed formulation. If an FRM project is constructed by the Corps, the City is required to develop a Floodplain Management Plan (as described under NS11 – Floodplain Management Plan). Any necessary changes to the currently utilized building code would be further evaluated as part of the FPMP development, which is part of the tentatively selected plan.

6. NS16 – Purchase of Land Development Rights. This is a tool used in state and local land preservation efforts in which an offer is made by the state or local agency to a landowner to buy the development rights on the parcel. The landowner is free to decline the offer or proceed with negotiations. Once an agreement is reached, a permanent deed restriction is placed on the property which limits the type of activities that may take place on the land in perpetuity. In this way, a legally binding guarantee is achieved to ensure that the parcel will remain agricultural or as open (green) space. This tool can be utilized in floodplain management to reduce future damages within the floodplain. In addition, by preventing and/or reducing structural obstructions within the floodplain, flood waters are allowed to naturally disperse unimpeded across the floodplain, potentially reducing water surface profiles.

Land acquired as part of a nonstructural project can be converted to a new use such as ecosystem restoration and/or recreation that is open space based such as trails, canoe access, etc. Conversion of previously developed land to open space means that infrastructure is no longer needed such as utilities, streets, sidewalks, etc. and can be removed as part of the project. The conversion to a new use such as ecosystem restoration or recreation can also be part of the project. By incorporating new uses of the permanently evacuated floodplains into the nonstructural flood risk reduction project, economic feasibility of the buyout or relocation projects is enhanced due to transfer of some flood risk reduction costs to ecosystem restoration and by adding benefits (and costs) of recreation.

D. Watershed Management

1. NS17 – Agricultural Lands Policy (Watershed Management). This measure involves working with property owners in the Cedar River watershed to manage lands to reduce runoff potential. Agricultural best management practices include; remove field drain tiles, plant riparian buffer strips, convert row crop lands to grasslands, and others. Such land use practices increase infiltration rates and help hold both water and soil in place.

Wetlands in the Cedar River watershed would be restored to increase flood storage. This is effective for smaller flood events but diminishes in value as storage capacity is exceeded by larger flood events such as those experienced by the City in 1993 and 2008.

Establishing a watershed management program would require the following steps: identify stakeholders, identify problems, develop goals, public involvement, develop plan, implement plan, monitor progress, and adjust accordingly. There is currently an ongoing effort in the Iowa/Cedar River watersheds to develop a watershed management plan.

VII. Summary of Non-structural Measures

Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding, either by changing the use made of the floodplains or by accommodating existing uses to the flood hazard. This study examined a range of non-structural measure as listed in table P-1 of this appendix. Some examples of nonstructural measures include flood proofing; modifying or elevating structures to minimize flood damages; permanent evacuation of structures; flood warning/preparedness systems; and regulation of floodplain uses.

Floodplain Management and Zoning (NFIP), Local Land Use Regulation and Zoning, Building Codes and Enforcement, and Purchase of Development Rights are the responsibility of the state and local governments. Flood Warning Systems, Floodproofing, and Permanent Acquisition are categories where there is a shared responsibility with the Federal government and each category was analyzed for feasibility as part of the study. Flood Warning Systems: The City of Cedar Rapids utilizes their current Flood Response Manual to initiate various response actions corresponding to various stages at the USGS gage station. This manual will be updated as changes to the City's FRM are made. The City continues to improve and update their flood warning system as needed. Major improvements to the system are unlikely to substantially reduce damages and were eliminated from further evaluation.

Flood Proofing and Permanent Acquisition were analyzed in this study and were screened out due to negative net benefits (costs outweigh the benefits of implementing; see table P-3 for a summary of the benefits and costs). Residential and non-residential structures were evaluated. The City is continuing to utilize the FEMA and HUD buyout programs and continued buy-outs of flood-prone structures are encouraged.

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX Q

THE CITY OF CEDAR RAPIDS
OTHER SOCIAL EFFECTS REPORT

OTHER SOCIAL EFFECTS REPORT

City of Cedar Rapids, Iowa - Flood of 2008















DRAFT

CEDAR RAPIDS
City of Five Seasons®

Created on June 7, 2010

ACKNOWLEDGEMENTS

Abbe Center for Mental Health

Cedar Rapids Community School District

Cedar Rapids Area Chamber of Commerce

Corridor Recovery

Cedar Rapids Downtown District

City of Cedar Rapids Departments

- Community Development
- Public Works
- Utilities (Water Department and Water Pollution Control)
- Parks and Recreation
- Finance
- Police Department
- Fire Department
- Code Enforcement
- CR Transit
- City Manager's Office

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Ken Potter, Professor of Civil & Environmental Engineering, University of Wisconsin

Red Cross

Salvation Army

Sasaki Associates

The Greater Cedar Rapids Community Foundation

United States Army Corps of Engineers, Rock Island District

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EXECUTIVE SUMMARY

THE FLOOD OF 2008 DEVASTATED BOTH THE ECONOMIC AND SOCIAL FABRIC OF THE CITY OF CEDAR RAPIDS, IOWA. A FLOOD MANAGEMENT SYSTEM IS NECESSARY TO ENSURE THE PROTECTION OF ALL RESIDENTS. THE CEDAR RAPIDS CIVIC CULTURE, EVIDENCED BY THE EFFORTS ALREADY ACCOMPLISHED TO DATE, AS WELL AS THE CITY'S ECONOMIC IMPORTANCE TO THE REGION, MAKE IT A GOOD INVESTMENT FOR THE NATION.

Why a Report on "Other Social Effects"?

- Although much of the Corps' report has been based on national economic development benefits, the Corps acknowledges that "next to solid engineering, it (other social effects) may be the most important factor in the success of a project. (Dunning, Social Vulnerablity Analysis Methods for Corps Planning)

- "Other Social Effects" include the impacts a flood management project can have on the local and regional economy and the impacts of flooding on socially vulnerable populations, including issues of environmental justice.

- The U.S. Army Corps of Engineers (Corps) Principles and Guidelines clearly support the recommending of projects where factors beyond national economic development justify the project.

The Cedar Rapids flood was a huge natural disaster with major community impacts

- Spring flooding began at the top of a 190-mile long, 6,510 square mile watershed combining with local and regional rains and melting snows in already water-saturated ground resulting in the disastrous 2008 flood, the fifth worst natural disaster in the nation for public facility losses.

- The river crested at 31.12 feet and inundated downtown and river corridor neighborhoods engulfing 1,300 blocks, spilling over on both sides of the river, causing over $3 billion in damage in Cedar Rapids and Linn County alone.

- There were 18,000 residents displaced by the muddy and sewage-filled waters that damaged more than 5,000 homes and 310 public facilities including City Hall, the Linn County Courthouse and the City's central fire facility, along with more than 900 businesses.

- Only one of seven bridges in the City (and metro area) across the Cedar River was accessible (I-380) limiting access to the hospitals on the east side of the river.

Cedar Rapids was quick to mobilize recovery and reduce future flood risk

- After cleanup efforts had begun, the City began a robust, collaborative community involvement process in advance of the usual Corps engagement schedule, to identify and develop support for a preferred flood management strategy.

- The four-month planning process involved a set of public open houses that engaged 2,680 community members in a rigorous analysis of pre-flood assets, options and a preferred option.

- The process was led by a partnership including multiple city departments, the Cedar Rapids City Council, an interdisciplinary consultant team, and numerous agencies ranging from the local to the federal level such as the Corps, FEMA, HUD, the Downtown District, the Chamber of Commerce, Linn County, and multiple departments of the State of Iowa.

- The City's interdisciplinary consultant team consisted of hydrologists, landscape architects, urban designers, hydraulic engineers, urban planners, civil engineers, transportation planners, architects, ecologists, sustainability specialists, market analysts and watershed experts.

- A series of steps was taken by the City to reduce future flood risk including the development of a preferred flood strategy to reduce the Corps process from five years to two, the development of an interim flood plan and purchase of interim flood walls, improving the community rating system, existing protection assessments, utility/infrastructure improvements, voluntary property acquisition program, flood education, encouraging flood insurance, building code review, and assistance to individual homeowners to flood proof their homes

Cedar Rapids' future is dependent on a flood management system to protect both sides of the river

- Cedar Rapids is an economic engine for the State of Iowa and the region, with major corporations headquartered there, and contributing $12.5 billion to the economy.

- Residents and business have committed to rebuilding, many with significant unreimbursed financial resources for that purpose. However if another flood occurs, many of these businesses and industry will likely go out of business or relocate, significantly damaging the City, region and State's economic vitality.

- The City of Cedar Rapids will be unable to fully recover without a future flood protection system. It will take time and money to rebuild and hesitation to reinvest in the area is increased by lingering questions about future flood protection. The inability to provide protection for both sides of the river will create a deterrent to all redevelopment in the flood-impacted area leaving the city unable to recover in a sustainable and successful manner.

- Environmental justice principles demand that all residents need protection regardless of socioeconomic status and the cost of their home. Many of the residents in the 5,000 flood-affected homes were located on the west side of the Cedar River and are working class neighborhoods with a high percentage of the elderly, poor and disabled, as well as female heads of households.

- Large historic urban working class neighborhoods on the west side of the river cannot be moved to greenfield development -- it is not an affordable option for residents or the City, housing costs and costs of infrastructure are too high, there is a lack of transportation options and a need for Cedar Rapids to be sustainable.

- Cedar Rapids is worth more to the nation as a vibrant, resilient regional economic hub than what its future would be without a flood management system that provides full protection to the community.

Climate change and uncertainty in predicting future flood levels

- Cedar Rapids location within the watershed, changes in land use, and sloping topography all make the City increasing susceptible to future flooding.

- The National Weather Service forecasts indicate that reoccurrence of a flood of the same magnitude as 2008 is more likely to reoccur than previously estimated.

- Climate change will increase flood frequency in Cedar Rapids, a fact not taken into account by the Corps' current Policies and Guidelines for predicting flood frequency, which is based on historical data.
- The Corps has acknowledged the impacts of climate change in the Fargo, North Dakota area and their panel of experts agreed that uncertainty in future precipitation and flood flow frequency must be taken into account.

INTRODUCTION

IN JUNE 2008, THE BANKS OF THE CEDAR RIVER CRESTED AT A RECORD SETTING 31.12 FEET, FLOODING MORE THAN TEN SQUARE MILES OF CEDAR RAPIDS' CORE NEIGHBORHOODS AND DOWNTOWN AREA.

OVERVIEW

The City of Cedar Rapids, Iowa, located in the northeastern region of the state, crowned 2008 the "Year of the River," a title meant to reinforce the connection between the City and the Cedar River that runs through its core. This name became even more significant in June 2008 when the worst flood in the Cedar Rapid's history inundated neighborhoods along the river and a large part of downtown with a record-breaking 31.12 feet of water. The Cedar River crested 11.12 feet higher than any previous flood, stretching along two miles of riverfront and engulfing 1,300 city blocks, forcing thousands of evacuations in the downtown and river corridor neighborhoods. When the waters receded, they left over $3 billion in damages to Cedar Rapids and Linn County alone, impacting 7,749 parcels, 310 public facilities including City Hall, the Linn County Courthouse and the City's central fire facility, and more than 900 downtown businesses.

Cedar Rapids continues to suffer from the flooding that took place almost two years ago. The City has a long road ahead to recover from the worst natural disaster in Iowa's history and the fifth-worst in the nation.

Immediately following the flood, the City worked quickly to evaluate the damage and determine the next steps. While the various municipal departments worked to ensure that all city services were restored, the City began flood recovery planning. Based on input received from other disaster-affected communities, the City found that it was imperative to gather community feedback and build support for the City's flood recovery planning efforts. Developing community consensus and broad public support ensures that recovery planning will be implemented successfully. As a result of these findings, the City, in partnership with Sasaki Associates, embarked on multiple phases of community engagement to create the River Corridor Redevelopment Plan. Phase I of this planning process collected community feedack on a preferred flood management strategy for future flood protection while Phase II of this planning process developed priorities for neighborhood reinvestment.

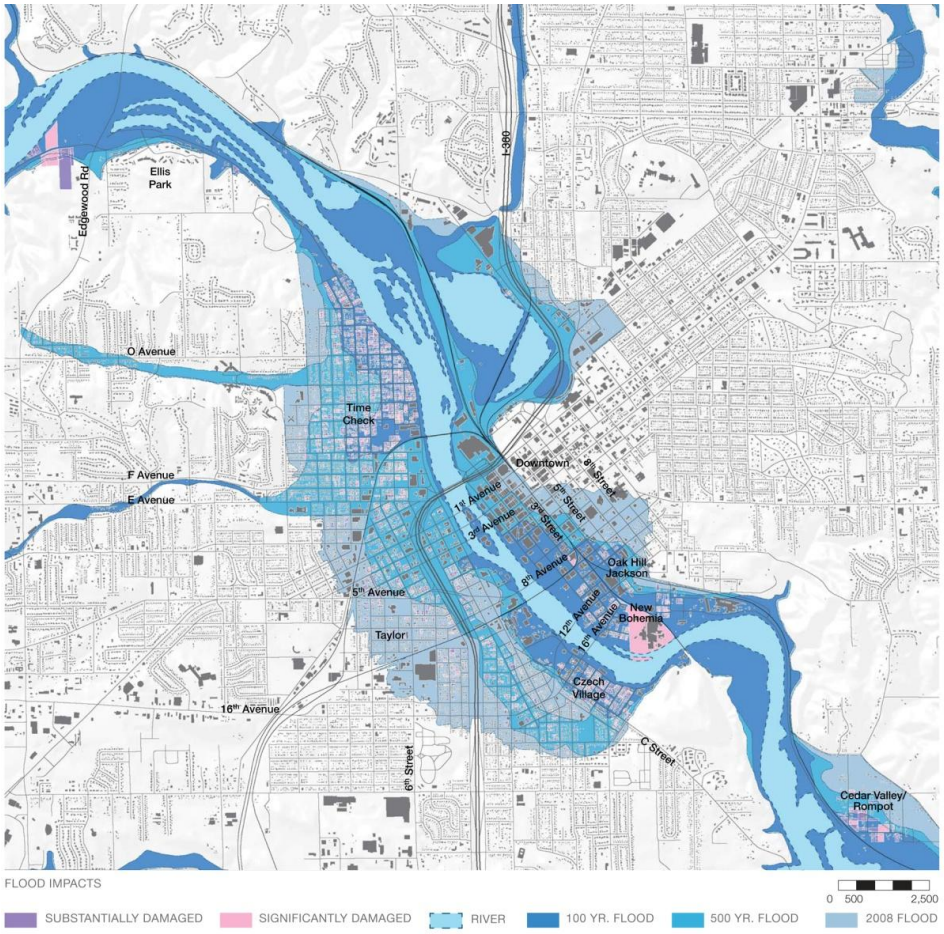
As a result of this year-long intensive public participation planning process (five months for each phase), the City was able to cut three years from the typical timeline for the Corps feasibility study. This process also helped to create a reinvestment plan for the entire flood-affected area. Each phase of the public planning process will be discussed in more detail later in this report.

By most estimates, the Cedar Rapids flood is considered the 5th or 6th worst natural disaster financially in the history of the United States. City Manager Jim Prosser described the difficulty of the recovery efforts:

> *"The post-flood recovery challenges faced by Cedar Rapids were complex and expensive. Our initial estimate, which turned out to be reasonably accurate, was that the City would need to invest about $2.5 billion in flood control measures, neighborhood redevelopment and repair and replacement of city facilities. Most funding would need to come from federal and state sources including Water Resource grants, FEMA, Small Business Administration, Community Development Block Grant, state disaster grants and economic development programs."*

The Flood of 2008 forever changed Cedar Rapids. It extended well beyond the 500-year floodplain and covered more than 10 square miles of the city. Today, many residents are still struggling to rebuild. While Iowans are known for strength and resilience, the people of Cedar Rapids can only do so much as they wait for a decision on future flood protection and additional financial support. The people of Cedar Rapids have created a vision plan for flood recovery and are committed to partnering with local, state, and federal entities to see that this vision becomes a reality.

Figure 1 – Flood Impacted Area



SCOPE OF REPORT

The necessity of analyzing social effects in addition to the typical economic impacts in the context of water resource planning has become apparent after the devastating natural disasters and difficult recoveries that have taken place throughout the nation in the past several years. Although the significance of Other Social Effects (OSE) factors have often been undervalued in the past, the Corps highlights that “next to solid engineering, it [OSE] may be the most important factor in the success of a project” (Dunning and Durden, Handbook on Applying "Other Social Effects" Factors in Corps of Engineers Water Resources Planning).

On June 11-13, 2008 the City of Cedar Rapids, Iowa experienced a flood of historic proportions. The Cedar River, running through the heart of Cedar Rapids, consumed 14 percent of the city, filling the first floor of high rise downtown office buildings and historic brick storefronts. More than 5,000 residential structures in 10 square miles succumbed to the sewage and debris-filled flood waters. Evacuations over two days displaced more than 18,000 residents and 9,000 employees. While these numbers describe the magnitude of this disaster, they fail to illustrate the impact of the event on the residents and businesses of the community.

This report will discuss the social effects that have occurred in Cedar Rapids as a result of the 2008 flood,— effects that may have otherwise been overlooked by other planning analysis, and show the following:

- The damages that occurred as a result of the flood in both a qualitative and quantitative manner.
- The intensive post-disaster public input process that worked to create a preferred flood management strategy and reinvestment plan for the flood-affected area— a process that worked in coordination with the Army Corps of Engineers Feasibility Study to eliminate three years from the typical review timeline.
- Uncertainty in predicting future flood levels and the impacts of climate change in Cedar Rapids.
- The detrimental effects to flood recovery and the future of the City if the preferred flood management strategy were not funded and implemented— these effects will be discussed based on the topics of environmental justice and sustainability.

Federal Principles and Guidelines that determine the Benefit-Cost Ratio do not take into account that a community which has already sustained a natural disaster, such as the City of Cedar Rapids, has much greater social, environmental, and fiscal impacts than those that are performing this analysis based on a hypothetical disaster. Cedar Rapids sits in a more vulnerable position today than before the flood. Sustaining another flood without the preferred flood management strategy would leave lasting scars on the city, its residents and businesses, and would decrease the possibility of a full recovery in the future.

KEY MESSAGES

Below are the key messages that will be addressed within throughout this report. These messages highlight the various social effects of the 2008 flood from when the flood first hit, into present day, and looking towards the future of Cedar Rapids.

1) Cedar Rapids is taking a comprehensive approach to flood management.
    - Through a broad-based citizen participation process, the City has developed a multi-pronged flood management strategy and a strong vision for the future of Cedar Rapids. Redevelopment to meet community expectations requires implementation of the City's preferred flood management strategy.
    - The City has partnered with local, state, and federal entities in order to put in place multiple levels of flood risk management for future events.

2) Uncertainty about future flood control has slowed Cedar Rapid's recovery from the 2008 flood.
    - Over 5,000 homes and 900 businesses are still working to recover from the 5th worst natural disaster in our nation's history. The City is unable to guarantee redevelopment consistent with the community's vision as the future of flood protection remains uncertain.
    - Residents, businesses, and major industry have demonstrated a commitment to rebuilding. Many have committed significant unreimbursed financial resources for that purpose. However, if another flood occurs, experience indicates many of these businesses and industry will likely go out of business or relocate, significantly damaging the City's economic viability while many residents will be unable to cope with the devastating financial effects of another flood.

3) Research shows that there is more uncertainty in the ability to predict future flood levels and flood frequency.
    - Recent research suggests that Cedar Rapids may be at greater risk for future flooding than predicted by models used by the Army Corps of Engineers.

4) A commitment to environmental justice underlies the City's approach to rebuilding.
    - The flood of 2008 disproportionately affected already disadvantaged residents—many elderly and lower-income. Redevelopment efforts should not amplify this by ignoring the flood protection needs of some residents while fulfilling those of others.

5) Environmental, economic and social sustainability is the key to our future.
    - The preferred flood management strategy enables more sustainable redevelopment than any of the alternatives. Protecting the city core on both sides of the river will help reduce sprawl, will contribute towards attracting a next-generation workforce, and will improve community cohesion by using the river to join, rather than divide, the city.
    - Cedar Rapids is a major Midwestern economic center. The City's ability to retain and attract a capable qualified workforce for major employers is critical to our ability to remain competitive. If another flood occurs the City will be unable to maintain the assets needed to retain and attract this workforce, which will also have a negative impact on the State of Iowa.
    - The flood caused significant environmental damage. Providing flood protection will not only reduce the likelihood of repeating this damage but will improve environmental quality by establishing systems to protect wildlife, water and air quality.

ARMY CORPS OF ENGINEERS ALTERNATIVES

The Army Corps of Engineers has produced several alternatives for future flood protection of Cedar Rapids and the bulk of their report has evaluated these alternatives via traditional benefit-cost analysis. It is important to examine the impacts of the Army Corps of Engineers alternatives from various additional viewpoints including environmental justice and sustainability, both of which will be discussed further in later chapters of this report.

The City is dedicated to redeveloping the flood-impacted area according to the River Corridor Redevelopment Plan, a flood recovery plan that was created through a year-long public participation process, in order for the City to not only recover but recreate itself stronger than it was before for future generations. Through this process the City identified the following criteria:

- Sustainability served as a key theme throughout this planning process. The low cost of utilizing existing infrastructure versus the high cost of constructing new infrastructure in greenfield areas supports the redevelopment of the flood impacted area. Rebuilding within the flood impacted area encourages families to move back to the multi-generational neighborhoods where they have built personal relationships.
- Environmental justice, the equal distribution of environmental risks and benefits without discrimination, must also be taken into account when evaluating these alternatives. The City must be able to guarantee future flood protection for all residents to ensure that environmental justice is upheld. This is why the City's preferred flood management system provides protection on both sides of the river where the majority of those impacted were low-income and elderly living in older and more affordable housing. Restoring this housing is more affordable than replacement housing in greenfield areas.
- Reconnecting the City to the river to make it the heart of the community instead of the divide that it was in the past. This will be accomplished with identifiable public spaces for the community, such as the Time Check Greenway, the Downtown Promenade Riverwalk, Riverside Amphitheater, and the New Bo Wetland Park.
- Redevelopment of as much of the flood impacted area as possible is key to Cedar Rapids recovery. Flood protection on both sides of the river promotes both residential and commercial redevelopment and removes the hesitancy to re-invest/invest that would take place with no protection or partial protection.

Many of these factors will be discussed in more detail throughout this report and will work to highlight the social impacts that should be considered in the analysis of each of the future flood protection alternatives.

Alternatives 1 and 1A

Alternatives 1 and 1A most closely reflect the City's preferred flood management strategy that was identified during the intensive post-flood public participation process and addresses the City's criteria noted above. These alternatives provide protection to both the east and west sides of the river. This comprehensive approach to flood management includes structural measures to protect the downtown and residential neighborhoods and promotes revitalization

and redevelopment while complementing the City's property acquisition initiative to relocate people from the impact of future flooding. These alternatives address environmental justice issues by protecting both sides of the river and the low-income, working class neighborhoods that were the most impacted by the flood and are at most risk from future flooding.

Figure 2 – Flood Protection Alternative 1

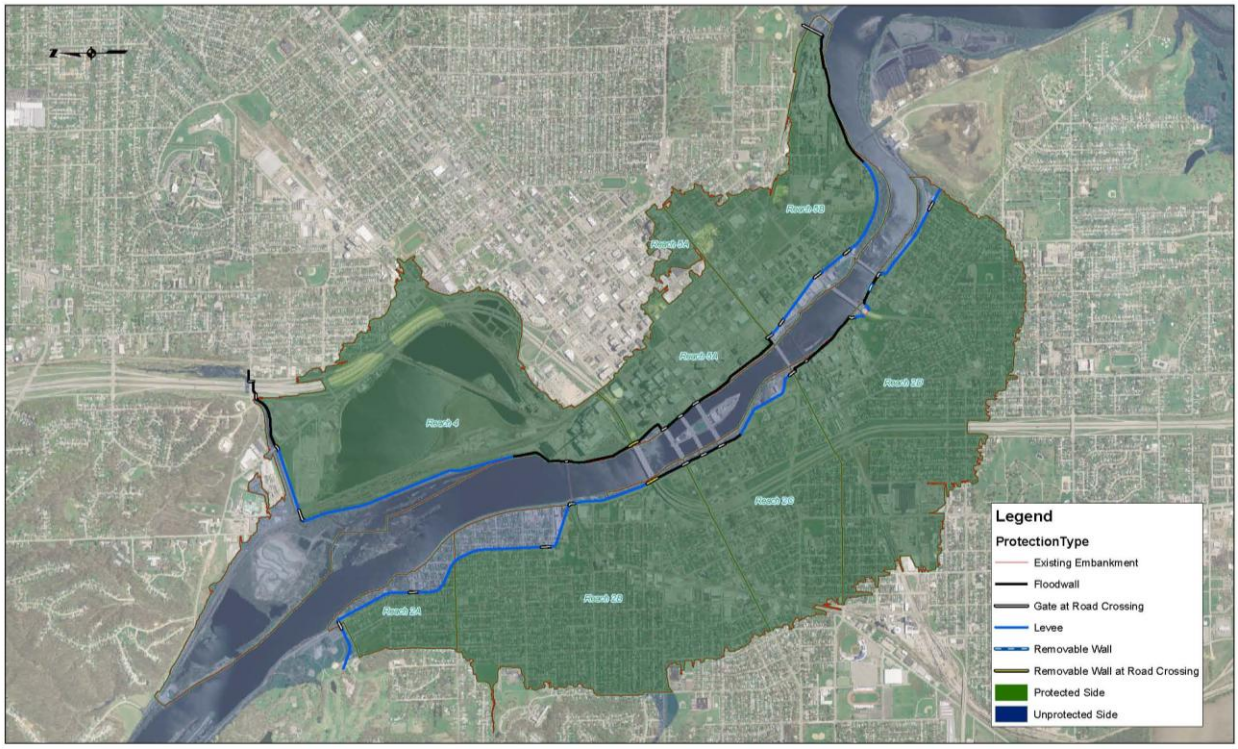


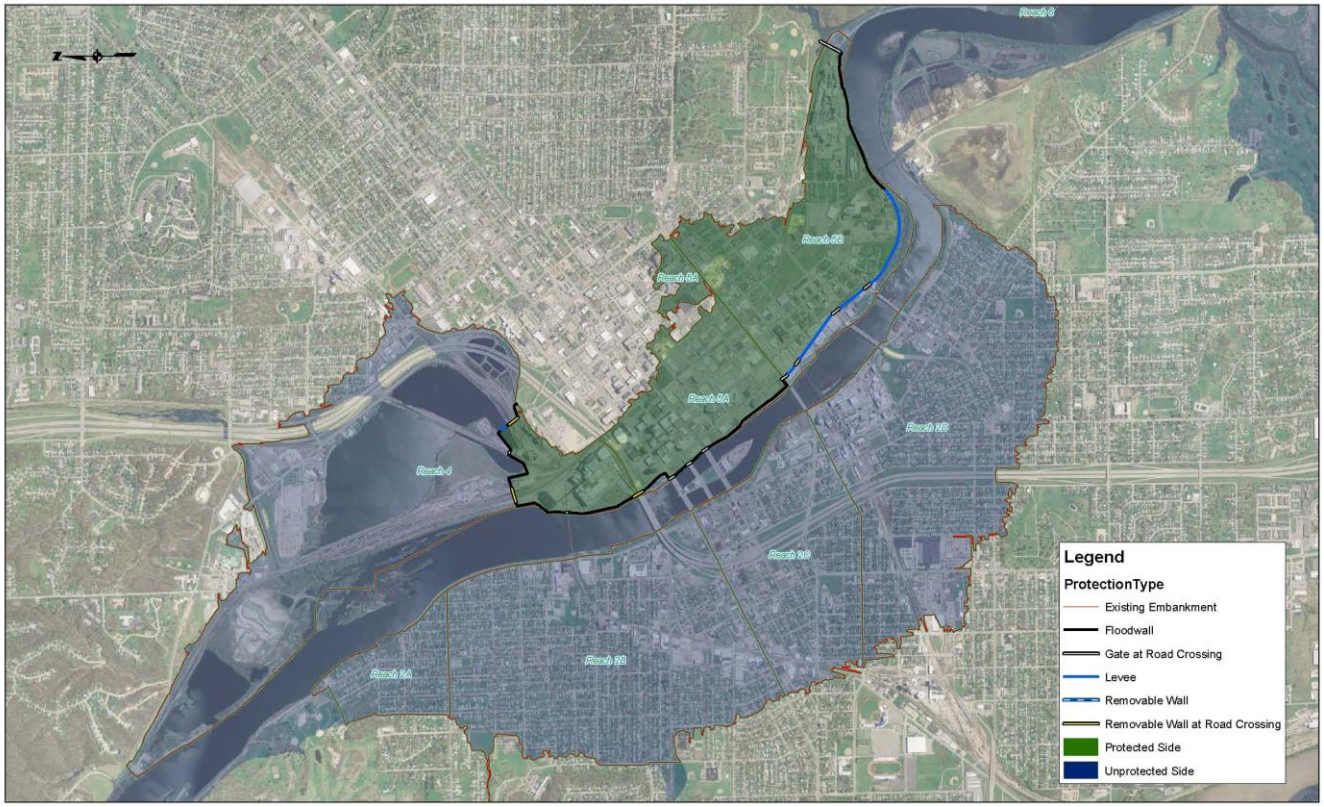
Figure 3 – Flood Protection Alternative 1A



Alternative 4

This alternative does not address the City's criteria of providing a sustainable solution that helps promote redevelopment for all of the flood impacted residents. This alternative is only a portion of the City's preferred flood management strategy as it only provides protection for the east side of the river, but does not provide protection for residents on the west side. This alternative is an environmental justice problem as it disproportionately distributes the negative impacts of flooding onto a majority of low-income and elderly residents. This alternative does not promote redevelopment on the west side of the river and could lead to blight and decay as existing property owners choose not to repair flood damaged homes and businesses and homeowners who stayed and reinvested leave to escape deteriorating neighborhoods.

Figure 4 – Flood Protection Alternative 4



MULTI-STRATEGIC APPROACH TO FLOOD RECOVERY

THE CITY HAS DEVELOPED A MULTI-PRONGED FLOOD MANAGEMENT STRATEGY AND A STRONG VISION FOR THE FUTURE OF CEDAR RAPIDS.

COMMUNITY-BASED FLOOD RECOVERY PLANNING

It cannot be stressed enough how important the City's two-part recovery planning efforts were. The City engaged its citizens on the type of flood protection they wanted to protect them from future flooding. The citizens desire to be connected to the river resulted in a combination of open green space, levees, and floodwalls. Selection of a preferred flood management system was used as the basis for working with citizens to plan how their flood impacted neighborhoods would not only recover but return revitalized better than they were before the disaster.

When the flood hit, the city mobilized. Rescue efforts successfully evacuated all residents from the flood-affected neighborhoods, preventing any flood-related deaths. Recovery planning began immediately; within days of the flood, Cedar Rapids City Council had outlined a series of strategic recovery goals:

- Improve flood protection to better protect homes and businesses
- Rebuild high-quality and affordable workforce neighborhoods
- Restore full business vitality
- Preserve our arts and cultural assets
- Maintain our historic heritage
- Assure that we can retain and attract the next generation workforce

With a strategy in place, the City embarked on multiple phases of community engagement for planning future flood protection and recovery.

With an ambitious scope and a need for quick action, cooperation has been essential in the development of a viable recovery strategy. The planning process has been a partnership among community members, multiple City departments, the Cedar Rapids City Council, and numerous agencies ranging from the local to the federal level such as the Downtown District, the Chamber of Commerce, Linn County, multiple departments of the State of Iowa, the U.S. Army Corps of Engineers, the Federal Emergency Management Agency (FEMA), and the U.S. Department of Housing and Urban Development (HUD). The City assembled an interdisciplinary team of consultants, including landscape architects, urban designers, hydraulic engineers, urban planners, civil engineers, transportation planners, architects, hydrologists, ecologists, sustainability specialists, market analysts and watershed management experts.

Phase I of the River Corridor Redevelopment Plan, the Framework Plan for Reinvestment and Revitalization, began only days after the flood and sought to minimize the risk of future flooding and improve the City's relationship to the River. Lessons learned from other flooded communities underscored the need to undertake an inclusive community-based process to achieve a supportable flood management plan, with the partnership of technical experts and especially the Army Corps of Engineers.

The Phase I planning process responded to these questions:

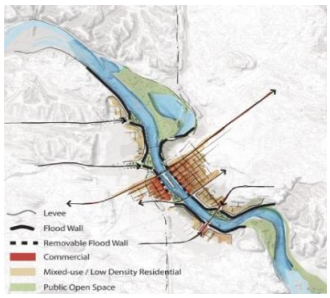
- What are the flood protection/mitigation options and what impact do they have on the City?
- What is the long-term framework for business reinvestment and revitalization of Cedar Rapids?
- How can the flood mitigation process be used to improve the City's connectivity, sustainability, and overall well-being?
- What new housing options can be made available for people who will not be able to return to their homes and neighborhoods?

Goals of the Phase I planning process included:

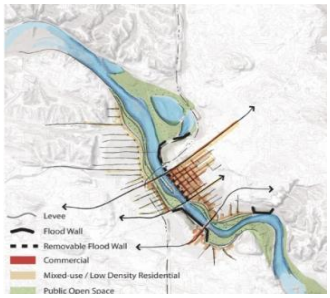
- Improve flood protection to better protect homes and businesses
- Assure that we can retain and attract the next generation workforce
- Rebuild high quality and affordable workforce housing and neighborhoods
- Restore full business vitality
- Preserve our arts and cultural assets
- Maintain our historic heritage
- Help our community become more sustainable

Between July and October 2008, the City held a series of Open Houses that engaged over 2,680 residents in evaluating several options for flood management and community revitalization. The first open house presented a rigorous analysis of pre-flood community assets, an inventory of flood impacts and sustainable principles for the City's recovery. An interdisciplinary consultant team subsequently worked with the U.S. Army Corps of Engineers to test and synthesize community feedback into a series of options for the second open house. These options included three radically different approaches: a floodwall lining the Cedar River throughout the City (Option 1), a combination of a greenway with levees and floodwalls (Option 2), or a drastically expanded greenway that would displace most of the westside neighborhoods (Option 3). Ultimately, a preferred alignment for future flood management was presented at the third Open House. Community members rallied behind the Option 3, noting that it would allow for the best visual and spatial connection to the River.

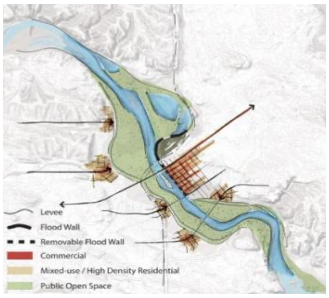
Figure 5 – Flood Management Strategy Options



Option 1

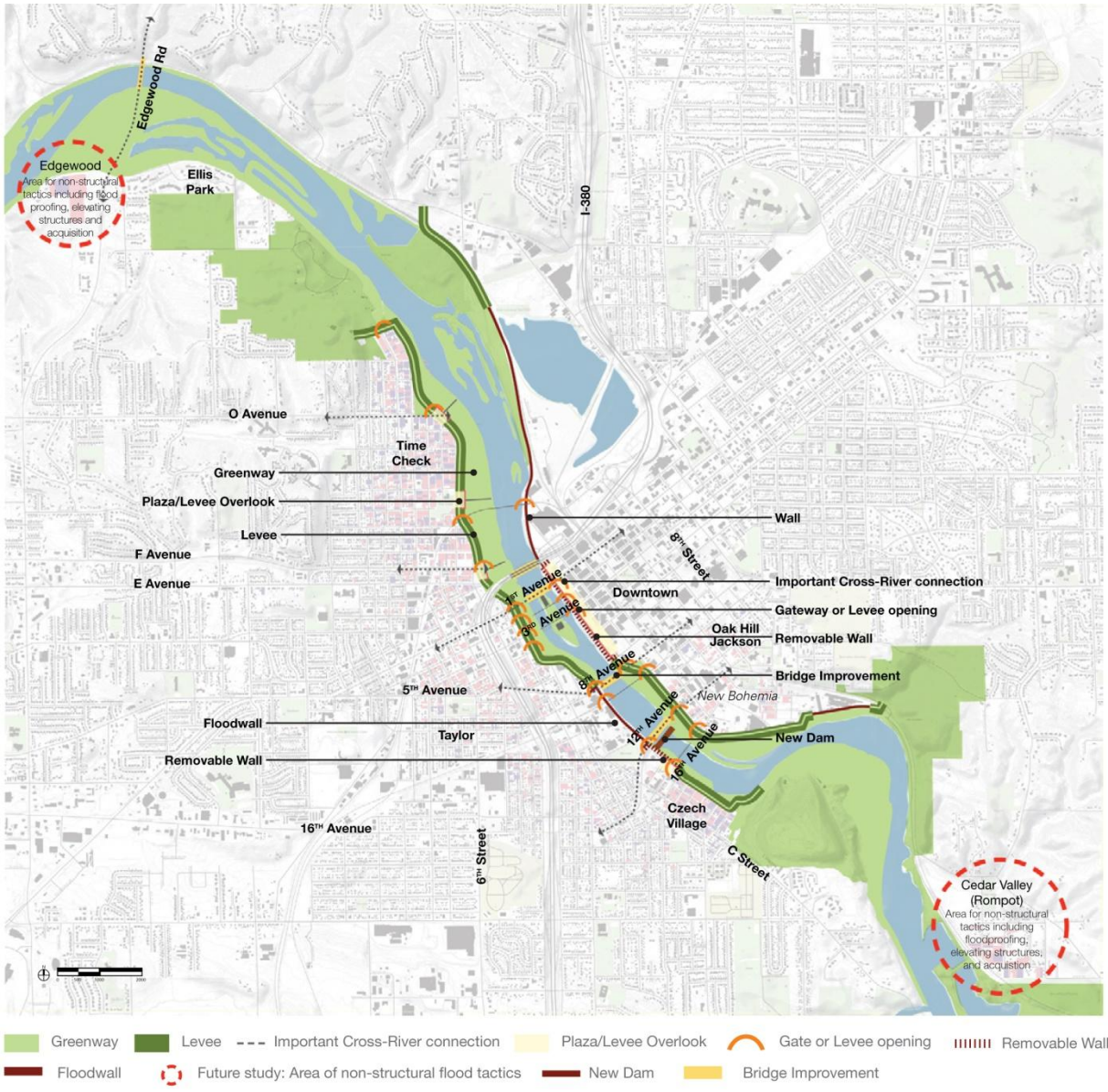


Option 2



Option 3

Figure 6 – Cedar Rapids' Preferred Flood Management Strategy



Flood Management

This transparent public process resulted in a Framework Plan for Reinvestment and Revitalization which outlines a flood management strategy to minimize future risk and improve the City's relationship to the Cedar River. Low-lying properties within the 100-year floodplain are converted into a 220-acre greenway park and levee system, providing public recreational space along the river. Along the edge of the downtown, an innovative removable floodwall system allows visual connections to the river and creates a new civic promenade. The comprehensive strategy also identifies non-structural measures, including improvements to evacuation planning, interim flood protection, flood proofing, and flood warning systems, as well as a future initiative to address Cedar River watershed issues. More importantly, this process resulted in a flood management system that allows the City to reposition itself for future generations by creating a destination riverfront that helps link the flood impacted neighborhoods.

The City Council formally adopted the Framework Plan for Reinvestment and Revitalization in November of 2008 with the support of the public, allowing the City to move forward with interim planning and acquisitions of houses damaged beyond repair. Implementation of the Framework Plan will require roughly $2.5 billion for flood control measures, neighborhood redevelopment and repair and replacement of city facilities. Most funding will come from federal and state sources including Water Resource grants, FEMA, Small Business Administration, Community Development Block Grants, state disaster grants and economic development programs.

Tangible Results and Outcomes

Since November 2008, the Framework Plan for Reinvestment and Revitalization has guided ongoing flood recovery initiatives, including:

- A community engagement process (Phase II) – involving more than 1,420 citizens, 6,070 hours of planning time and eight public meetings – to develop a Framework for Neighborhood Reinvestment in the City's nine flood-affected neighborhoods. Collectively, the plans envision a sustainable Cedar Rapids characterized by strong pedestrian, transit and vehicular connections, a network of open spaces, a variety of housing types, diverse economic opportunities, and thriving cultural destinations. An Action Plan was developed to guide redevelopment over the next 10 to 15 years.
- A training program for 75 City staff to promote cross-departmental coordination, communication and leadership, and to outline how to successfully develop relationships with community members.
- Coordination with FEMA and HUD on the acquisition of flood damaged properties. More than 5,000 residential properties were damaged during the flood, and the City is working with property owners to acquire roughly 1,300 properties that were damaged beyond repair. The City presently has come to agreement on the acquisition of a portion of the properties using FEMA funding and is working with HUD on additional acquisitions.
- Coordination with the State and HUD on the distribution of Community Development Block Grants to assist in reconstructing flood damaged infrastructure, such as roads, sidewalks, and utility lines.
- Coordination with housing developers to help deliver more than 600 units of high-quality, sustainable replacement housing for those that lost their homes during the flood, and to bridge the gap of affordable homes that existed prior to the flood.

- A community process to prioritize replacement and rehabilitation of flood-damaged City facilities. This includes the rehabilitation of City Hall, the construction of a new library and new facilities for the central fire station, CR Transit, and Animal Control. It also will create a consolidated City Operations Center for Public Works and other City Departmental facilities and maintenance yards.
- Coordination with the U.S. Economic Development Administration on grants to assist in economic development initiatives to help re-build and strengthen the damaged local economy.
- A public process to shape the Parks and Recreation Master Plan and integrate the future 220-acre floodplain greenway into the Parks system.

PHASE II – NEIGHBORHOOD PLANNING PROCESS

Phase II of the River Corridor Redevelopment Plan, the Neighborhood Planning Process, engaged community members in reinvestment planning for the City's ten flood-affected neighborhoods. The goals of the process were to:

- Promote leadership and neighborhood governance: Encourage leadership building and improved communication between the City and community to create stronger neighborhoods. To oversee, champion, promote the process, and ensure transparency, the City Council appointed a steering committee representing the community.

- Establish Area Plans and Action Plans for each neighborhood (North, Central, South): Create a detailed set of actions for reinvesting in our neighborhoods and meeting our vision. The nine flood impacted neighborhoods were organized into three area plans in order to bring neighborhoods that had traditionally competed to focus on shared interests and use the river to unite instead of divide the community.

- Develop community goals and an evaluation framework: Create a framework for evaluating proposals and plans to ensure adherence to community goals

In Phase II, the consultant team and 70 trained City staff members facilitated public meetings in an engagement process that sought to increase community leadership, promote neighborhood governance, and test a new model for interaction with City government. Over 1,420 citizens attended eight public meetings and spent 6,070 hours collaborating to create the Framework Plan for Neighborhood Reinvestment, to outline a detailed action plan, and to establish the community's role in ongoing review. These plans will continue to guide the City and its partners in reinvestment over the next 10 to 15 years.

Goals and Elements of the Plan

The goals emphasize the high-level vision for the plan. The community and the City worked together to develop the following goals for the Neighborhood Planning Process:

- Provide accessible transportation options
- Promote green space as a central amenity
- Construct sustainable infrastructure
- Maintain vibrant neighborhoods

- Meet multi-generational needs
- Provide affordable housing
- Encourage economic vitality
- Support art, culture and entertainment opportunities
- Create exciting downtown destinations
- Encourage citizen-directed planning
- Uphold economically feasible planning

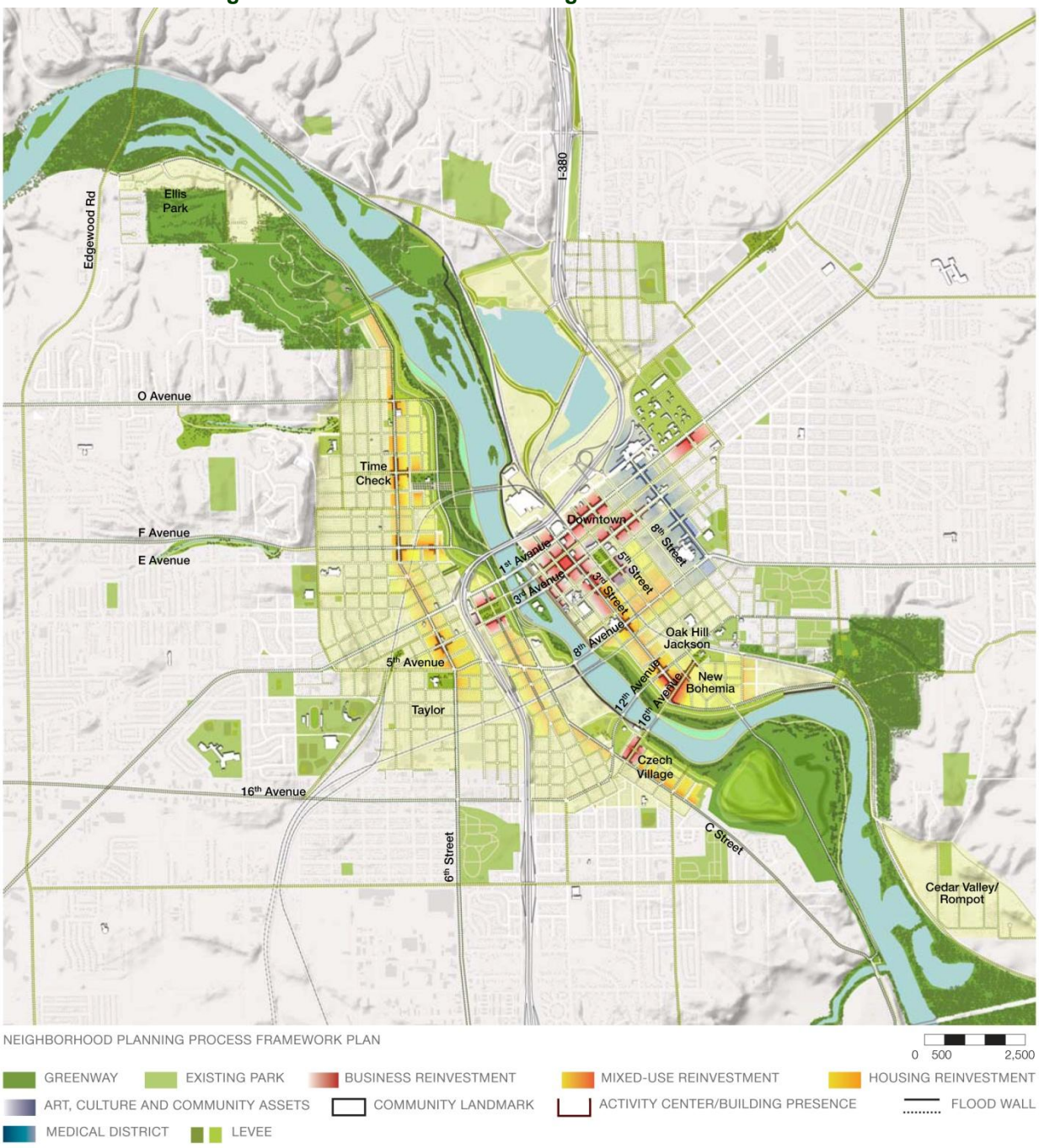
These 11 goals were grouped into five overarching categories — the plan elements listed below—to be used to support the community goals throughout the process.

1. Transportation and Connectivity
    - To create accessible transportation options
2. Open Space and Recreation
    - To promote green space as a central amenity for all residents
    - To construct sustainable infrastructure
3. Arts and Culture
    - To support art, culture and entertainment opportunities
    - To create exciting downtown destinations
4. Neighborhood Reinvestment
    - To maintain vibrant neighborhoods
    - To meet multi-generational needs
    - To provide affordable housing
5. Business Reinvestment
    - To maintain vibrant neighborhoods
    - To encourage economic vitality

Collectively, the Area Plans embody a compelling vision for reinvestment and recovery in Cedar Rapids over the next 15 years. They envision a sustainable Cedar Rapids characterized by strong pedestrian, transit and vehicular connections between downtown, the neighborhoods and the Cedar River, with a network of diverse open spaces in between. The Plans also envision reconstructed neighborhoods that promote diversity and vibrancy, and provide a variety of housing types for a range of ages. Finally, they envision a City that provides a wide range of economic opportunity for its residents, as well as thriving arts, culture and entertainment destinations.

In May of 2009, the City Council unanimously voted to adopt the Framework Plan for Neighborhood Reinvestment, a guide for the flood-affected neighborhoods for the next 15 years.

Figure 7 - Framework Plan for Neighborhood Reinvestment



Tangible Results and Implementation Strategy – The Action Plans

During the Neighborhood Planning Process, residents provided over 600 action steps for flood recovery, including roles and responsibilities. These action steps ranged from repairing flood-damaged utilities to strengthening the economic sustainability of Downtown. City staff worked to compile these ideas into a set of action plans that include 158 specific action items. The Action Plans developed by the City and the community guide the implementation of the Neighborhood Reinvestment Plan. The Neighborhood Reinvestment Plan provides a vision for the future of the neighborhoods, whereas the Action Plans provide specific steps that can be taken to bring the Reinvestment Plan to fruition, as well as assigns a timeline for implementation.

On June 15, 2009, the initial Action Plan was unveiled to the community using an online format, which allows residents to see the plan and the City to provide updates on its progress. The Action Plan will be accessed by all City Departments and partner agencies in order to be updated on a quarterly basis. These updates are tracked by City staff to ensure citizens can view the most up-to-date information on each of the action items. The Action Plan includes the following information:

- List of overall **Area Plan Elements**
- List of **Initiatives** within each Area Plan Element
- List of individual **Action Items** to achieve Initiatives
- **Timetable** for completion of each action item
- **Roles** and **responsibilities** for each action item
- **Status** of each action item

The community provided input on each of these elements, including roles and responsibilities, while the City developed a timetable for the condensed action items. Timing may be dependent on factors such as funding or phasing where some actions must occur before others. The status of an action item will be updated by City Departments on an on-going basis. The action plans will continue to be implemented for the next 10-15 years. The information below displays the status of the action items to date as well as the highlights and barriers to implementation.

Figure 8 - Phase II Action Items Status

NPP ACTION ITEMS	
TOTAL	*158*
Anticipated	45 (28.5%)
In Progress	89 (56.3%)
Completed	**24 (15.2%)**

Shared Highlights

- City has received several awards for these planning processes
- Most action items are in process or completed
- Phase I and II provided consistent and clear direction for new recovery initiatives

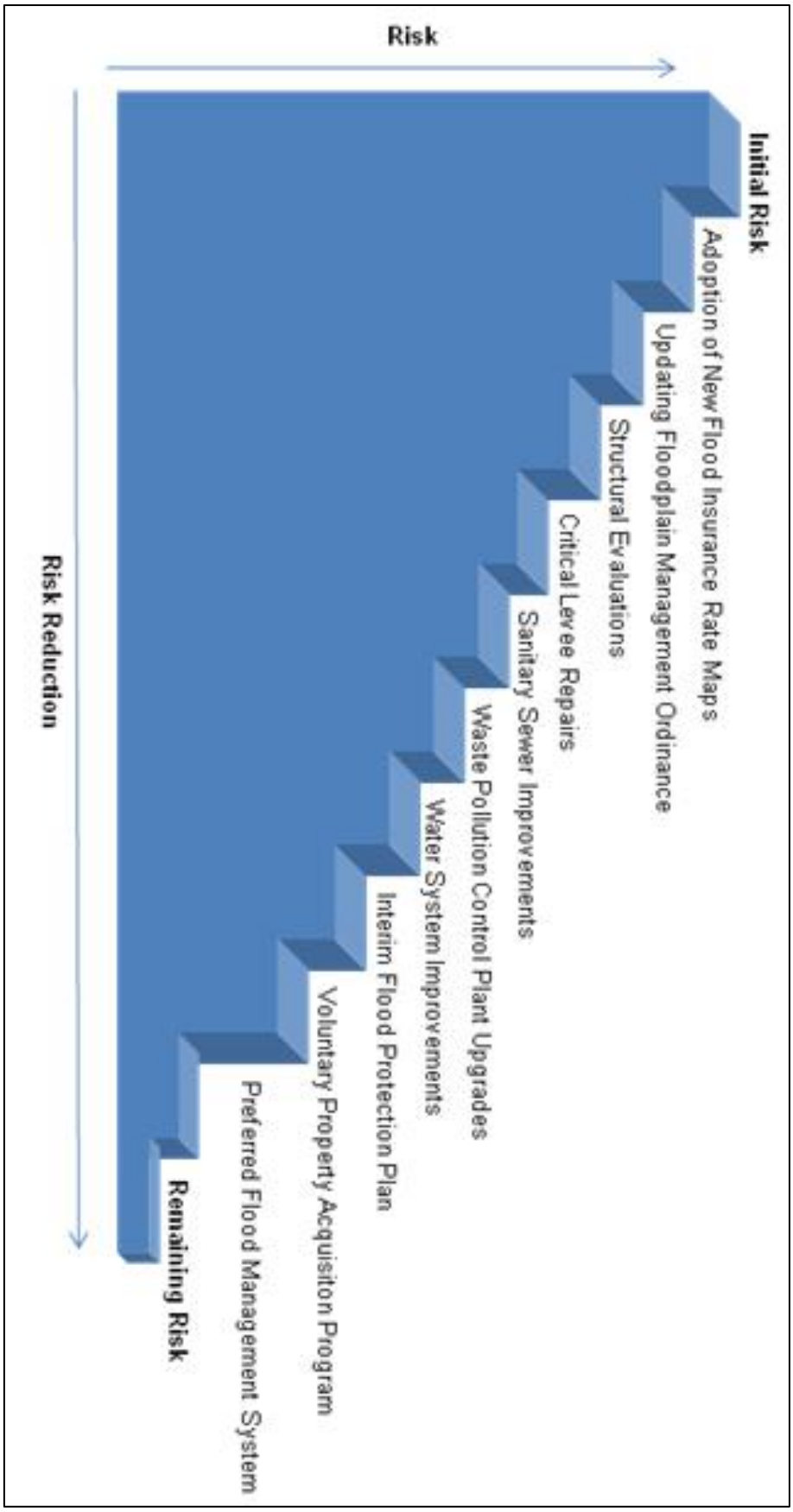
Shared Barriers

- Limited City funds and outside funding sources
- State and Federal regulations
- Maintaining the level of public engagement and investment in these plans

MULTIPLE STEPS TO FLOOD RISK MANAGEMENT

The City of Cedar Rapids recognizes that the responsibility for flood risk reduction is shared among the federal, state, and local governments as well as among the citizens of the community. Cedar Rapids has made a full scale effort to identify and act on every risk reduction tool that has been brought to its attention. The City is collaborating with entities at the local, state and federal levels to employ multiple strategies for flood risk management. The following graphic outlines the multiple approaches the City is taking to mitigate the damages from the June 2008 flood. The vertical spectrum represents the amount of risk from future flooding. The horizontal spectrum represents the reduction in risk each time a strategy is put in place. The amount of risk is reduced as the City implements or utilizes a strategy. Some strategies have a larger impact than others. For example, the City's preferred flood management system has a greater impact on reducing risk than improving the Community Rating System. Each time the City implements a strategy the amount of risk is reduced until there is only a residual or Remaining Risk that remains. A detailed description of the each step within the model is given in the subsequent pages.

Figure 9 – Cedar Rapids Flood Risk Management Strategies



Improving Community Rating System

The City is currently working with Stanley Consultants of Muscatine, Iowa to prepare a Community Rating System (CRS) Application for submittal to the Federal Emergency Management Agency (FEMA). Initial analysis anticipates that the City of Cedar Rapids can attain a CRS score of 9 or 8 for current floodplain management practices. As a prerequisite for application, a Community Assistance Visit will occur on May 12 and 13, 2010. The City will be assisting IDNR and FEMA representatives during this visit.

Components of the Community Rating System application process:

1. Adoption of New Flood Insurance Rate Maps: FEMA proposed preliminary updated maps in 2009. After no appeals from the community, the maps were finalized by FEMA and published for adoption on April 5, 2010. The City of Cedar Rapids made the following efforts to inform and educate property owners of the change:

    - A communications plan was generated and adopted.
    - An information packet was sent to property owners identified as moving into a higher flood risk category.
    - Presentations were made to City Council, business leaders and homeowners.
    - A map modification public informational session was conducted in collaboration with FEMA and IDNR representatives.
    - Approximately 60 inquiries about individual properties were addressed over the telephone and in person.
    - Numerous TV interviews were conducted to explain the repercussions of the new maps.

2. Updating Floodplain Management Ordinance - As part of the map change process, the City was required to ensure that its floodplain management ordinance came into compliance with 44 CFR 60.3 (d) by April 5, 2010. City Engineering Division staff worked alongside IDNR and the City Attorney's office to update the ordinance. The new floodplain management ordinance was passed on February 9, 2010. This new version, however, was updated to only take account of federal and state regulations. It is anticipated that further refinement and geographically sensitive "enhancements" be added at a future time, in collaboration with all interest groups.

Existing Protection Assessments

1. Structural Evaluations – Immediately following the 2008 flood event, the City initiated inspections of the levees, floodwalls, and bridges. This included engaging divers to inspect the piers and substructures, as well as visual assessments of the earthen structures.

2. Critical Levee Repairs – A number of repair projects have been approved for funding through the Emergency Watershed Protection Program,

Utility/Infrastructure Improvements

1. Sanitary Sewer Improvements – Following the flood, the City video-inspected the sanitary sewers in the flood zone and visually inspected sanitary sewer manholes to evaluate their condition. Most of the sanitary sewer collection system was found to be damaged and in poor condition. The City is planning to repair the damages over a 5 year period. The damages to the sanitary sewer system have led to excessive flows resulting in basement backups and sanitary sewer overflows during wet weather. Basement backups are a health hazard and a nuisance to property owners while sanitary sewer overflows are detrimental to the environment.

   In addition to the 5-year repair plan, the City has a backwater valve reimbursement program that provides property owners with up to $500 towards installation of a backwater valve. A backwater valve provides protection against basement backups and many property owners have taken advantage of this program over the past several months.

2. Waste Pollution Control Plant Upgrades - Cedar Rapids Water Pollution Control Facilities (CRWPCF) provides wastewater treatment services for local Fortune 500 food-processing and bio-tech grain-based industries, many commercial businesses, and numerous residential customers in Cedar Rapids and adjacent communities such as Marion, Hiawatha, and Robins. The key service requirement for all of these customers is reliability or the continuous availability of wastewater treatment services, particularly for those industrial customers considering Cedar Rapids as a location for new or expanded operations. All industrial and many commercial customers are extremely risk adverse and very concerned about their and the City's environmental liability due to the loss of Water Pollution Control operations.

   Recent Water Pollution Control activities include:

   - Upgrading the generator controls and electrical reliability to adequately operate the main lift.
   - Relocating the Alliant substation and WPC main switchgear to higher ground to reduce the risk of future flooding.
   - Mitigating plant components being replaced under FEMA funds.
   - Improving education and awareness of staff on how to deal with and react to high water events.

3. Water system Improvements – In an effort to protect the water system, the City has raised ten vertical well platforms 10 feet above the current level. Nine more are planned to be raised by early 2011 with additional wells planned for elevation in 2012 and 2013. The City also has two new collector wells in the design phase. These will be designed to a higher elevation to account for the 2008 flood level.

Interim Flood Protection Plan

1. Temporary Flood Protection Barriers – The City has purchased HESCO Barriers and Tiger Dams as interim flood protection measures. This acquisition has included extensive training of staff for efficient and effective installation of the devices. The barriers are intended to reduce the risk of flood damage for most neighborhoods along the river including: Time Check, Downtown East, Downtown West, and Czech Village. This reduces flood risk, potentially to the 100-year flood stage.

2. Storm Sewer Modifications – The City is installing two storm water pumping stations and six additional outlets have been retrofitted with check valves to reduce river backflow and improve the performance of the City's storm sewer system at the time of a flood event.

3. Improved Flood Forecasting – Additional flood gauges have been installed to provide more accurate forecasting of the flood stages.

4. Flood Response Manual – The City's manual has been updated to reflect lessons learned during the flood event of 2008. This has provided an opportunity to increase the level of efficiency for the use of staff and equipment.

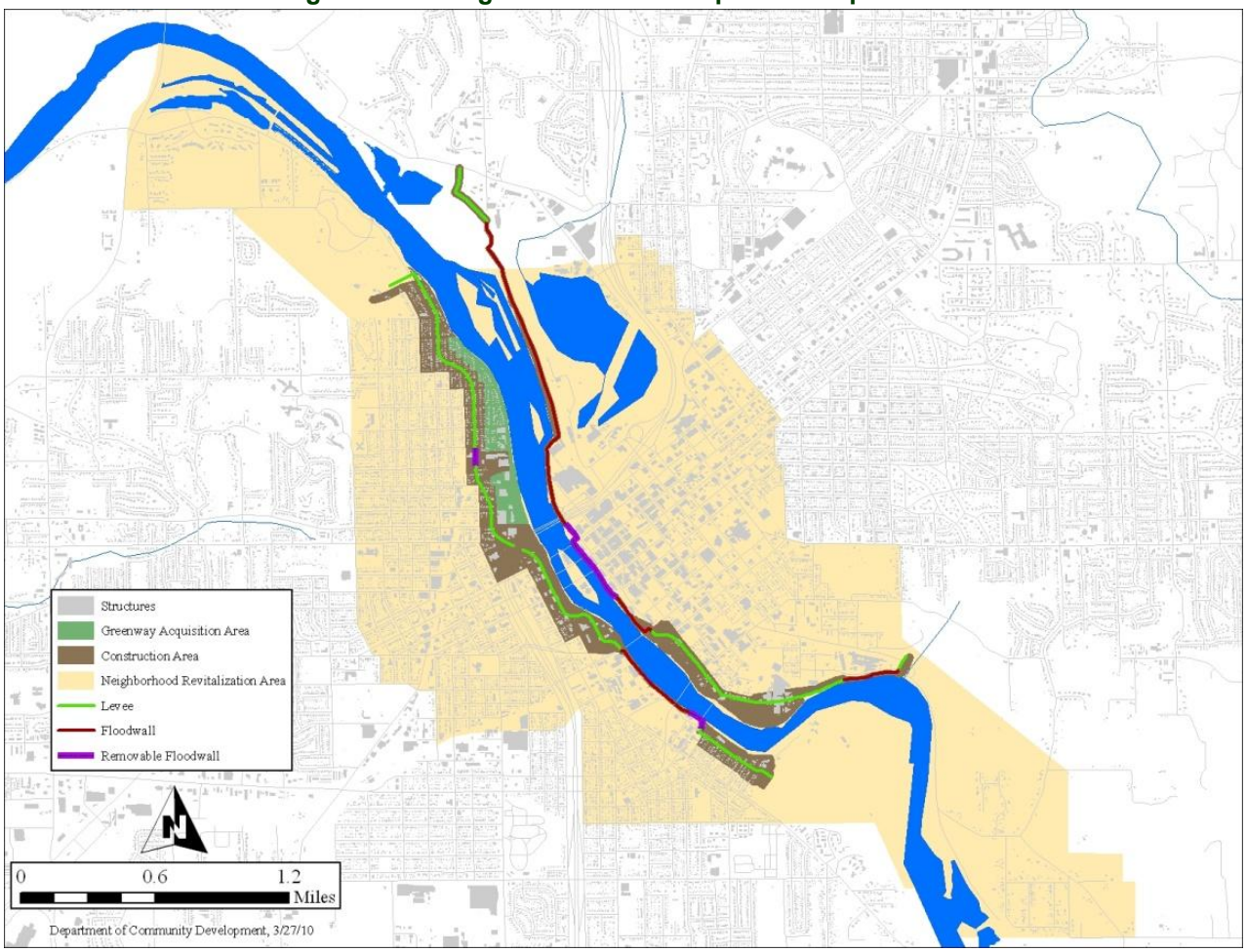
Voluntary Property Acquisition Program

The objective of the Preferred Voluntary Acquisition Plan is to acquire the properties impacted by the flood of 2008, removing the risk of future reoccurring damage to homeowners and taking the first step towards broad sustainable neighborhood reinvestment. To date, approximately 1,300 properties are registered to be voluntarily acquired.

On December 10, 2008, the City Council adopted a Preferred Voluntary Acquisition Plan. This plan outlined the City's strategy and identified three specific categories of flood impacted properties based on the purpose of acquisition as follows:

1. Greenway Voluntary Acquisition Area – unprotected area between the river and proposed structural flood management system. There are 117 parcels identified in this area that are eligible for acquisition through FEMA's Hazard Mitigation Grant Program. There are another 75 parcels that are eligible for acquisition through HUD's Community Development Block Grant Disaster funds.
2. Construction/Study Area – designated zone represents approximate areas likely to be impacted by the construction of a flood management system, based on similar flood management projects. Impacts include construction of the levees, floodwalls, and relocation of utilities and roadways. The zone was established based on the US Army Corps of Engineers experience on projects of a similar scope. There are 554 parcels identified in this area that are eligible for acquisition through HUD's Community Development Block Grant Disaster funds.
3. Neighborhood Reinvestment Area – properties scattered throughout the remaining flood affected neighborhoods that were damaged beyond reasonable repair. Currently, over 600 parcels have been registered by the property owner for voluntary property acquisition.

Figure 10 - Categories for Flood-Impacted Properties



The City has moved forward implementing the FEMA Hazard Mitigation Grant Program (HMGP) with 96 accepted offers to purchase and 54 closings completed to date. The City is scheduling initial consultations with those registered for acquisition through the HUD Community Development Block Grant (CDBG) Disaster Recovery funds. The total projected cost for both of these programs is $144 million which includes acquisition, demolition, and related expenses.

Preferred Flood Management System

As outlined in the previous section, residents were engaged in an intensive public participation process in order to create a preferred flood management strategy. This strategy has been adopted by the City Council and all flood recovery efforts are currently being implemented based upon this preferred flood management plan. The City's work on this preferred plan has accelerated the Army Corps of Engineers feasibility study by an estimated three years. Funding for the City's preferred flood management system is currently being sought in order to greatly reduce the risk of future flooding.

EFFECTS WITHOUT A PREFERRED FLOOD MANAGEMENT STRATEGY

The complex process of flood recovery will require years of collaboration between residents, City departments, and experts. Christine Butterfield, Director of Community Development, has said of the flood recovery process:

> *"The goal was not to simply rebuild, but to rebuild better than before. It's important to note that even though we were able to organize a plan for 10 neighborhoods in 5 months, which is unprecedented under normal circumstances, the implementation of these plans will take between 10 and 15 years. That is why it has been so important for the community to be engaged in the decision-making."*

Both phases of the public participation process were aimed at accelerating the flood recovery process by gaining public support and investment in these plans. The public dedicated hundreds of hours to ensure the revitalization of neighborhoods, businesses, parks, and entertainment venues within the flood-impacted area. The City has continued redevelopment efforts according to the City's preferred flood management strategy created through these intensive public participation processes. If the preferred flood management strategy is not implemented in the future, these plans will be completely negated and the City's framework for reinvestment in the flood-impacted area will need to be reworked.

Additionally, it is evident that that City is taking an active, multi-step approach to flood recovery through partnerships at the local, state, and federal levels of government. Cedar Rapids is dedicated to a full recovery aligned with the preferred flood management strategy and will continue to work towards this shared vision of flood recovery. Implementing the preferred flood management strategy is a necessary component of achieving this vision.

RECOVERING FROM THE FLOOD

UNCERTAINTY ABOUT FUTURE FLOOD CONTROL HAS SLOWED CEDAR RAPIDS' RECOVERY FROM THE 2008 FLOOD.

Cedar Rapids strives to recover from the 2008 flood but remains in a precarious position while waiting for a decision on the actual alignment of future flood protection. The City has engaged citizens in flood recovery planning efforts and worked to create a shared vision for flood reinvestment in the flood-impacted area. However, this plan, along with most redevelopment efforts, hinges on the implementation of the preferred flood management strategy. Due to this uncertainty, many of the recovery and redevelopment efforts have been slowed.

EFFECTS OF THE FLOOD

On June 11-13, 2008, the City experienced a flood of historic magnitude— the worst natural disaster in Iowa's history. The flood caused billions of dollars in damages to neighborhoods, businesses, and city services alike and will require at least 10-15 years for the City to completely recover.

Everyone in Cedar Rapids was impacted by the flood in some way. Those who lost their homes faced months of finding temporary housing and waiting for notification of whether they can return to their damaged property along with the additional costs associated with each of these scenarios. Thousands of downtown workers lost their jobs, some temporarily and many permanently, due to the flood damages that forced many businesses to close. Arts and cultural institutions that attracted residents from across the region were forced to close their doors for months, years, or even permanently. City services including the City Hall, the county courthouse, and central fire station sustained billions of dollars in damages. The following information gives an overview of the damages and impacts that occurred as a result of this historic flood.

Flood Magnitude

- 31.12 feet – Record-setting crest of Cedar River on Friday, June 13, 2008
- More than 10 square miles (14%) of the City impacted by floodwaters
- 1,126 city blocks impacted (561 severely damaged)
- 423 boat rescues performed by Cedar Rapids firefighters

People

- Amazingly there were zero flood-related deaths
- 18,623 estimated persons lived in flood-impacted area
- 10,000 estimated residents were displaced by the flood
- 120 families in flood areas receiving Section 8 housing assistance
- 1,300 estimated jobs lost as a result of the flood
- 1,800 elementary students were displaced

Property

- 41,771 tons of flood debris removed
- 7,749 total parcels flooded - 5,900 residential properties flooded (56% were owner-occupied; 34% were rental properties)
- 310 City facilities flooded
- 1,300 estimated flood-damaged properties will be demolished

City Services

- 6 major City buildings damaged and displaced - Veterans Memorial Building (home to city hall), Central Fire Station, Animal Control building, Public Works building, Ground Transportation Center (city transportation hub) and main public library
- Cedar Rapids Community School District central offices and elementary school flooded and displaced
- 8 iconic cultural assets displaced and destroyed, including museums, theaters and cultural centers
- 3 of 4 city collector wells and 46 vertical wells disabled
- 486 property tax-exempt facilities damaged (government, schools, churches, nonprofits, etc.)
- 136 other properties damaged (utilities, railroads, etc.)

Costs and Damages

To Homeowners:

- $376 million damage to homes
- $25,000 estimated cost per house to elevate above 100 year floodplain (if house can be saved and rebuilding is allowed)

To City Government:

- $504 million to clean up and repair or replace flood-damaged city buildings and other infrastructure
- $810 million to protect the city against future floods through an assortment of flood management efforts like levees, floodwalls, a new reservoir and property buyouts
- $504 million + $810 million = $1.3 billion in total (current flood clean-up plus future flood management options)

HOUSING AND NEIGHBORHOODS



Many houses in Cedar Rapids were impacted by the flood, but the area adjacent to the river was hit hardest. That area includes Time Check, Czech Village, Oak Hill Jackson and Downtown, along with the Taylor Area Neighborhood and the neighbors of the Sinclair factory. It will take time and money to repair these structures and homeowners are faced with many lingering questions as the future of flood protection remains uncertain.

As the flood waters receded, the City began assessing the damage immediately. Inspectors from the Code Enforcement Division systematically assessed properties in the damaged areas of the City, assigning each building a colored placard indicating its structural stability. The colored placards quickly communicated a building's safety to property owners and residents. The graph below gives an inventory of the assessed damage:

Figure 11 – Estimated Value of Damaged Homes

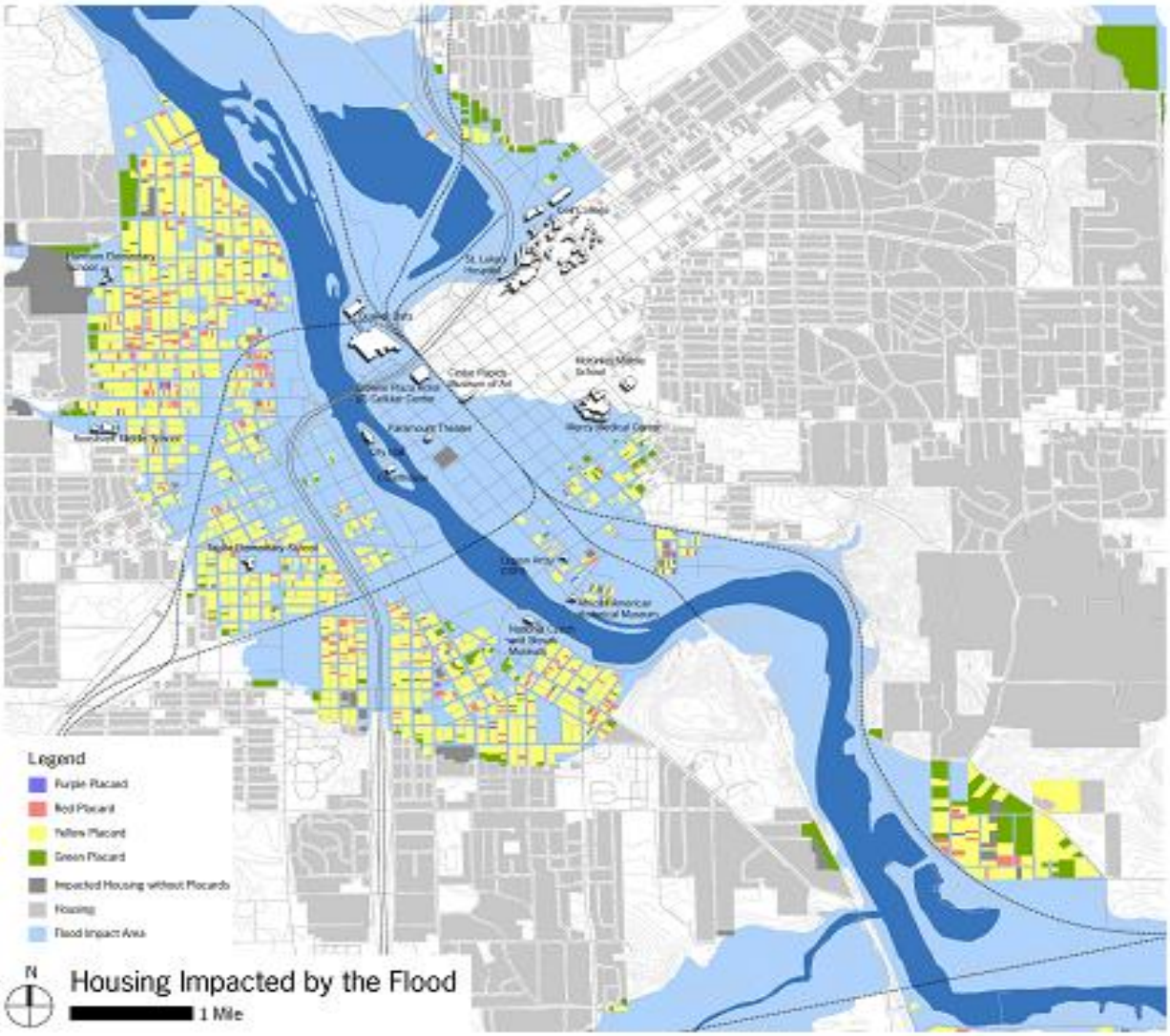
Value of Damaged Homes		
BY LOCATION	*NUMBER OF HOMES*	*VALUE*
100-year flood plain	1,083 homes	$88.9 million
500-year flood plain	2,975 homes	$240.8 million
2008 flood	4,509 homes	$367.5 million
BY PLACARD COLOR	*NUMBER OF HOMES*	*VALUE*
Purple[1]	44 homes (1%)	$2.3 million
Red[2]	357 homes (7%)	$24.1 million
Yellow[3]	3,220 homes (68%)	$239.9 million
Green[4]	1,145 homes (24%)	$151.6 million
TOTAL	**4,766 homes**	**$417.9 million**

[1] Purple placard indicates the building has sustained significant structural damage and needs to be demolished.

[2] Red placard indicated the building has sustained structural damage, is unsafe to enter, and most likely cannot be salvaged.

[3] Yellow placard indicates the building has sustained some water damage, and there is likely to be water in the building that may prevent operation of some critical electrical or mechanical systems.

[4] Green placard indicates the building may have water damage, but they are structurally safe and the mechanical systems were not significantly impaired.



In an effort to accelerate the flood recovery process, the City created a preferred flood management strategy with the input of over 2,600 residents who participated in a series of open houses over the course of four months. The City has used this preferred flood management strategy as a guide for redevelopment and flood recovery efforts, and will continue to encourage citizens to redevelop according to this plan.

RECOVERY PROGRAMS

Although the future remains uncertain, the City has continued to provide housing programs that will assist residents with flood recovery. However, uncertainty about the future of flood protection has complicated and delayed implementation of these programs. The following descriptions give an overview of the efforts the City has taken to assist residents with flood recovery, many of these are low-income and elderly citizens who had not planned on changing their housing situation.

JumpStart Housing Program

This program was originally created in October of 2008 to provide assistance to flood-impacted households. The program focused on three primary forms of assistance: Rehabilitation, Down Payment Assistance, and Interim Mortgage Assistance. The program incorporated both State and Federal funding to provide approximately $32 million in assistance. Rehabilitation funding was not awarded to anyone in a buyout area, including the 100 year floodplain and the construction/study area (targeted for levy construction).

Voluntary Property Acquisition Program



The first acquisitions occurred in late February of 2010, approximately 20 months after the disaster. Approximately $150 million has been set aside to acquire the nearly 1,300 households currently signed up for the program. FEMA Hazard Mitigation Grant Program (HMGP) funds will be used to purchase 107 properties in the 100 year floodplain. These parcels will be required to remain open space in perpetuity. The remaining 1,100 structures will be acquired with Community Development Block Grants (CDBG) funds. The majority of acquisitions are anticipated to be made in 2010 with a handful being completed in 2011.

Rental Rehabilitation Program

More than 200 flood-impacted rental units (outside the 100 year floodplain and Construction/Study Area) are in the process of rehabilitation. To date, more than $3 million has been disbursed to flood-affected landlords. An additional program is being developed with the use of local funds to address those rental rehab units (outside the 100 year floodplain and study area targeted for levy construction) that could not qualify for the original rental rehabilitation program.

Landlord Business Support Program

This program provides up to $15,000 to owners of flood-impacted residential rental properties to offset lost rental income and address additional carrying costs. The program began processing applications in February 2010 and will begin distributing funds in April 2010.

Replacement Housing Programs

According to a study performed by Maxfield Research in August 2008, the following housing needs were identified as a result of the flood:

Figure 13 – Replacement Housing Needs

REPLACEMENT RENTAL HOUSING NEED	
TYPE	UNITS REQUIRED
Market Rate	150
Affordable	230
Subsidized	86
Totals	**466**

REPLACEMENT OWNER-OCCUPIED HOUSING NEED	
TYPE	UNITS REQUIRED
Market Rate	210
Affordable	210
Subsidized	0
Totals	**420**

City staff has worked with the community and partner agencies to deliver new post-flood single family homes and multiple family apartments. As of October 2009, the City Council had approved a total of 233 new single family homes and 403 apartments with a total investment of over $117.3 million. The following chart gives an overview of the programs that have assisted in this replacement housing initiative.

Figure 14 - Replacement Housing Provided to Date

Replacement Housing				
Housing Program	**Completed or Approved**	**Private/State Investment**	**City Investment**	**Total Investment**
Single Family Programs:				
Oak Hill Neighborhood (HAND) Program	30	$3,770,000	$809,238	$4,579,238
IDED Single Family/Condominium Program	103 / 81	$26,343,000	$0	$26,343,000
Habitat for Humanity	20	$25,000,000	$1,000,000	$26,000,000
Total Single Family Housing	**233**	**$55,113,000**	**$1,809,238**	**$58,456,238**
Multiple Family Programs:				
Low Income Housing Tax Credit Projects	342	$48,403,555	$6,533,173	$54,956,728
IDED Multiple Family Program	61	$3,965,000	$0	$3,965,000
Total Multiple Family Housing	**403**	**$52,368,555**	**$6,533,173**	**$58,901,728**
Total Replacement Housing	***636***	***$107,481,555***	***$8,342,411***	***$117,357,966***

- **Single-family New Construction Program:** Approximately $21 million for the construction of more than 400 new single family housing units. During the first round of the program, the City of Cedar Rapids leveraged $8 million to construct 184 units. The City has been awarded approximately $13 million for a second round of the program. Staff is estimating this round will develop an additional 240+ units of affordable and workforce housing.
- **Multi-family New Construction Program:** Approximately $4 million in the first round of the program was leveraged to construct more than 300 multi-family units. A second round is currently under development.
- **HAND Program:** This program was established pre-flood to provide attainable workforce housing in a neighborhood that needed revitalization. After the flood, the established HAND program provided a means to quickly respond to housing needs for flood displaced families. In less than one year, 30 new homes have been completed.

The majority of the housing that was affected by this flood is in low- to moderate- income neighborhoods. All of the replacement housing programs have worked to provide replacement housing to those looking for affordable housing options.

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

The City has worked tirelessly to provide flood victims with several options for new housing or rehabilitation to flood-impacted properties. However, the City is unable to guarantee protection of this area as the future flood management strategy remains uncertain. This uncertainty results in many unanswerable questions for residents and forces them to make relocation and rebuilding decisions before the future of the area is fully determined. As a result, many of the flood-impacted neighborhoods have redeveloped at a much slower pace than desired. Residents are fatigued and discontent with the myriad of questions that still surround their flooded properties.

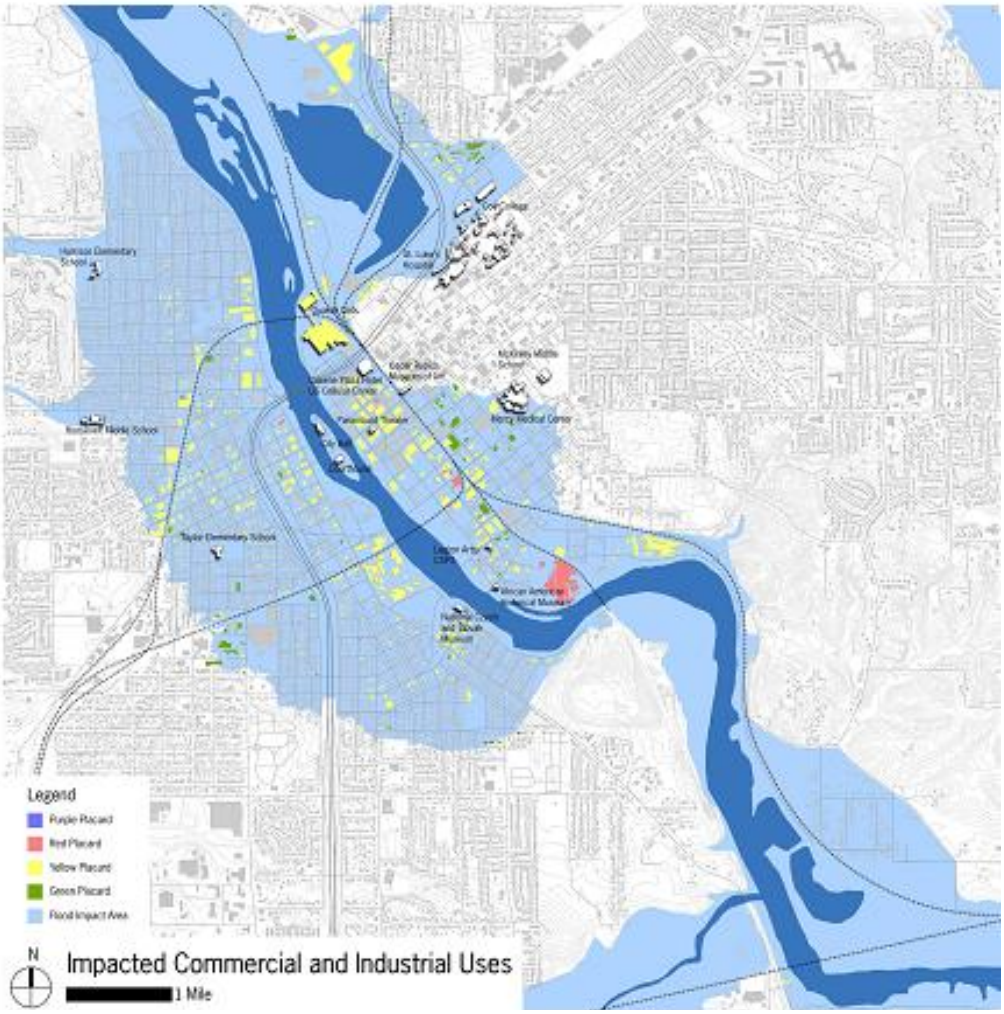


The City has implemented several programs in an effort to assist residents with flood recovery, but is often unable to provide definitive answers due to the lack of knowledge on future flood protection. Many of the flood recovery strategies have been implemented based upon the preferred flood management strategy and cannot be fully realized until Cedar Rapids receives funding. City staff has been working to create a foundation for the preferred flood management strategy through the many flood recovery programs, but remain in a precarious position as they work to assist residents with flood recovery without a guarantee of future flood protection. The preferred flood management strategy must be implemented in order to achieve the goals that the entire City has been working to achieve for years since the flood.

BUSINESS

The majority of downtown Cedar Rapids was impacted by the 2008 flood with over 900 businesses, large and small, heavily damaged by floodwaters. Among those businesses were some of the City's and State's largest employers including Quaker Oats, Alliant Energy, St. Luke's Hospital, Mercy Medical Center, Penford, and Cargill. Further disruption was caused due to the flood damages caused to the Union Pacific and CRANDIC railroads. Flood-impacted businesses have taken on over $120 million of additional debt as a result of the flood. Seventy percent of businesses view the flood related obstacles as their biggest challenge– even more of a challenge than the economic downturn.

Figure 15 – Businesses Impacted by the Flood



The Self-Supporting Municipal Improvement District (SSMID) is a 58-block area in the downtown core. Within the district, a voluntary tax of $2.75 per $1,000 of taxable value is collected. This tax revenue is directed towards streetscape enhancements, economic development and business support within the SSMID. Flood damage eroded the downtown property tax base that generates revenues of about $180 million.

More than 100 of 132 blocks within the greater downtown area were impacted by the 2008 flood.

Of the 907 businesses that operated prior to the flood, at least 55 have closed and another 76 have been unreachable and presumed closed or relocated outside the City. On the positive side, 671 businesses have reopened downtown, at least 26 are in the process of returning to downtown and another 79 have successfully reopened outside of downtown. Many in the latter group have expressed interest in returning downtown when issues such as flood protection are resolved.

Figure 16 - Flooded Downtown Businesses



Total damages to all flood affected businesses include:

- Total damage to jobs & businesses: $2.57 billion
- Total number of businesses directly or indirectly impacted by the flood[5]: 1,281
- Number of businesses lost as a result of the flood: 131
- Number of jobs in the flood impacted area before the flood: 11,814
- Number of jobs lost as a result of the flood: 1,865
    - Permanent: 1,324
    - Temporary: 541
- Number of businesses that have reopened: 671
- Number of businesses that reopened outside the city or flooded area: 143

[5] Directly impacted businesses had physical water damage, while businesses impacted indirectly suffered business interruption due to the flood.

BUSINESS RECOVERY PROGRAMS

The City has provided the following programs to assist businesses with flood recovery. The future of flood protection remains uncertain and much of the progress in business recovery has been slowed due to businesses' unwillingness to risk rebuilding when flood protection is not guaranteed.



Jumpstart Business I

This program began in the fall of 2008 to provide up to $50,000 in assistance to flood-impacted businesses. The program distributed over $19 million in assistance.

Business Rental Assistance

This program began in the spring of 2009 to provide up to 6 months of rent assistance (at fair market rents) to businesses located in the flood-impacted area. The program distributed nearly $5 million to date. An additional $2 million remains to be distributed.

Business Loan Interest Expense Assistance & Commercial Rent Revenue Gap

Approximately $20 million has been allocated to these two business programs. The Commercial Rent Revenue Gap is designed to provide up to 12 months of lost rent assistance (up to $24,000 per business). The Loan Interest Expense program is designed to provide up to three years of assistance to offset the carrying cost of flood-related debt payments and lost rent for flood-impacted businesses. These programs began processing applications in February and will start distributing funds in April.

Steam Conversion Program

Approximately $21 million has been allocated to a Steam Conversion Program. The program provides funds to high- and low-pressure users to offset the increased cost of steam post-flood and the cost to convert from steam to a new energy source (i.e. natural gas).

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

Before the flood, there were 907 known businesses operating from downtown, and nearly every month, new businesses were being added to the mix. Since the devastating flood, downtown Cedar Rapids has fought to regain that momentum. One of the significant factors that will determine success is the ability to rebuild investor and developer confidence by ensuring protection from another flood.

While 671 businesses have returned and believe in the potential of the downtown neighborhoods, they also face the risk of losing everything again for as long as our community remains vulnerable to another flood. It is a big risk to continue to develop and reclaim downtown during this time of uncertainty, but it is virtually impossible to abandon 10.2 square miles of a community and expect it to survive. Downtown alone represents the largest concentration of

jobs in the community and the city's largest business center. Since the flood at least 25 new businesses have opened in greater downtown. Downtown is also the historic, cultural, civic and entertainment center of the community.

Within the first five post-flood years, it is likely that more than $1 billion will be invested downtown. Part of that has already gone into private properties that have added significant improvements as businesses rebuilt from the flood. Public sector investment is currently predominant, but private investors are enthused by that progress and public sector commitment and are planning projects of their own. However, if flood protection that most thought would be planned and constructed is stymied, those plans will never be implemented, and our progress toward realizing the vibrant city center will be compromised.

Even businesses that had zero water damage have been facing economic hardships over the past 18 months. While much of the downtown area was covered in water, many of the surrounding businesses that "survived" were completely isolated and unable to do business for periods of time because of the damage and work going on around them. If the Cedar Rapids community goes without funding for permanent flood protection structures and management, the local businesses and economy will continue to be worn down as we continue to face the threats of further flooding year after year.

While 74% of businesses have returned to downtown Cedar Rapids, most of the remaining properties have been all but abandoned and are in terrible condition. Several of these flood-blighted properties are located within the heart of downtown Cedar Rapids' core business district and are inhibiting redevelopment. When blighted properties sit abandoned among open businesses and cultural attractions, they diminish the visitor experience and weaken the perception of the quality of our downtown neighborhood. Impacts on neighboring properties, particularly when those are customer-oriented businesses, can be severe.



If Cedar Rapids is unable to have the degree of flood protection provided by the City's preferred flood management system, future flooding will continue to haunt our downtown as it creates a cycle of more blighted properties, discouraging growth and the ability to meet the City's full potential.

Business assets also remain tied up as a result of flood mitigation uncertainty. Businesses with buildings located in the 100 year flood plain cannot make sound long-range decisions without a definitive protection plan. Properties in the 100 year flood plain have seen their market valuations decline dramatically without flood protection and can't afford to move elsewhere as a result. In effect, they are forced by economics back into their old location and threatened by future flooding.

Three scenarios exist as a result of uncertainty in future flood protection:

- Businesses that are reinvesting in their plants and buildings which will elevate the costs of moving later due to risk of flooding without the preferred flood management strategy.
- Businesses that have returned to their facilities but invested little or nothing in flooded buildings and are losing productivity and growth as a result of waiting to see if their businesses will be protected in the future.
- Businesses that have not returned to their buildings and have assets in limbo as they cannot get financing to rebuild but cannot sell their properties to build or move elsewhere due to the lack of certainty in future flood control measures.

Even with the uncertainty of future flood protection, businesses and major industry have demonstrated a commitment to rebuilding. Many have committed significant unreimbursed financial resources for that purpose. However if another flood occurs, experience suggests that many of these businesses and industry will simply go out of business or relocate, significantly damaging the City's economic viability. The preferred flood management strategy must be implemented in order to ensure the future economic success of the City of Cedar Rapids.

CITY FACILITIES

In June 2008, all of the city's primary municipal buildings were evacuated and eventually flooded. No other city has ever so many facilities– City Hall, Jail, Municipal Court Facilities, Central Fire, Central Library and the Police Headquarters– in a single event. Based on damage to public facilities, this is the 5th largest state disaster in U.S. history.



In all, 310 municipal facilities were damaged. In spite of the quick and in some respects total devastation of various municipal facilities, all city services continued uninterrupted, and a fully functional City Hall was opened within two days of the flood's crest. By the heroic efforts of many, and the tireless dedication of all, services that the citizens of Cedar Rapids relied upon continued, despite the challenges faced by every city department. City Hall, which houses the city administrative departments, sits on a small island in the middle of the Cedar River, and was evacuated two days before the river's crest. Both the Central Fire Station and the Police Department were also evacuated. The fire station was a total loss, having filled with water to the ceiling. Damage to the police station, a 10-year old state-of-the-art law enforcement facility, included the flooding of the basement evidence room, locker

rooms, and electrical system and generator. The public works and code enforcement building, located over a half of a mile from the river, filled with several feet of water. The main public library, a neighborhood recreation center, and several park buildings went under water as well. All communication methods for the city were lost, including computer networks, telephone systems, and the 9-1-1 dispatch and radio system. The Ground Transportation Center (GTC), the transfer station for the metropolitan area transit system was flooded and transit operations were moved twice and were up and running the Wednesday after the flood.

The wastewater treatment facility was submerged and lost power, and all but one well water source for water treatment was incapacitated, dropping water production to 25 percent of what is necessary to supply uninterrupted residential and industrial service to the community. The city faced the very real possibility of losing its potable water system completely. It is important to note that the City of Cedar Rapids provides water service to the City of Robins and the Benton County Water Service. The City also is the regional wastewater treatment provider handling the waste from the Cities of Marion, Hiawatha, Robins, and portions of Linn County. Although the wastewater treatment facility has a service area of approximately 160,000 people it actually treats the population equivalent of 1,600,000 due to the extensive network of food processing, biotech, and related industries that are located in Cedar Rapids. Besides the business interruption and economic loss as a result, the impacts on the environment were enormous. From June 12th until August 25th approximately 3.1 billion gallons of untreated wastewater was released into the Cedar River until full treatment systems were back online.

Trained for decades in emergency response as a result of having the small nuclear power plant, Duane Arnold Energy Center, 9 miles away, the public safety response resulted in no loss of life, no serious injuries, and the orderly evacuation and rescue of thousands of residents and their pets.

In addition to City facilities damaged, Linn County also suffered major facilities losses. County buildings were evacuated, included the administrative building, Sheriff's Office, jail, and district court displacing operations for months. The Cedar Rapids Community School district lost their Educational Service Center, which housed all administrative functions, as well as buildings for warehouse and maintenance operations. Several schools were also inundated but have since been rehabilitated and resumed classes.



Beginning in the summer of 2009, the City of Cedar Rapids conducted a series of open house to solicit public input on how to move forward with flood-damaged City facilities. Buildings included in this process included those buildings, facilities, and programs where major policy decisions

would need to be made by the City Council regarding how or where they will be rebuilt. The Cedar Rapids City Council requested options be prepared for each of these facilities that included:

- Returning to existing buildings as they were at the time of the flood
- Returning to existing buildings as they were at the time of the flood with service improvement upgrades to meet current building codes and accessibility guidelines
- Consideration of new buildings, alternate locations, and the possibility of co-location of services with other governmental entities to help reduce operating costs and improve community service delivery

Many other damaged city facilities were not included in this process as an extensive public input component was not necessary to make the policy decisions required for where or how they would be rebuilt. Facilities and programs included in the open house process included:

- City Services – those customer-facing services provided by the city, some of which were previously housed in the Veteran's Memorial Building (City Hall)
- City Operations – public works operations and fleet maintenance operations
- Main Public Library
- Animal Care and Control Facility
- Central Fire Station

Input from the public was sought regarding how the city provides services to its citizens, and how city facilities contribute to reducing the long-term cost of government, in relation to each of these facilities. Feedback from the public was received at each of three sets of open houses, one in June 2009 presenting the challenges to the community, one in August 2009 outlining the options for each facility or program, and one in November 2009 providing an outline of recommendations for the City Council's consideration. Strong themes within the feedback included:

- Protect or relocate vital City services outside the Cedar River flood plain – future flooding remains a high concern
- Create multiple options for community facilities as a component of a renewed and vibrant downtown
- Social sustainability (livability/walkability) should be a priority in future option considerations
- Develop options with accessible and centralized services, and plentiful free parking
- Demonstrate fiscal responsibility – present financial data in future option considerations

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

As the City of Cedar Rapids repairs and rebuilds its own facilities damaged by the flood of 2008, concerns about future flooding and the impacts of factors such as evacuation and continuity of services, flood insurance costs increasing long-term operating costs, and rebuilding to best suit the needs of the city's residents and businesses are paramount. While the City Council continues to express a strong desire to commit to providing services from the core of the City, it is quite challenging to do so while also ensuring that services can be provided uninterrupted.

Two major city facilities, the Main Public Library and Central Fire Station, are slated for relocation to new sites, both primarily using FEMA reimbursement funds. The Main Public Library site selection process is underway, with a preferred site selected by the City Council. Sites were considered that were impacted by the June 2008 flood, and others on higher ground. Concerns for future flooding by both the Library Board and the community were prevalent. The site ultimately selected as the preferred site for the Library was flood-impacted, but is located on the edge of the flood inundation zone, and the new facility is slated to be built above the record flood-elevation. Nonetheless, there are concerns regarding this investment without the assurances of a flood management strategy in place. The Central Fire Station relocation process has just begun, with emergency response times providing a primary factor for site selection in the core of the city. Without a flood management strategy in place, additional concerns exist related to access for emergency response on the east and west sides of the river during flooding episodes that may close bridges and roads.

As noted with the Library facility, new buildings are intended to be designed to be built above the record flood elevation. However, use of existing facilities, even with upgrades for service provision and flood mitigation that can be retrofitted, highlight concerns about the long-term viability of those buildings providing critical services to the city without a flood management strategy.

ARTS AND CULTURAL INSTITUTIONS

Cultural Attractions

The 2008 flood in Cedar Rapids impacted 80% of the historical and cultural landmarks directly and with huge devastation. The major cultural institutions are in the downtown district, many in historic buildings. Three riverside museums– the National Czech and Slovak Museum and Library, the African American Museum and Cultural Center of Iowa and the Science Station– were inundated as were two historic theatres– the Paramount Theatre that is home of Orchestra Iowa and Theatre Cedar Rapids– within which water covered the stages and multiple rows of seating. The Cedar Rapids Public Library lost much of its collection as well as the entire building.

The following is a list of the major cultural assets that were impacted as a result of the 2008 flood:

- Mother Mosque of America
- Czech & Slovak National Museum & Library

- African American Historical Museum & Cultural Center
- Theatre Cedar Rapids
- Paramount Theater
- Legion Arts (CSPS)
- Science Station
- Cedar Rapids Museum of Art

Loss of each of these places and attendant programs was another blow to the citizen's sense of identity and place. Cedar Rapids Museum of Art lost a new collections storage system and the collection was endangered by loss of environmental controls. Indian Creek Nature Center suffered significant damage to its landscape and historic barn. Legion Arts, a nationally recognized performing arts organization, was knocked out of its historic home, the National Register listed CSPS hall.

Suddenly there were no performance spaces, no meeting spaces, few arts or cultural experiences. Performing groups like the Cedar Rapids Opera Theatre, Urban Theatre Project of Iowa, SPT Theatre, Concert Chorale, and Chorale Midwest had no place to perform. Many individual performing and visual artists lost their homes as well as their studios.

Initial estimate of direct financial damage to eight cultural organizations was nearly $18 million. Rebuilding costs are millions more. In February 2010, Theatre Cedar Rapids completed a $7 million renovation of their space, which is a wonderful expansion of necessary production and administrative space, in a restored historic building. The National Czech and Slovak Museum and Library has undertaken a $25 million project which includes moving the flooded, iconic red roof building and constructing a new museum while restoring two historic houses and a historic commercial building in the heart of the Czech Village. The African American Museum has returned to their original building after spending hundreds of thousands of dollars to clear and repair the building and creating a new permanent exhibit, which is modular so it can be moved should the waters rise again.



The Paramount Theatre is among the more complex projects because of its elaborate architecture, historic status, and demands of a performing arts center. City-owned with outside management, its restoration has been painstakingly slow for a multitude of reasons.

Legion Arts/CSPS is essential to the arts community, but equally to the New Bohemia neighborhood in which they are located. Through their efforts, Legion Arts will have new performance and exhibit areas that are fully accessible with heating/cooling/plumbing adequate for a public building. A major historic building will be restored and a neighborhood will be enhanced. The impact of this $6.8 million effort will be far reaching in attracting new audiences, telling regional and national groups what Cedar Rapids has, and strengthening the cultural life of this community.

Assigning dollar amount to the damage and the loss is to miss the real value of our historic buildings, our visual and performing arts, and the cultural spirit of the community. These are invaluable factors in the quality of life so important to attracting and retaining a strong work force. In Cedar Rapids, arts and culture contribute $63 million to the local economy, as measured by Americans for the Arts.

Historic Buildings

There are at least 212 historic buildings in flood impacted neighborhoods, either listed or eligible to be listed on the National Register of Historic Places (NRHP), that are now facing demolition and four historic districts have been severely damaged. Twenty-one other NRHP sites and districts were affected by the flood. Other historic districts saw loss of contributing properties that may threaten their listing. At the former Sinclair Meatpacking site, now one of the City's brownfield sites, eleven NRHP eligible buildings are slated for demolition.

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

At least 10 of 14 major cultural attractions in our downtown were impacted by the flood, and at least five are still trying to recover and return to their original location, or work through finding a new location. The Paramount Theatre, a historical landmark of our community, will be closed for years as the City and Historical Society hope to rebuild it better than ever. The Main Public Library is in the middle of relocating according to FEMA funding stipulations, and has been operating out of small temporary units dispersed throughout the Cedar Rapids area. The Czech and Slovak Museum & Cultural Center, Science Station, and Freedom Festival all fight to move their events and programming back to the downtown area. Without proper flood protection there will be more barriers for these cultural attractions to overcome and our community will remain without them.

The response of the arts and cultural sector has been remarkable. The resiliency of the people and organizations is amazing as they sought new venues and new means of continuing their missions of bringing the arts to the people. Repeatedly, the importance of our culture has been illustrated by word and deed as efforts to return better than ever come to fruition. To restore and repair all these places has and will continue to cost millions from governmental, private, and corporate funders. Each organization has to package grants, contributions, appropriations, and in-kind donations to pay for returning to full operation. This cannot be allowed to occur a second time; these investments must be protected from another natural disaster.

SOCIAL SERVICES

As a result of the 2008 flood, there was a significant increase in the need for a variety of social services in Cedar Rapids. The Greater Cedar Rapids Community Foundation[6] has awarded $4.7 million to 67 local nonprofits to assist in this increased demand for social services as a result of the flood. FEMA has also worked to provide funding for several social service centers within Cedar Rapids.

Mental Health

The flooding of June 2008 had a profound effect on the physical and mental health of those who work and live in parts of Cedar Rapids. Mental health and stress related issues from traumatic events such as the Flood of 2008 are felt for many years. Past disaster experiences tell us that there is an increase in demand for mental health treatment for 8-10 years after the traumatic event.

The Abbe Center for Community Mental Health provided more than 6,300 crisis counseling services since the flood. Many of the people impacted by the flood, in need of continued mental health treatment, were also in need of a funding source for that treatment. To alleviate this barrier to service, Abbe Center secured several local grants totaling $80,000 to provide these needed services. Nearly 300 individuals have been provided more than 725 services, which include individual therapy, psychiatric evaluation and follow-up. This increase in the need for mental health services has resulted in 3,000 additional hours of therapy/psychiatry services in the year following the flood- a 20% increase from services provided pre-flood.

Substance Abuse

The area's only major drug/alcohol rehabilitation center in Linn County, the Area Substance Abuse Center (ASAC) reported a big increase in service provision post-flood. Since the flood, ASAC has worked with 683 clients who were flood impacted–350 of those experiencing major flood impacts[7] and 333 experiencing minor flood impacts[8]. These numbers indicated that several hundred people directly affected by flooding needed drug/alcohol rehabilitation. When comparing similar date ranges pre- and post-flood, Linn County outpatient counselors showed a significant increase in outpatient sessions as shown below:

[6] The Greater Cedar Rapids Community Foundation is a public charitable foundation holding more than 500 different funds, large and small, established by individuals, families, nonprofit agencies and businesses to benefit Linn County, Iowa.
[7] Residents who experience major flood impacts were those that either lost their home or home was damaged in the flood, lost their job, or lost personal possessions in the flood
[8] Residents who experience minor flood impacts were those with transportation issues related to the flood, financial issues, friends or family were impacted, temporarily displaced, utilities interrupted, pet injured/killed, or under stress due to the flood

Figure 17 - Mental Health Demands Pre- and Post-Flood

	Outpatient Sessions	Intensive Outpatient Therapy Days[9]	Extended Outpatient Therapy Hours[10]
Pre-Flood	13,874	2,129	8,685
Post-Flood	16,912	2,654	10,617
% Change	+22%	+25%	+22%

Flood Recovery Assistance

Of the over 18,000 persons impacted by the flood, hundreds of households were still living elsewhere as of October 2009, according to the Linn Area Long Term Recovery Coalition (LALTRC). This organization spent millions of dollars since July 2008 on case advocacy, volunteer coordination, spiritual/emotional care, crisis counseling, and rebuilding. This coalition documented 536,044 volunteer hours spent in the first 15 months after the flood, mostly on housing related activities.

Additionally, the LALTRC was a distribution center for appliance vouchers and grants with a total value of over $700,000. They also administered the 'Unmet Needs' grant program for the County, distributing $3,581,788 to more than 1,400 flood-affected households.

The Red Cross served 9,499 flood-impacted clients. They provided food, clothing, medication replacement, ran two emergency shelters for several months, which included feeding programs. Their total cost for services provided, just in 2008, was $3,459,296.

The Salvation Army has assisted 187 flood-impacted residents by allocating over $99,000 in assistance funds. These funds helped to pay for rent, lights, gas, water, auto repair, furniture, lot rent, and much more.

The Linn County Mental Health/Developmental Disabilities Services has spent $1.1 million assisting over 100 flood impacted residents. Residents received services such as supported community living, supported employment, transit, counseling, case management, and inpatient care from a variety of non-profits. This organization also provided some direct financial assistance to help with temporary housing costs, food and clothing. The residential area impacted by the flood included a significant number of low-cost housing units rented by residents with mental disabilities– relocating them has been a significant part of the flood recovery effort.

[9] Intensive Outpatient therapy, a level of care requiring meetings of 3 hours/day, three times/week
[10] Extended Outpatient therapy, a level of care averaging around 5 hours/week of treatment

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

Although the City has not had the capacity to document all services provided to persons affected by the flood, estimated costs of these services are between $10-20 million[11]. With the negative impact on social stability, emotional stresses, loss of housing, additional costs of living, compounded by mental health and other resultant areas of suffering, there is not enough that can be said about the enormous impact the 2008 flood has had on the social fabric of this city.

As can be seen by the figures above, the social services that were provided as a result of the flood have had an enormous financial impact on the City of Cedar Rapids and its residents. As people continue to recover from the flood, the need for health and volunteer services is a necessary component. Those that were worst hit by the flood will continue to struggle with the psychological impacts far into the future.

Without the guarantee of future flood protection, flood-impacted residents remain in a state of uncertainty and often panic as the water levels rise each spring. Many residents are unable to move due to financial struggles and the City must be able to ensure their protection from future traumatic flooding events by implementing a preferred flood management strategy.

11 An additional report comes from Craig Wood, the Linn County, IA, Mental Health/ Developmental Disabilities Services Administrator

CLIMATE CHANGE, UNCERTAINTY, AND FUTURE FLOOD LEVELS

RECENT RESEARCH SUGGESTS THAT CEDAR RAPIDS MAY BE AT GREATER RISK FOR FUTURE FLOODING THAN PREDICTED BY CORPS METHODS.

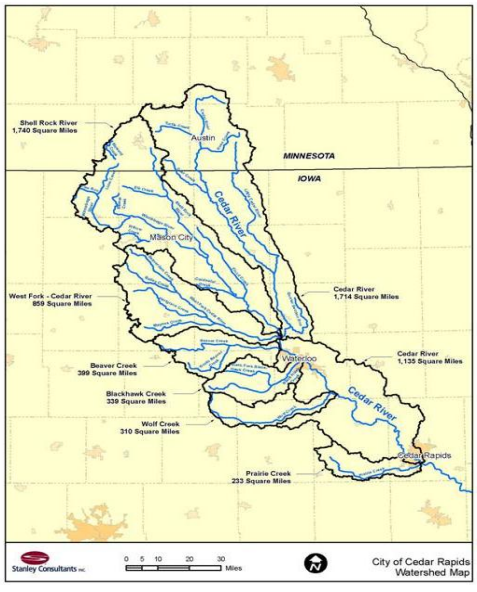
There is an enormous difficulty in predicting the magnitude of the next flooding event. The HEC-RAS model (Hydrology Engineering Center-River Analysis System) used by the Corps of Engineers is widely accepted because its hydraulic modeling of future flood frequency is based upon historical data. However, there is uncertainty of the behavior of hydraulic water flow through rivers and channels when exceeding previous historic levels. Academicians are researching certain components of metaphysics, including fractal powerlaws, multifractals, and chaos dynamics, to affect natural phenomena, such as drainage networks, flooding, erosion, and earthquakes (Turcotte). Another disadvantage of the HEC-RAS model is that it does not take into account other factors, such as climate change, and its potential impact on storm distribution, duration, and timing. These factors collectively suggest the potential for increased levels of future flooding as compared to those assumed by the Army Corps of Engineers.

The City of Cedar Rapids lies in a vulnerable position as the future flood protection remains uncertain and the threat of another flood could be more imminent than predicted by Corps studies.

Cedar Rapids' location within the watershed, changes in land use, and sloping topography all make the City more susceptible to future flooding.

Cedar Rapids' location along the Cedar River increases the probability of flooding. Foremost, the City is at the bottom of a 190 mile long watershed, receiving upland waters from approximately 6,510 square miles. Secondly, the river corridor through the City is quite narrow, leaving little room as water levels rise.

Figure 18 - Cedar Rapids Watershed Map



Additionally, the transformation of land uses surrounding the river has magnified the effects of precipitation events. Traditionally, precipitation events were retained by the thousands of acres of prairie lands whose deep roots quickly infiltrated rainfall. As Iowa developed, prairies and their underlying productive soils were converted into agricultural lands and oak forests were logged or developed as residential neighborhoods. The capacity of the watershed to retain water has decreased significantly and the water that once slowly flowed through the City can now rush in with little warning time. For example, in 2008, the City only had 72 hours notice from the time the forecast went from 24 feet and was then increased to 32 feet.

Finally, Cedar Rapids is located within a geographic bowl, with gentle slopes on all four sides and a flat topography within the downtown area. As flood waters rise the City fills very quickly across the shallow downtown elevations causing catastrophic damages such as those experienced in the flood of 2008.

CLIMATE CHANGE

1. ***Climate change will increase flood frequency in Cedar Rapids, a fact that is not taken into account by the Corps' current Principles and Guidelines for predicting flood frequency.***

As stated by the Institute for Water Resource,

> *"The entire portfolio of USACE Civil Works water resources infrastructure and programs, existing and proposed, could be affected by climate change and adaptation to climate change."* (Institute for Water Resources)

However, the current Principles and Guidelines that are utilized by the Army Corps of Engineers to estimate flood probabilities are based on historical data, under the assumption that climate will not change significantly.

2. ***Climate change plays a large role in calculating the magnitude and frequency of future flood events within the City of Cedar Rapids and should be taken into account when determining flood risk in the project area.***

It is now recognized that the earth's climate is changing as a result of increasing concentrations of greenhouse gases due to human activities. Furthermore, leading water resource experts have concluded that the assumption of an unchanging climate "should no longer serve as a central, default assumption in water-resource risk assessment and planning" (Milly, Betancourt and Falkenmark).

As part of the Wisconsin Initiative for Climate Change Impacts, University of Wisconsin researchers have been evaluating the potential impacts of climate change on the magnitude and frequency of riverine flooding in Wisconsin. Analysis to date suggests that the magnitude and frequency of large riverine floods in Wisconsin will increase significantly in the coming decades dues to climate change, particularly in watersheds in which major floods are caused by a combination of both rain and melting snow. Given the close proximity of the Cedar River watershed to Wisconsin and the fact that the largest floods have been caused by both rain and melting snow, the Wisconsin results are relevant to ongoing flood planning for the City of Cedar Rapids.

- A substantial increase in the magnitude of the 100-year, 24-hour rainfall. (For Eau Claire in western WI, the average projected increase is 7.5%.)

- A large increase in the frequency of exceedance of 3 inches in 24 hours. (For Eau Claire, the average projected increase is 29%, from one event every 4.4 years to one event every 3.4 years.)
- Substantial increases in winter and spring precipitation and very large increases in the proportion of that precipitation that is rain. (For Eau Claire, the average projected increase in December through April precipitation is 17%. Averaged over WI, the average projected increase in December through March rainfall is 84%)

The record-setting 2008 flood occurred in mid-June as a result of several days of heavy rainfall on soils that were still wet from an unusually wet spring. The statistically downscaled precipitation data for Wisconsin indicate increases in both the frequency of extreme rainfall events and wet springs. This strongly suggests that analyses based on the historical streamflow record of the Cedar River significantly underestimate the probability of the 2008 flood. Although climate model projections are uncertain, it would be prudent to accommodate the design of the Cedar Rapids flood protection system to potential increases in the probability of catastrophic flooding (Potter).

Figure 19 – Calendar of Historic Floods on the Cedar River (U.S. Geological Survey)

Date	Flow, cfs	Stage, feet	Elevation, feet NGVD 29
June 13, 2008	140,000	31.12	731.59
June 1, 1851	65,000	20.00	720.47
March 18, 1929	64,000	20.00	720.47
March 31, 1961	73,000	19.66	720.13
April 4, 1993	71,000	19.27	719.74
April 4, 1933	58,400	18.60	719.07
April 10, 1965	66,800	18.51	718.98
July 25, 1999	62,300	18.31	718.78
May 27, 2004	62,500	18.30	718.77
June 16, 1947	56,200	18.23	718.7

3. ***In Fargo, North Dakota, the Army Corps of Engineers thoroughly researched the impacts of climate change within the study area and incorporates these finding into the report.***

The St. Paul District of the U.S. Army Corps of Engineers, who performed the feasibility study in Fargo, North Dakota, collected data from a panel of experts to serve two purposes:

- Provide general guidance on how to account for climate change in the hydrologic and hydraulic analyses that support the feasibility study
- To identify specific actions that should be taken into account for future probability and uncertainty in flood flows in the quantification of flood risk in the project area

The expert panel agreed that there was a clear trend toward greater magnitudes and frequency of flooding in the area, and these shifts in and uncertainty in future precipitation and flood flow frequency must be taken into account. (David Ford Consulting Engineers, Inc.)

The magnitude of research performed by the St. Paul ACOE highlights the importance of examining the effects of climate changes within the region. Climate changes have had a significant impact on flood frequency in Cedar Rapids and should be taken into account throughout the analysis of the project area.

4. ***The flow of the 2008 flood was the same as a 200-year flood predicted by the Army Corps of Engineers in 1964. With the impacts of climate change, the 200-year flood as predicted by the Corps would be far more frequent.***

The Interim Review of Reports for Flood Control on the Iowa and Cedar Rivers, Iowa and Minnesota, US Army Engineer District, Rock Island, 28 January 1964, on page C-18, paragraph 42, states "A project for protection of the balance of the urbanized flood plain providing protection against a flood with recurrence interval of 200 years was presented to the representatives of Cedar Rapids. The crest flow for the 200-year flood is 130,000 c.f.s. as compared to the 73,000 c.f.s. for the 1961 flood, the highest in the 60-year period of flow record."

EFFECTS WITHOUT A PREFERRED FLOOD MANAGEMENT STRATEGY

Research into alternative hydraulic models and climate change is progressing, although still at its early stages. However, these alternative views are demonstrating that the likelihood for increased flood frequency and duration, and the timing of these events, will put Cedar Rapids at even greater risk to future flooding.

ENVIRONMENTAL JUSTICE

THE FLOOD OF 2008 DISPROPORTIONATELY AFFECTED ALREADY DISADVANTAGED RESIDENTS–MANY OF WHOM ARE ELDERLY AND LOWER-INCOME. REDEVELOPMENT EFFORTS SHOULD NOT AMPLIFY THIS BY IGNORING THE FLOOD PROTECTION NEEDS OF SOME RESIDENTS WHILE FULFILLING THOSE OF OTHERS.

Environmental justice is the equitable treatment[12] and meaningful involvement[13] of all people regardless for their socioeconomic status, race, or color with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice can only be accomplished when all people are afforded the same degree of protection from environmental and health hazards and are able to participate equally in the decision-making process in developing a safe and healthy living environment (U.S. Environmental Protection Agency).

When comparing the different flood protection alternatives for the City of Cedar Rapids, it is imperative to consider the principles of environmental justice related to each plan. There are three fundamental environmental justice principles (U.S. Department of Transportation):

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the decision-making process.
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

The City of Cedar Rapids worked to incorporate these principles into their planning practices throughout the flood recovery process. As outlined in the previous section of this report (Community-Based Flood Recovery Planning), the city worked to engage all residents in an intensive flood recovery planning process immediately following the flood. Throughout this process, all citizens were afforded the opportunity to participate by providing input and feedback at a series of open house events. Outcomes from this process included the selection of a preferred flood management strategy which provides protection for residents and businesses located along both sides of the river within the flood-impacted area. This preferred flood

[12] Equitable treatment means that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies.

[13] Meaningful involvement means that people have an opportunity to participate in decisions about activities that may affect their environment and/or health; the public's contribution can influence the regulatory agency's decision; their concerns will be considered in the decision making process; and the decision makers seek out and facilitate the involvement of those potentially affected.

management strategy worked to ensure that no group was disproportionately affected by future flood events.

In 1994, a Presidential Executive Order was released stating that every Federal agency must include environmental justice as part of their mission. Each agency was required to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low-income populations (U.S. Environmental Protection Agency).

Without the preferred flood management strategy, the City will suffer immeasurable human health and environmental impacts if another flood were to occur. The flood of 2008 disproportionately affected already disadvantaged residents–many of whom are elderly and lower-income. Future flood protection cannot amplify this by ignoring the flood protection needs of some residents while fulfilling those of others.

SOCIAL VULNERABILITY ANALYSIS

One way of analyzing the social impacts of a disaster is through the use of social vulnerability analysis methods–describing the relationship between social characteristics of a population and vulnerability to hazards such as a flood (Dunning, Social Vulnerablity Analysis Methods for Corps Planning). The following social vulnerability analysis identifies the vulnerable populations that exist within the Cedar Rapids flood-impacted area and analyzes the disproportionate risks that they face.

Socially vulnerable populations:

- Have the fewest resources to prepare or recover from a flood
- Live in the highest-risk locations often in substandard housing conditions
- Have the least access to resources
- Lack the political and social connectedness to aid in their recovery

All of these factors contribute to slower recovery from devastating events such as a flood.

Social vulnerability analysis methods evaluate the characteristics of a population that may predispose them to being more at-risk during a natural disaster by using a variety of U.S. Census Bureau data categories including: minorities, poor, children, elderly, disabled, and female headed households. These categories are used to analyze the vulnerability of a certain population as displayed in the table below.

Figure 20 – Social Vulnerability Factors and Implications

Vulnerability Factor	During Event	Recovery
Low Income/Poverty Level	Lack of resources may complicate evacuation	Lack of resources may hinder ability to recover
Elderly/Very Young	Greater difficulties in evacuation, more health and safety issues, potential for higher loss of life	May lack resources, willingness, ability to rebound
Disabled	Greater difficulties in evacuation, special health and safety issues, potential for higher loss of life	Lack of facilities and medical personnel in aftermath may make it difficult to return
Female-Headed Households	Lack of resources and special needs may complicate evacuation	Lack of resources may hinder ability to recover
Minorities	Lack of influence to protect interests; lack of connections to centers of power or influence	Lack of influence to protect interest; lack of connections to centers of power or influence
Occupants of Mobile Homes/Renters	Occupy more vulnerable housing	Potential displacement with higher rents
Transient/Homeless	**Difficult to locate and provide information to; difficult to estimate numbers**	**Difficult to locate and provide information to; difficult to estimate numbers**

SOCIAL VULNERABILITY OBSERVATIONS

By simply observing the demographic data, the prevalence of socially vulnerable populations within the Cedar Rapids flood-impacted area can be seen.

1. There is a higher percentage of minorities within the flood-impacted area than within the City as a whole – 10% compared to 8%.
    - Minority groups are likely to occupy more vulnerable positions in the social order, more likely to be located in hazardous locations, and less likely to have connections to outside centers of power and influence.
2. There is a high percentage of elderly residents both within the City and the flood impacted area[14] - 13%.
    - The elderly are likely to have greater difficulty in evacuating from homes and may lack the ability, energy, and resources to bounce back after the event.
    - The frail elderly may be in nursing homes or hospitals, which places the burden for their safety in a flood emergency on others.
3. There is a higher percentage of disabled residents within the flood-impacted area than within the City as a whole – 19% compared to15%.
    - Like the elderly, the disabled are likely to have greater difficulty in evacuating during a flood emergency.

[14] According to U.S. Census data the nation average for percent of population over 65 (considered elderly) is 12.4%

4. The percentage of female-headed households is doubled within the flood impacted area- 20% within the flood impacted area and only 10% within the entire City.
    - Females who head households are more likely to have fewer resources and bear special burdens for child care that limit options for employment.
5. The average median household income is much lower (over $10,000) within the flood impacted area with a higher percentage of residents using public assistance – 5% compared to 3%. In the flood impacted area, 12% of citizens are in poverty compared to 7% in the entire City.
    - Poorer households are more likely to occupy more risky locations and to be in housing that is older and in poorer condition.
    - Poorer households may lack resources such as cars to evacuate in a flood emergency and have less ability to absorb losses from a flood, less access to insurance, fewer resources to provide a cushion for a long recovery period, and less access to social networks that can lobby on their behalf for assistance.
    - Lower income jobs appear to be at greater risk of being lost after a flood event.
    - Low income is highly correlated with low education and the less educated tend to be less well informed about developing hazards.
6. There are a greater percentage of renters within the flood-impacted area than within the City as a whole – 41% compared to 31%.
    - Renters run a greater risk of displacement in the aftermath of a flood event, as rents of existing intact housing often increase and make it difficult for former residents to remain.

Figure 21 – Cedar Rapids Demographic Data[15]

	CITY OF CEDAR RAPIDS	FLOOD IMPACTED AREA[16]
POPULATION	120,758	14,526
White	110,931	13,016
Minority	9,827	1,510
% Minority	8%	10%
Female	61,925	7,366
Male	58,833	7,160
Elderly	15,794	1,941
% Elderly	13%	13%
Disabled	*17,897*	*2,797*
% Disabled	*15%*	*19%*
POVERTY		
Population studied	*120,758*	*11,927*
Below Poverty	*8,843*	*1,554*
Age most impacted (18-64 years)	*6,140*	*857*
% in Poverty	*7%*	*12%*
Above Poverty	*111,915*	*10,373*
HOUSEHOLDS	49,820	5,737
Average Household Size	2	2
Female Headed Households	4,974	1,122
% Female Headed Households	10%	20%
Possible Homeless	-	23
Average Median Household Income	*$43,704*	*$33,653*
Total Households	*49,879*	*5,267*
Households with Public Assistance	*1,363*	*285*
% Households with Public Assistance	*3%*	*5%*
Households with Retirement Income	*8,206*	*831*
% Households with Retirement Income	*16%*	*16%*
FAMILIES	30,824	3,115
Average Family Size	3	2
HOUSING UNITS	52,240	6,179
Occupied	49,820	5,737
Owner Occupied	34,393	3,378
Renter Occupied	15,427	2,359
% Renter Occupied	31%	41%
Vacant	2,420	442

[15] All information compiled using U.S. Census Data- italicized information was compiled at the block group level; all other information was collected at the block level.
[16] The flood-impacted area refers to land within the boundary of the Army Corps of Engineers feasibility study located at the core of the city surrounding the river. This does not include properties damaged by flooding from various creeks in other areas of the city.

SOCIAL VULNERABILITY PROFILING

Social vulnerability can be measured in a number of ways including through the use of the Social Vulnerability Profiling method. This method identifies socially vulnerable populations by collecting census data for the following indicator variables at the appropriate geographic level:

- % of the population at or below the poverty level
- % of the population less than 5 years old
- % of the population equal to or greater than 65 years old
- # of persons with a disability
- # of female headed households
- % of housing units that are renter occupied
- % of population that is minority

Once the data is assembled, basic calculations are performed to determine which areas possess characteristics associated with higher levels of social vulnerability– areas labeled as statically significant are those that have higher levels of social vulnerable residents.

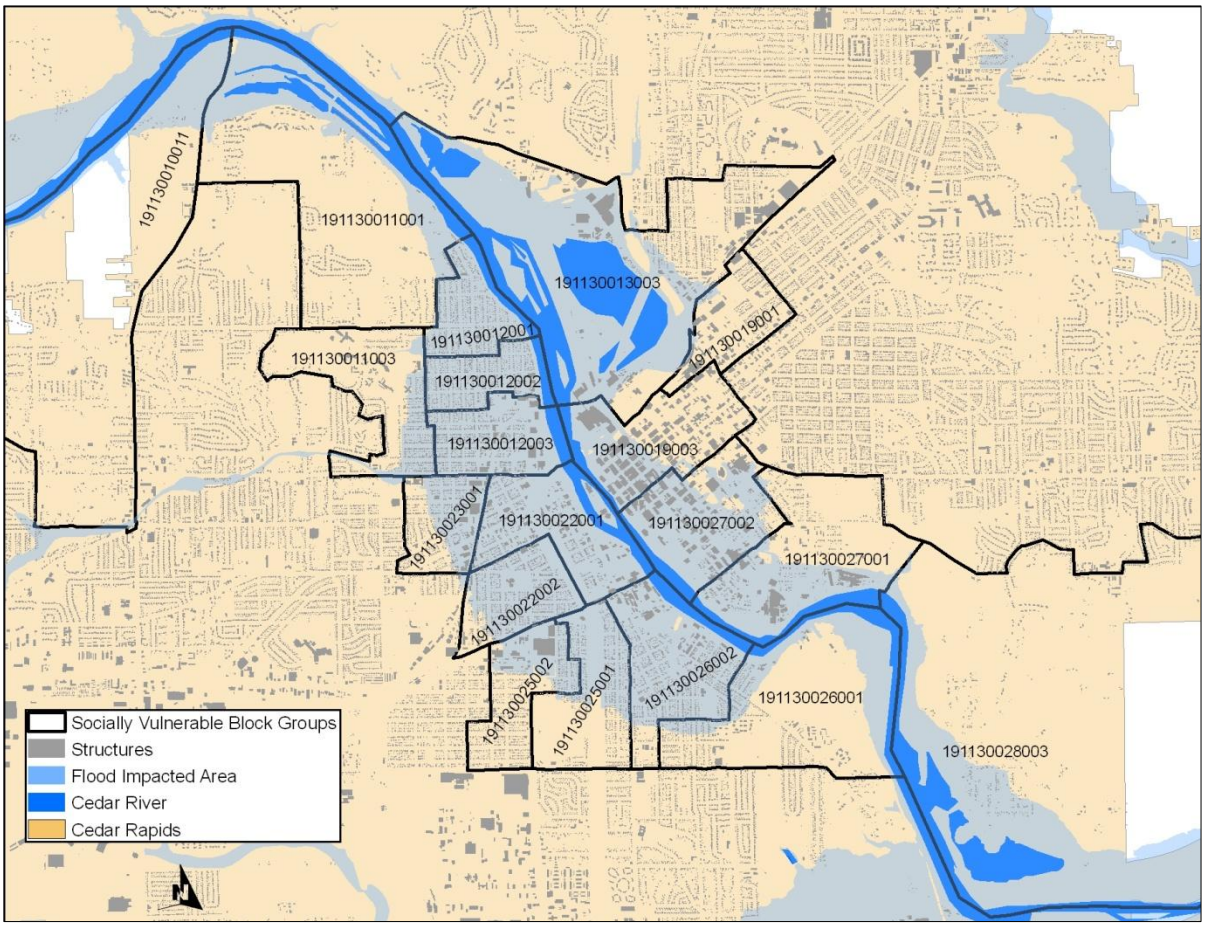
As designated by the U.S. Census, there are 91 block groups that are in or partially in the City of Cedar Rapids. Of those 91 block groups, 19 were impacted by the Flood of 2008. The Social Vulnerability Profiling method was performed on these 19 flood-impacted Block Groups to determine if there were any statistically significant vulnerability measures.

The Social Vulnerability Profiling method indicates the following:

- **Every flood-impacted block group includes at least one type of socially vulnerable population** (see map below for flood-impacted block group boundaries).
- **Poverty:** 15 of the 19 flood impacted Block Groups had a higher percent of residents in poverty as compared to the City average with 2 Block Groups being statistically significant.
- **Young:** 10 of the 19 flood impacted Block Groups had a higher percentage of children that are less than five years old as compared to the City average with 1 Block Group being statistically significant.
- **Elderly:** 14 of the 19 flood impacted Block Groups had a higher percentage of elderly residents as compared to the City average with 5 Block Groups being statistically significant.
- **Disabled:** 15 of the 19 flood impacted Block Groups had a higher number of disabled persons as compared to the City average although no Block Groups were statistically significant.

- **Female-headed Households:** 13 of the 19 flood impacted Block Groups had a higher number of female headed households as compared to the City average although no Block Groups were statistically significant.
- **Renters:** 14 of the 19 flood impacted Block Groups had a higher percentage of renter occupied housing units as compared to the City average with 3 Block Groups being statistically significant.
- **Minorities:** 9 of the 19 flood impacted Block Groups had a higher percentage of minority residents as compared to the City average with 2 Block Groups being statistically significant.

Figure 22 – Socially Vulnerable U.S. Census Block Groups



These results demonstrate that a significant portion of population in the flood-impacted area consists of socially vulnerable residents– many of whom are elderly and lower-income. This concentration of socially vulnerable residents further complicates the process of flood recovery and amplifies the necessity to protect all Cedar Rapids residents from future flooding without regard to socioeconomic standing.

These socially vulnerable residents are less equipped to handle the mental, physical, and financial ramifications of a natural disaster and would be unable to sustain the impacts of another significant flood. Although many of these socially vulnerable residents lived in houses that are valued far below the City's median household value, the value of the lives that will be protected should account for much more than simply the value of the property when determining the feasibility of a future flood protection system.

Without flood protection for residents on both sides of the Cedar River, as in the City's preferred flood management system, the City's socially vulnerable population would incur a disproportionate share of the negative consequences in the event of another flood, directly violating the principles of Environmental Justice. As the City looks to the future, it is imperative that the future flood protection system that will work to protect these socially vulnerable populations from experiencing another flood of this magnitude.

INEQUITABLE DISTRIBUTION OF FLOOD PROTECTION

Environmental Justice works to ensure the equitable distribution of resources to all people regardless of their socioeconomic status. One future flood protection alternative presented by the Army Corps of Engineers offers protection to the east side of the Cedar River while leaving the west side open and vulnerable to future flooding. Considering an option that only protects the east side, comprised mostly of large corporations and downtown businesses, while disregarding the west side, comprised mainly of older neighborhoods and socially vulnerable residents, completely negates the principles of Environmental Justice and social equity that governmental agencies are responsible to uphold.

By offering flood protection to only one side of the Cedar River, entire neighborhoods comprised of thousands of residents, including students, are left vulnerable to future flooding. In addition, many of these neighborhoods, which are still struggling to recover, are comprised of socially vulnerable residents that would be financially unable to recover from another flood. In the event of an unequal distribution of flood protection, these socially vulnerable residents would be forced to bear an unequal distribution of negative impacts of a future flood. These negative impacts may include the following:

1. ***Due to financial constraints, socially vulnerable residents would be forced to stay in neighborhoods at risk of future flooding.***

The 2008 flood destroyed a vast majority of the affordable housing stock within the core neighborhoods of Cedar Rapids. The value of homes in the flood-impacted neighborhoods range from $15,000 to $120,000, some of the lowest housing prices in the City of Cedar Rapids. Although the City has worked to create several affordable replacement housing options, homes are unable to be built at the same prices as those lost as a result of the flood.

Additionally, many of these homes are being built outside the flood-impacted area. All of these units were built outside of the core neighborhoods for many reasons. One of the main reasons

was the lack of confidence from the development community that there would be flood protection for these core neighborhoods. Financing and insurance were another big factor that drove developers to locate these new homes into building in greenfields.

Many of the flood-impacted residents that owned their homes are now unable to absorb the financial burden of having to pay a mortgage on a new home outside of the flood-impacted area. As a result, they are forced to stay in their old homes and remain at risk if a flood management strategy does not protect both the east and west side of the river.

2. Socially vulnerable students are subject to health issues and learning problems, requiring greater resources for area schools.

Two neighborhoods hit hardest by the flood were the Time Check neighborhood west of the river near Roosevelt and the Czech Village neighborhood between Wilson and Metro, also west of the river. District students displaced by the flood totaled 1,280 or about 8% of the City's enrollment. Yet, the percentage displaced at two of the three area schools is 2.5 times higher than the district average.

The undisclosed damages to the mental health of children in these neighborhoods are more difficult to quantify. The school must provide a safe, secure, and healthy school environment in contrast to the unpredictable life students experience outside school, visible as children walk through neighborhoods where damaged homes still need repair. Increased absences, increased mobility, and increased discipline, counseling, and family assistance referrals are indicators that the flood has threatened the family structure of students attending these schools. Additional and/or reallocated district resources, i.e. counseling services for individuals and their families, are being targeted for these schools.

Unfortunately, each of the three area schools has seen a decline in test results and increases in the poverty level, with 500 students currently homeless in the district. The District has asked the Iowa Department of Education for recognition of mitigating factors influencing performance on test scores for the time being. The School District has agreed over the next five years to document the social, emotional and behavioral progress of students traumatized by the tragedy of the flood.

3. In the event of another flood, residents on the west side would be at risk of losing access to health care facilities.

Due to quick action and heroic efforts, the City of Cedar Rapids experienced zero flood-related deaths. However, access to health care facilities still remained a major concern during the flood due to the inundation of nearly every east-west connector across the river. Both of the City's major medical facilities are located on the east side of the river and experienced flooding of varying degrees. Residents located along the west side of the river were unable to gain access to these facilities as all roads connecting the east and west sides of the river were closed for up to half of a day as the water reached its maximum crest. Eventually, the city was able to provide access along one of the major east-west connectors, Interstate 380, but all other east-west connectors remained closed for several days or weeks.

The closure of all major east-west connectors, except for Interstate 380, severely limited access from one side of the river to another for emergency response vehicles and medically trained professionals to offer assistance for all citizens, flood-impacted or not. This is not a scenario that the city can afford to repeat. The ability to provide medical services for residents along both sides of the river is of the utmost importance.

Without the preferred flood management strategy, this same scenario could be at risk of happening again. The inability for a city to offer emergency health care services is a life, safety, and welfare issue that no city can afford to lose. Placing half of the community at risk having limited or no access to medical facilities is morally unjust.

Additionally, both hospitals will remain at risk for future flooding without the preferred flood management strategy. Since the flood, the city has partnered with both medical facilities to create a vision for a new medical district. This medical district will serve as a healthcare destination for the region, and as such, the City must be able to ensure its protection into the future.

4. Socially vulnerable residents may be at risk of experiencing extreme mental health issues in the event of another flood.

The flooding of June 2008 had a profound effect on the physical and mental health of those who work and live in parts of Cedar Rapids. Statistics collected from the Area Substance Abuse Center indicate a 25% increase in the number of counseling sessions post-flood. There are significant and ongoing social costs being borne by those who were affected by this flood. The impact of emotional stress, loss of housing, additional costs of living, compounded by mental health and other resultant areas of suffering, all contribute to the large negative impact on the social fabric of this city. Mental health and stress related issues from traumatic events such as the Flood of 2008 are felt for many years.

The residential area impacted by the flood included a significant number of low-cost housing units rented by residents with mental disabilities– relocating them has been a significant part of the flood recovery effort.

The Other Social Effects Report written for the Tug Fork Valley in 1982, worked to quantify human resource costs of the 1977 flood. Through their detailed research, estimated cost for human resources totaled about $91 million. The 4,466 houses that were damaged by the 1977 Tug Fork Valley flood is very comparable to the number of houses that were impacted by the 2008 flood in Cedar Rapids. Taking these factors into account, it can be reasonably assumed that the human resource costs in the Tug Fork Valley could be similar to the costs incurred by the City of Cedar Rapids due to the 2008 flood. Taking into consideration the 30 year time gap and price inflation between these two events, the City of Cedar Rapids can be assumed to have incurred well over $100 million in human resource costs as a result of the 2008 flood.

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT SYSTEM

Without implementation strategy that protects both sides of the Cedar River, residents on the west side will remain at risk of the following:

1. Socially vulnerable residents unable to move out of the flood zone due to financial restraints will unequally bear the negative impacts of another flood.
2. Quality of schools will be negatively impacted: Without the preferred flood management system, the school district will be at risk of not being able to provide the needed counseling and family assistance services to an already vulnerable population experiencing yet a subsequent flood. The increased poverty level of students, lowered test scores and need for services will make it difficult if not impossible for these schools to weather another flood, as well as for the students to come back from another wave of tragedy. A moral sense of justice dictates that children on the west side of the river deserve the chance to lead healthy flood-free lives and go to school and learn, just as children on the east side will.
3. Inability to ensure high-quality medical services: Without the preferred flood management strategy, the City would be at risk of not being able to ensure emergency medical services to residents on the west side of the river. The inability for a city to offer emergency health care services is a quality of life issue that no city can afford to lose. Placing half of the community as risk having limited or no access to medical facilities is environmentally unjust. Additionally, both hospitals will remain at risk for future flooding without the preferred flood management strategy. Since the flood, the city has partnered with both medical facilities to create a vision for a new medical district. This medical district will serve as a healthcare destination for the region, and as such, the City must be able to ensure their protection into the future.
4. Up to $100 million in trauma cost associated with another flood: If the City is unable to secure funding for the preferred flood management strategy, these effects will be felt throughout the community once again. As outlined in the above section, many of the residents that were directly affected by the flood are lower-income and cannot afford the costs of mental health services. Placing this group of socially vulnerable residents at the risk of experiencing future flood events does not work to uphold the principles of environmental justice.

SUSTAINABILITY

ENVIRONMENTAL, ECONOMIC, AND SOCIAL SUSTAINABILITY IS THE KEY TO OUR FUTURE.

Sustainability, in a broad sense, is the ability to "meet the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly). A sustainable approach to any issue integrates the social, economic and environmental dimensions to ensure no undue impact is created in either of these factors. In short, sustainable development ensures environmental, economic and social well-being for today and tomorrow.

In Cedar Rapids, residents have indicated a desire to approach both flood mitigation and flood recovery in a sustainable manner. For the first phase of flood recovery planning, one of the seven major goals for the process was to "Help our community become more sustainable" (Sasaki Associates). The second phase of flood recovery planning was accompanied by extensive research on sustainability, resulting in the Cedar Rapids Plan for a Sustainable Future. The Sustainable Plan describes the many indicators of a sustainable community and provides a status report on the long-term cultural, economic and environmental health of the city (ARUP).

Given the focus on sustainability during the planning process, it is not surprising that two of the main elements of the recovery strategy are extremely sustainable measures. Cedar Rapids' approach to housing redevelopment and the creation of a central greenway along both banks of the river both attend to short-term needs while retaining a long-term outlook. The remainder of this chapter discusses the housing redevelopment and greenway plans, explaining how they are dependent on the preferred flood management strategy.

SUSTAINABLE HOUSING REDEVELOPMENT

There is little question that the flood of 2008 has precipitated the need for new development in Cedar Rapids. Over 5,000 homes and 900 businesses were impacted by the flooding. While some of these structures can be repaired, over 1,400 housing units are being voluntarily acquired and demolished as part of the overall flood management strategy. Approximately 100 units are being purchased through FEMA's Hazard Mitigation Grant Program, another 500 units are being purchased using CDBG funds and will become part of the envisioned Greenway, while the remaining 700-800 units will be acquired by the City through the CDBG neighborhood reinvestment program.

The issue at hand is where this redevelopment will occur. Without reliable flood protection in the downtown neighborhoods, recent development trends suggest that the bulk of the new housing units would be constructed in the outskirts of Cedar Rapids, far from the flood-prone zone. However, building in the core is a much more sustainable solution for the City:

1. ***Rebuilding in the city core reuses land that already has already been developed rather than committing even more of the area's prime and unique farmland to residential expansion.***

Recent development in the outskirts tends to be at a much lower density than existing development in the downtown neighborhoods. For instance, homes in Lincolnway Village South (median year built is 1996)—about five miles from downtown Cedar Rapids—have an average density of 2.7 dwelling units per acre (du/acre). Homes in Jackson Park (median year built is 2002), 3.5 miles from downtown, have an average density of 4.2 du/acre.[i] The 184 homes built during 2009 as part of the single-family new construction program have a typical lot size of 80' x 120' (9,600 sf), which gives density of 4.5 units per acre. About 311 acres of land in the outskirts would be developed if the remaining 1,400 replacement homes are built at this same density. This housing development will put pressure on prime agricultural farmland.

In comparison, redevelopment of downtown neighborhoods that flooded in 2008 would take much greater advantage of available land and infrastructure. Flood-affected downtown neighborhoods such as Oak Hill Jackson and Wellington Heights have respective densities of 7.8 and 8.1 du/acre (Bujold). Building 1,400 housing units at 8.0 du/acre requires 175 acres of land, just over half of what would be needed in the outskirts development scenario described above. Furthermore, rebuilding in the city's core would reuse land that already has been developed rather than committing even more of the area's prime and unique farmland to residential expansion.

2. ***For Cedar Rapids, redevelopment in the core provides the benefit of being able to reuse existing infrastructure, substantially reducing the City's operational costs associated with additional greenfield development.***

According to Bruce Jacobs, the Utilities Engineering Manager in the Cedar Rapids Utilities Department,

> *"The cost of providing water service per mile of system piping, including all costs for production, treatment, personnel and maintenance [is] $42,500 per mile of system pipe. This cost is recovered most efficiently with higher density development (higher numbers of customers per mile). This will be true for sewer service, solid waste pick up, or any other city service that must be provided to an area."*

Without the certainty of a future flood protection system, it is reasonable to assume that approximately half of all residential development impacted by the flood, or about 2,500 properties, will not return to the flood-impacted area and instead will relocate to the City's greenfield areas. Using the City's average housing density of 2 people per household, this will result in the relocation of 5,000 residents to the City's greenfield area. The following table gives the projected impacts to the City's yearly operational costs if residential redevelopment planned for the core area were instead relocated to the City's greenfield areas. It is important to consider that, in order to pay for itself, this new housing would have to be approximately $400,000 per unit, which would clearly not be affordable for a majority of the flood impacted residents.

Figure 18 - Cost of City Services for Greenfield Development

Department	Cost
Public Safety	$3,385,700
Public Works	$384,741
Park & Recreation	$426,250
Community Development	$38,400
Solid Waste	$45,000
Water	$892,500
Transit	$220,000
General Government	$140,800
Other Government	$446,000
TOTAL	**$5,979,391 per year**[17]

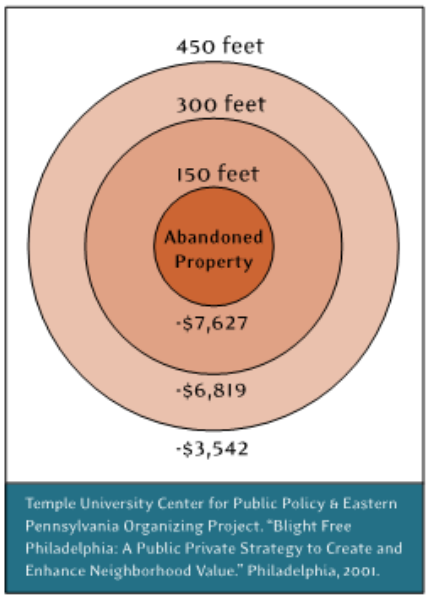
This indicates that the inability to rebuild within the core area, and subsequent development in the greenfield area, would result in almost $6,000,000 in added cost to the City's operating budget per year. Over the course of 50 years (the estimated lifespan of the flood protection system) this would amount to an extra $298,969,550in costs to the City's operating budget.

Furthermore, if the flood zone is not substantially repopulated, services for the few remaining residents would be highly subsidized, as the revenue from each connection would not outweigh its cost.

3. Filling vacant lots with new housing avoids issues of maintenance, decreasing property values, and unpleasant urban environments that might otherwise arise.

Redevelopment in the core is not only an efficient use of existing resources, but also prevents future problems that could arise if properties remain vacant. As demonstrated by shrinking cities such as Detroit and Cleveland, there are many negative outcomes from having large numbers of abandoned or vacant properties:

- the high costs of municipal services to keep the properties from being a threat to public health and safety;
- the decreased property values and associated tax revenues– research done around the country suggests that being within about a block of a vacant lot(s) can reduce home values by 2-11% (Watcher);
- lower quality of life and poor aesthetics for



[17] In this scenario, the cost of public safety includes the cost of constructing and running a new fire station in order to maintain proper fire response times. It is also assumed that these 2,500 units would be on 80 foot by 120 foot lots per mile, which is consistent with the approximately 3.5 density units per acre in most greenfield development, and would require 21 miles of roads in a square mile.

residents remaining in the area; and
- potentially cumulative effect of blight (National Vacant Properties Campaign).

There was a decrease in property values between 2008 and 2009 of $213,075,527. This equates to a loss in property taxes to the City of $2,100,144. As stated above if vacant properties are not redeveloped or existing homes not rehabbed property values would continue to decline. Taken over a 50 year time period (life of the flood management system) the total loss would be $105,007,200. The loss in property tax to the City is extremely negative as local governments in Iowa have only one source of revenue and that is property taxes.

4. The community supports rebuilding in the core.

If we turn back to the River Corridor Redevelopment Plan goals that came out of the post-flood community engagement process, it is clear that protecting the city core to allow for dense and cost-efficient redevelopment aligns with the residents' wishes. Community feedback specifically called upon the City to:

- Protect housing from future flooding
- Ensure high-quality replacement houses are built quickly
- Provide affordable housing options
- Retain character of pre-flood communities
- Support sustainable neighborhoods where residents can walk to schools, parks and services

This preference for higher-density housing options is reinforced by community input from December, 2009 that was collected as part of the Corridor Metropolitan Planning Organization's regional planning and visioning process for development of its long-range transportation plan. Averaging the preferred density distributions gives the following scenario:

Figure 23 – Preferred Housing Densities for Cedar Rapids

Preferred Housing Densities for Cedar Rapids		
	Current	Proposed
Low Density (4-5 DU/Acre)	85%	50%
Medium Density (8-10 DU/Acre)	10%	22%
High Density (12-16 DU/Acre)	5%	18%
Mixed-Use (Residential + Commercial)	0%	10%
Total	**100%**	**100%**

Source: Connections 2040 Visioning Forum (LSA Associates)

Assurance of reliable flood protection is necessary for Cedar Rapids to move forward with the sustainable redevelopment of the city's core. If developers, buyers and lenders alike have confidence in the safety of their investment, there is much promise in the situation.

5. Rebuilding long-standing neighborhoods promotes community cohesion.

Community cohesion is a component of social sustainability, and refers to the quantity and quality of interactions among people in a community, as indicated by the degree residents know and care about their neighbors and participate in community activities (Litman). The Flood of 2008 forced the evacuation of entire neighborhoods in the core of Cedar Rapids. Residents who had lived in the same place for decades were scattered throughout the county in temporary housing, interrupting the countless day-to-day interactions with neighbors that help to make a house feel like a home.

However, there is potential to remediate this disruption to community cohesion in flood-affected neighborhoods such as Time Check, Czech Village, Taylor School and New Bohemia. Providing adequate flood protection along both the eastern and western banks of the Cedar River will enable residents to return, rebuild, and reestablish. It is only with this sort of security and long-term commitment to a place that community cohesion can be expected to grow.

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

Through the intensive post-flood planning process, the City and its residents created a reinvestment plan for the ten flood-impacted neighborhoods. This plan demonstrates the City's dedication to rebuilding with the flooded area- to seize the opportunity for making this area greater for residents. It is imperative that the City is allowed to redevelop within the flood-impacted area in order to achieve this vision and create a sustainable community for future generations.

Unfortunately, without the guarantee of future flood protection, this vision will never fully be realized as development, both commercial and residential, will be unwilling to move into an area that remains at risk of future flooding. Reinvestment and redevelopment in the flood-impacted area will be overlooked in favor of greenfield development.

Without the certainty of flood protection in the city core on both sides of the Cedar River, the following consequences are likely:

1. In the outskirts of Cedar Rapids, 270 acres—some of it prime and unique farmland—will be unnecessarily redeveloped just to replace housing lost in the flood. Without a safe city core, other types of development will also move to the edge of the city, encroaching upon open space.

2. The City will incur costs of $4.4 million to build additional infrastructure and provide services for the replacement neighborhoods in the outskirts.

3. The quality of Cedar Rapid's neighborhoods will decline if lots are left vacant. Furthermore, vacant properties will be costly to maintain and will decrease nearby property values and the associated tax revenue.

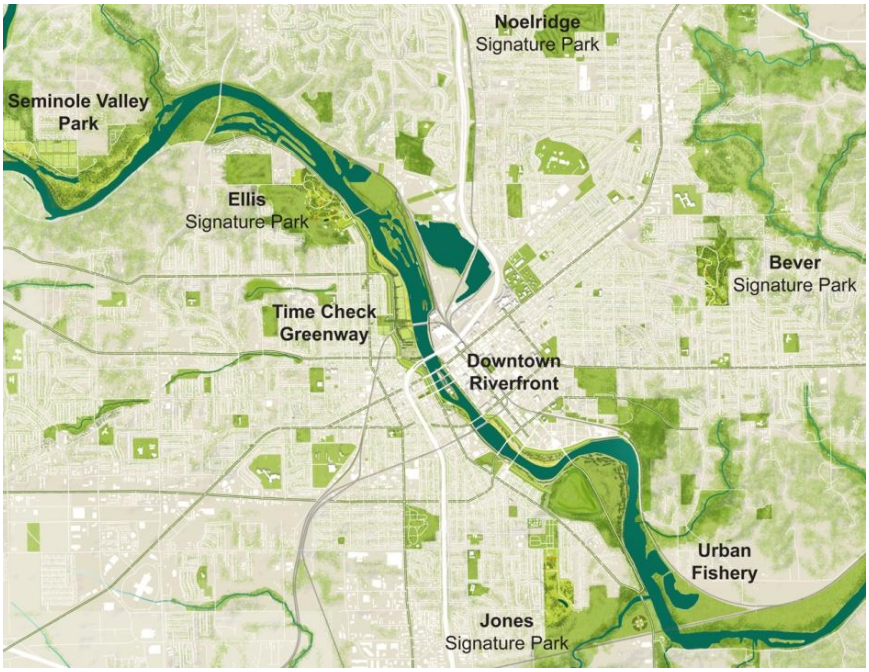
4. The community-stated preference for moving to higher-density housing development will remain unmet.

5. The opportunity will be lost to rebuild the pre-flood community cohesion that existed in flood-affected neighborhoods

GREENWAY FOR A SUSTAINABLE CEDAR RAPIDS

A new 220 acre greenway along the Cedar River is a major component of Cedar Rapids' preferred flood management strategy. The greenway concept grew out of community input during the first phase of flood recovery planning in 2008, while specifics of the project were considered in detail in 2009 as part of the citywide Parks and Recreation Master Planning effort. Creating the Greenway is a significant step towards a more environmentally, economically, and socially sustainable Cedar Rapids.

Figure 24 - Preferred Parks and Recreation Plan: Destination Riverfront and Signature Parks



1. The Greenway contributes to a sustainable flood protection strategy.

Creating a Greenway along the banks of the Cedar River contributes to flood management in several ways. First, creating a floodable buffer between the river and adjacent development can reduce flood impact on valued property—but the functionality of the buffer depends on it being bounded by a future levee. Otherwise, water will continue moving inland and flood the neighborhoods. Second, naturalizing the river's edge can help prevent flood conditions. Laying back the river banks and stabilizing them with herbaceous vegetation will help slow and absorb flood waters. Naturalization makes it less likely for quickly moving flood waters to scour the edges of the river channel and overflow its banks; it also works to slow and reduce the amount of stormwater runoff. The runoff coefficient for prairie grasses is much lower than paved

surfaces or turf, meaning stormwater that hits a naturalized area will be more readily infiltrated into groundwater. Any remaining runoff will be slowed as it moves toward the river, reducing the City's contribution to flash flooding in the watershed.

2. The Greenway will improve the ecological health of Cedar Rapids.

A protected riverfront helps to maintain biological diversity, improve water quality and provide wildlife travel corridors within Cedar Rapids. Currently, parkland protects almost 50% of the existing riparian corridor within Cedar Rapids city limits. The proposed Greenway will help to connect disjointed patches of riverfront habitat into a continuous swath of natural area that will effectively support flora and fauna. Newly connected trails through these areas will allow people to experience the ecological value of the Greenway first-hand.

Improvements along the river will have a positive effect on the regional watershed as well. Riverbank naturalization will not only affect the quantity of runoff, as discussed above, but will also improve the quality of the runoff by filtering out sediment and pollutants. This further reduces Cedar Rapids' negative contribution to the health of the watershed.

3. The Greenway can help to create economic value for the city.

A high-quality park system is a wise investment for Cedar Rapids. New amenities including a multi-generational community center, multi-purpose fields, an outdoor amphitheater, a downtown promenade and a new reflecting pool/ice rink at May's Island may bring 1.3 million more visitors to the core of the City each year. These visitors may generate upwards of $80 million annually in food, hotel, retail and travel spending that will help downtown businesses and the community.

Additionally, for every dollar spent on park improvements, private sources spend four or five dollars. This can be seen in projects throughout the country:

- Charleston Waterfront Park & Maritime Center, SC
  - $73 million—public investment
  - $337 million—private investment
  - 4.6 private dollars for each public dollar
- Cincinnati Central Waterfront Park, OH
  - $90+ million—public investment
  - $500 million—private investment
  - 5 private dollars for each public dollar
- Central Indianapolis Waterfront Project, IN
  - $86 million—public investment
  - $425 million—private investment
  - 4.9 private dollars for each public dollar

The Trust for Public Land has demonstrated in their studies that high-quality parks increase property values and tax revenue by as much as 22%.

4. The Greenway can contribute positively to economic development by helping to retain current residents and to attract a next-generation workforce.

Creation of the Greenway and naturalization of the Cedar River Corridor will be implemented in tandem with other initiatives to expand multi-purpose trails along the river to improve connectivity in the City and transform the image of the City as a community that has a strong connection to the outdoors and an active lifestyle. The Cedar Rapids Next Generation Commission is a group of young professionals convened to advise the City Council on ways to make Cedar Rapids a more appealing place for the next generation to live, work and play. In a report produced in December 2008, the Commission's first recommendation is to "Develop a spectacular riverfront park making the Cedar River the long-term centerpiece of the city, setting aside adequate land and uninterrupted green space for flood mitigation, recreation and year-round activities (Cedar Rapids Next Generation Commission)."

5. ***Furthermore, the Greenway will be efficient and cost-effective to maintain rather than being a burden to the City.***

Careful consideration during the planning process ensures that the parks and recreational system is operationally sustainable, despite absorbing responsibility of approximately 220-acres of new park land dedicated to the system via the acquisition of flood-damaged properties. Current park system operations will be streamlined and new revenue sources will be tapped to cover costs according to a carefully balanced phasing plan.

EFFECTS WITHOUT THE PREFERRED FLOOD MANAGEMENT STRATEGY

While the Greenway will exist regardless of the future flood management system, it will not provide flood protection unless it is bound by levees as indicated in the City's preferred alternative. During a flood event, high water would inundate the open space along the river, but rather than being contained, would then flow into adjacent neighborhoods. This flood risk would reduce property values in areas where value might have otherwise risen because of proximity to the Greenway, and the loss in value will be passed along to the City in the form of lower tax revenues. Having a Greenway that functions as open space but not flood protection also reduces the importance of the project and undermines an unusual opportunity to implement an innovative and sustainable method of flood control.

Furthermore, the City will miss out on up to $80 million per year of spending in downtown by potential Greenway users and will have missed an ideal opportunity to contribute to the City's identity as a vibrant, urban hometown that appeals to the next-generation workforce.

CONCLUSION

THE CITY WILL CONTINUE TO WORK TOWARDS ACHIEVING THE COMMUNITY'S PREFERRED PLAN FOR REINVESTMENT AND FLOOD RECOVERY. HOWEVER, THE PREFERRED FLOOD MANAGEMENT SYSTEM IS A CRUCIAL ELEMENT IN ACHIEVING THE COMMUNITY'S VISION FOR THE FUTURE OF CEDAR RAPIDS.

	Effects With the Preferred Flood Management System	**Effects Without the Preferred Flood Management System**
Housing & Neighborhoods	• The flood-impacted area can redevelop in the way outlined in the plans created by the community	• Slower pace of redevelopment within the flood-impacted area due to uncertainty of future flood protection • Almost 5,000 homes remain at risk of future flooding • Over $400 million in damages to homes could occur in the event of another flood
Business	• New businesses will be willing to move into the downtown area increasing the property and aesthetic value of the downtown • Current businesses will feel secure to invest in improvements or expansion of their businesses	• Businesses would remain at risk of future flooding • An estimated $1 billion that will be invested downtown in the years following the flood will remain at risk of future flooding • Blighted building will remain vacant and diminish the character and economic vitality of downtown • The City will be at risk of losing the City's major industries – research has indicated that they will not stay in Cedar Rapids and reinvest in the occurrence of another flood without protection
City Facilities	• City facilities can be redeveloped based upon the Facilities Master Plan that was created through citizen input • The City would be able to ensure the continuation of services in the	• Hundreds of City Facilities will remain at risk of future flooding • City services for the entire City will remain at risk of being unable to provide quality service for days,

	event of another flood – this ensures a quality of life that works to attract and retain residents	weeks, or months
Arts & Cultural Institutions	• The City's most important arts and cultural attractions will be able to reinvest in the area thus improving the quality of life for the City's residents	• Many of the City's most important cultural facilities will remain at risk of future flooding
Social Services	• Non-profits will be able to provide services without having to worry about the excess demand related to another flood	• These services would remain at risk in the event of another flood
Environmental Justice	• The City could ensure protection tot eh most socially vulnerable residents • Residents on both sides of the river would be protected	• The most socially vulnerable population within the City would remain at risk of future flooding • Socially vulnerable residents unable to move out of the flood zone due to financial restraints will unequally bear the negative impacts of another flood • the school district will be at risk of not being able to provide the needed counseling and family assistance services to an already vulnerable population • Inability to ensure high-quality medical services • Up to $100 million in trauma cost associated with another flood
Sustainability	• The Greenway will be developed properly, as both park space and flood protection for the surrounding neighborhoods – this unique area could help the City implement an innovative and sustainable method of flood control. This unique area could work to attract next generation workforce and add up to $80 million to spending in the	• In the outskirts of Cedar Rapids, 270 acres—some of it prime and unique farmland—will be unnecessarily redeveloped just to replace housing lost in the flood. Without a safe city core, other types of development will also move to the edge of the city, encroaching upon open space. • The City will incur costs of $4.4

	downtown area. •	million to build additional infrastructure and provide services for the replacement neighborhoods in the outskirts. • The quality of Cedar Rapid's neighborhoods will decline if lots are left vacant. Furthermore, vacant properties will be costly to maintain and will decrease nearby property values and the associated tax revenue. • The community-stated preference for moving to higher-density housing development will remain unmet. • The opportunity will be lost to rebuild the pre-flood community cohesion that existed in flood-affected neighborhoods • The greenway, an integral part of the City's preferred flood management system, will not function properly without the levee system that is also part of the City's preferred flood management system. Although the greenway will still exist, the system of levees will not exist and the neighborhoods will be inundated with water.

Having a Greenway that functions as open space but not flood protection also reduces the importance of the project and undermines an unusual opportunity to implement an innovative and sustainable method of flood control.

Furthermore, the City will miss out on up to $80 million per year of spending in downtown by potential Greenway users and will have missed an ideal opportunity to contribute to the City's identity as a vibrant, urban hometown that appeals to the next-generation workforce.

In conclusion, the Cedar Rapids' Preferred Flood Management System is necessary to ensure the business and neighborhood reinvestment necessary to fully recover from the 2008 flood; to ensure that Cedar Rapids remains a strong economic force in the state and region; and, to ensure Cedar Rapids' future growth, vitality and resiliency.

Comprehensive Approach - In 2008, Cedar Rapids suffered one of the worst floods in this nation's history. The City has aggressively taken steps of its own to protect the community from future flooding in structural and non-structural ways as part of its flood management strategy. The City has brought together all community partners, neighboring communities, the public, and state and federal agencies in one process, forging a partnership to reduce future flood risk of the Cedar River to the community.

Need for Current Recovery - It will take time and money to rebuild and hesitation to reinvest in the flood-impacted area is increased by lingering questions about future flood protection. A commitment to the City's Preferred Flood Management System is necessary in order to quickly and fully recovery from the 2008 flood.

Need for Future - Some residents, businesses and major corporations have committed significant unreimbursed financial resources in flood-impacted areas to rebuild. If another flood occurs without adequate flood protection, experiences shows many businesses and corporations will likely go out of business or relocate. The City could not afford the devastating financial consequences.

Environmental Justice - Most of the residents in the 5,000 flood-affected homes were located on the west side of the Cedar River and are working class neighborhoods with a high percentage of the elderly, poor and disabled, as well as female heads of households. A commitment to environmental justice underlies the City's approach -- all residents need protection regardless of socioeconomic status and the cost of their home, or its location.

Unpredictability of Future Flooding - Recent research suggests that Cedar Rapids may be at greater risk for future flooding than predicted by models used by the Army Corps of Engineers. Research shows there is more uncertainty in the ability to predict future flood levels and flood frequency.

Importance to the Nation – Finally, Cedar Rapids is part of the heartland of America and as the heart of eastern Iowa serves as a central node for economic, cultural and civic life in America. Investing in a the preferred flood management system will preserve and grow Cedar Rapids – its homes, businesses, economy, governmental facilities, arts and cultural organizations, non-profits and all the hard-working people that are the fabric of this community. A healthy, resilient Cedar Rapids is not just a good investment for Iowa or the region. It is a good investment for the nation.

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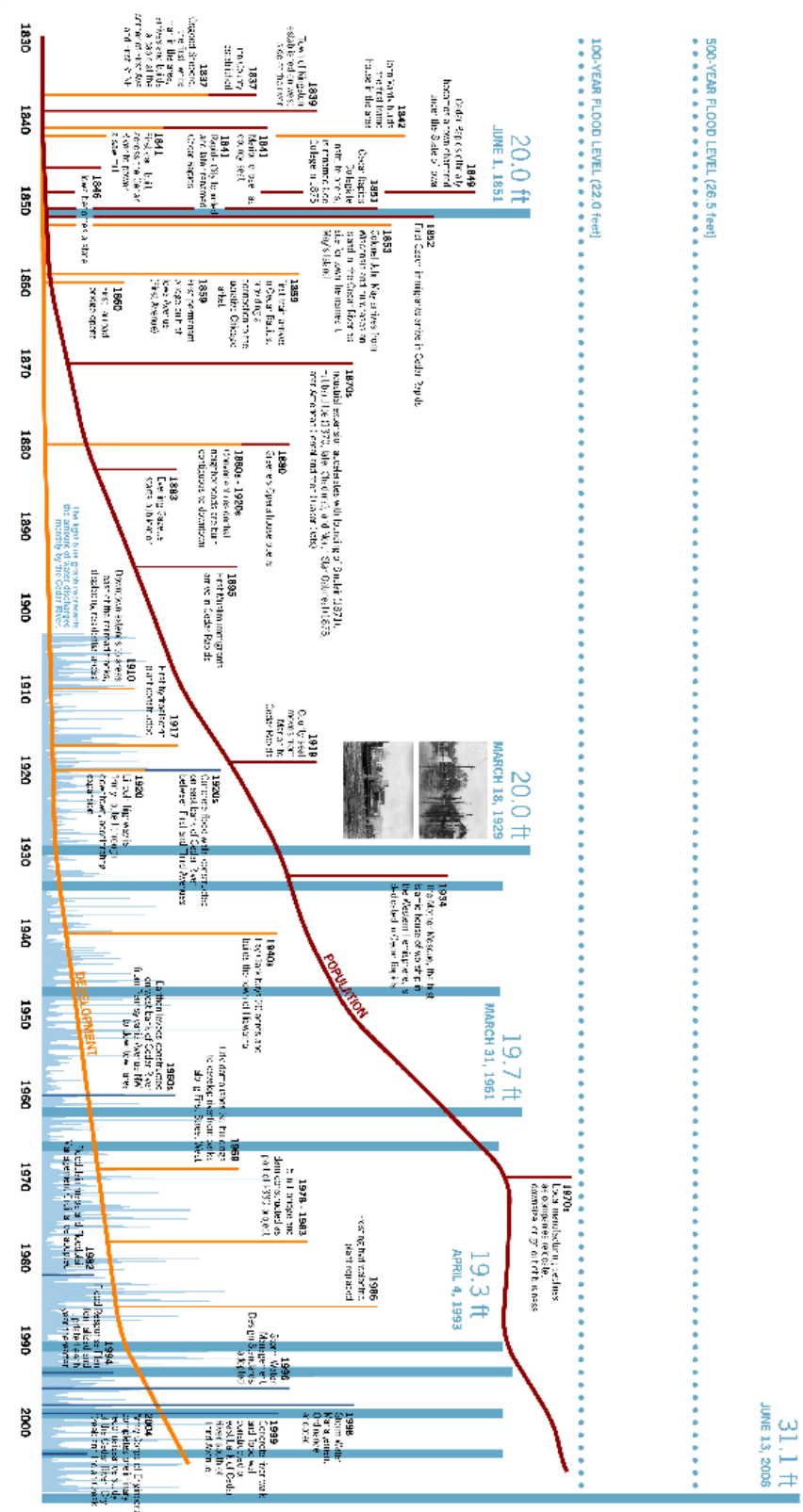
APPENDIX


500-YEAR FLOOD LEVEL (26.5 feet)
100-YEAR FLOOD LEVEL (22.0 feet)
20.0 ft
JUNE 1, 1851
20.0 ft
MARCH 18, 1929
19.7 ft
MARCH 31, 1961
19.3 ft
APRIL 4, 1993
31.1 ft
JUNE 13, 2006
POPULATION
DEVELOPMENT
1830
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

Vulnerability Measure

Census Block Groups	% of Population at or below Poverty Level	Difference from City Mean	Significance Test*	% of Population <5 years old	Difference from City Mean	Significance Test*	% of Population =>65 Years old	Difference from City Mean	Significance Test*	Number of Persons with a Disability	Difference from City Mean	Significance Test*	Number of Female Headed Household	Difference from City Mean	Significance Test*	% of Housing Units Renter Occupied	Difference from City Mean	Significance Test*	% of Population that is Minority	Difference from City Mean	Significance Test*
191130023001	5.26%	-3.23%	Not Significant	6.83%	-0.10%	Not Significant	0.14%	0.04%	Not Significant	218	24	Not Significant	79	23	Not Significant	37%	11%	Not Significant	16.58%	8.48%	Not Significant
191130011003	5.29%	-2.17%	Not Significant	5.75%	-1.18%	Not Significant	0.05%	-0.05%	Not Significant	224	30	Not Significant	57	1	Not Significant	17%	-8%	Not Significant	2.48%	-5.63%	Not Significant
191130011001	8.58%	1.12%	Not Significant	4.55%	-2.38%	Not Significant	0.04%	-0.06%	Not Significant	111	(83)	Not Significant	29	(27)	Not Significant	44%	18%	Not Significant	3.98%	-4.12%	Not Significant
191130025002	22.06%	14.60%	Not Significant	8.94%	2.01%	Not Significant	0.12%	0.02%	Not Significant	326	132	Not Significant	64	8	Not Significant	33%	7%	Not Significant	6.42%	-1.69%	Not Significant
191130023002	11.01%	3.55%	Not Significant	9.16%	2.23%	Not Significant	0.20%	0.10%	Not Significant	300	106	Not Significant	101	45	Not Significant	40%	14%	Not Significant	11.18%	3.07%	Not Significant
191130025001	15.82%	8.36%	Not Significant	8.75%	1.81%	Not Significant	0.21%	0.11%	Statistically Significant	265	71	Not Significant	68	12	Not Significant	30%	5%	Not Significant	6.45%	-1.66%	Not Significant
191130022001	14.72%	7.26%	Not Significant	6.51%	-0.42%	Not Significant	0.20%	0.10%	Statistically Significant	226	32	Not Significant	91	35	Not Significant	65%	39%	Statistically Significant	14.70%	6.60%	Not Significant
191130026002	14.00%	6.54%	Not Significant	7.03%	0.10%	Not Significant	0.23%	0.13%	Statistically Significant	327	133	Not Significant	68	12	Not Significant	25%	0%	Not Significant	2.62%	-5.49%	Not Significant
191130027002	34.46%	27.00%	Statistically Significant	6.68%	-0.25%	Not Significant	0.16%	0.06%	Not Significant	312	118	Not Significant	48	(8)	Not Significant	72%	47%	Statistically Significant	27.53%	19.43%	Statistically Significant
191130012003	13.62%	8.16%	Not Significant	7.36%	0.63%	Not Significant	0.19%	0.09%	Not Significant	223	29	Not Significant	76	20	Not Significant	32%	6%	Not Significant	12.66%	4.55%	Not Significant
191130012002	7.70%	0.24%	Not Significant	8.72%	1.78%	Not Significant	0.24%	0.14%	Statistically Significant	198	4	Not Significant	73	17	Not Significant	24%	-2%	Not Significant	1.36%	-6.75%	Not Significant
191130012001	3.63%	-3.83%	Not Significant	7.04%	0.11%	Not Significant	0.15%	0.05%	Not Significant	167	(27)	Not Significant	42	(14)	Not Significant	14%	-12%	Not Significant	3.18%	-4.92%	Not Significant
191130013003	15.91%	8.45%	Not Significant	7.26%	0.33%	Not Significant	0.15%	0.05%	Not Significant	215	21	Not Significant	83	27	Not Significant	30%	4%	Not Significant	3.67%	-4.43%	Not Significant
191130019003	16.57%	9.11%	Not Significant	3.66%	-3.28%	Statistically Significant	0.03%	-0.07%	Not Significant	183	(11)	Not Significant	10	(46)	Not Significant	89%	63%	Statistically Significant	14.41%	6.31%	Not Significant
191130019001	15.09%	7.63%	Not Significant	3.72%	-3.21%	Not Significant	0.05%	-0.05%	Not Significant	295	101	Not Significant	44	(12)	Not Significant	55%	30%	Not Significant	8.96%	0.86%	Not Significant
191130028003	11.69%	4.23%	Not Significant	8.03%	1.10%	Not Significant	0.11%	0.01%	Not Significant	163	(31)	Not Significant	78	22	Not Significant	25%	-1%	Not Significant	11.29%	3.18%	Not Significant
191130010011	1.81%	-5.65%	Not Significant	5.90%	-1.03%	Not Significant	0.11%	0.01%	Not Significant	228	34	Not Significant	47	(9)	Not Significant	26%	1%	Not Significant	4.93%	-3.17%	Not Significant
191130026001	17.72%	10.26%	Not Significant	5.60%	-1.33%	Not Significant	0.07%	-0.03%	Not Significant	288	94	Not Significant	101	45	Not Significant	58%	32%	Not Significant	7.70%	-0.41%	Not Significant
191130027001	26.97%	19.51%	Statistically Significant	8.54%	1.61%	Not Significant	0.25%	0.15%	Statistically Significant	272	78	Not Significant	106	50	Not Significant	45%	19%	Not Significant	34.97%	26.86%	Statistically Significant

*Statistically Significant at the 95% confidence level

Indicates a higher population relative to the city average

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX R

THE CITY OF CEDAR RAPIDS
REGIONAL ECONOMIC DEVELOPMENT REPORT

Regional Economic Impacts of the 2008 Cedar Rapids Flood



Dennis P. Robinson, Ph.D.

5/17/2010

Executive Summary

Why a report on the regional economic development effects of flooding?

- The U.S. Army Corps of Engineers (Corps) Principles and Guidelines clearly support the recommending of projects where factors beyond national economic development (NED) justify the project. Although much of the US Army Corps of Engineers project evaluation procedures are based on NED benefits, the Corps acknowledges that regional economic development (RED) effects may be important factors in the success of a project.

- Using the NED rule (i.e., choosing the project options having the largest net benefits) only ensures that a project will generate the largest possible economic "pie" (so-to-speak). However, having a larger economy says nothing about how the distribution of the economy's components--in other words, more is not necessarily better (Robinson, 1999).

- Regional economic development effects of flooding include the impacts of not implementing a flood management project can have on the local and regional economy. RED effects are usually measured in terms of business activities such as the employment they provide and the income the workers are paid.

- The Corps of Engineers (2010) has undertaken a RED analysis of alterative flood management options on the Cedar River at Cedar Rapids, Iowa. The regional economic development effects of the 2008 Cedar Rapids Flooding are not currently being evaluated by the Corps of Engineers.

The Cedar Rapids flood was a huge natural disaster with major community impacts

On the last day of May 2008 the Cedar River at Cedar Rapids, Iowa rose above its average gage height (7 feet) and then reached near flood stage (12 feet) on June 2. It reached a historical high water mark over 31 feet on Friday, June 13 (over 11 feet higher than the previous record set in 1851). The Cedar River remained above flood stage until June 21 and continued at or above the average level through the third week of July.

The flooding waters caused devastation throughout the city on its citizens, businesses, property owners, public buildings, religious and cultural organizations and transportation facilities (City of Cedar Rapids, 2010).

- The flooding waters extended well beyond the 500-year floodplain and covered more than 10 square miles of the city.

- There were 18,000 residents displaced by the muddy and sewage-filled waters that damaged 5,000 homes and 310 public facilities including City Hall, the Linn County Courthouse and the City's central fire facility.

- Total number of businesses directly or indirectly impacted by the flood: 1,281
    - Number of businesses lost as a result of the flood: 131
    - Number of businesses that have reopened: 671
    - Number of businesses that reopened outside the city or flooded area: 143

- Number of jobs in the flood impacted area before the flood: 11,814

- Number of jobs lost as a result of the flood: 1,865
    - Permanent: 1,324
    - Temporary: 541

- Only one of seven bridges in the City (and metro area) across the Cedar River was accessible (I-380) limiting access to the hospitals on the east side of the river.

The Cedar Rapids flood had large local and regional impacts that may persist long into the future

Three types of regional economic development analysis are addressed in this report. First, the direct, indirect and induced economic impacts of business are the losses caused by the 2008 Cedar Rapids Flood during the recovery period.

- The cumulative economic impacts caused by the 2008 Cedar Rapids Flood during the period of business recovery. We estimate that the economic impacts due to the 2008 Cedar Rapids Flood generated losses in Linn County totaling

    - $2.5 billion in business sales over the flood recovery period,
    - 14,500 work-years of employment and nearly $590 million employee compensation,
    - $60 million in proprietor's income,
    - $466 million in rents, dividends, profits, etc. were lost or not paid,
    - $103 million in indirect business taxes, and
    - $1.2 billion in gross domestic product (value added).

- We estimate that the cumulative economic impacts due to the 2008 Flood generated losses in rest of Iowa totaling

    - $105.8 million in business sales over the flood recovery period,
    - 513 work-years of employment and nearly $19.2 million employee compensation,
    - $4.9 million in proprietor's income,
    - $18.8 million in rents, dividends, profits, etc. were lost or not paid,
    - $2.4 million in indirect business taxes, and
    - $45.2 million in gross domestic product (value added).

- We estimate that the cumulative economic impacts due to the 2008 Flood generated losses in State of Iowa totaling

	Output	Employment (jobs)	Value Added	Labor Income
Linn County	$590,665	3,543	$265,967	$161,520
Rest of Iowa	$25,195	125	$9,868	$5,786
State of Iowa	$615,860	3,668	$275,835	$167,306
Monetary impacts in thousands of 2010 dollars				

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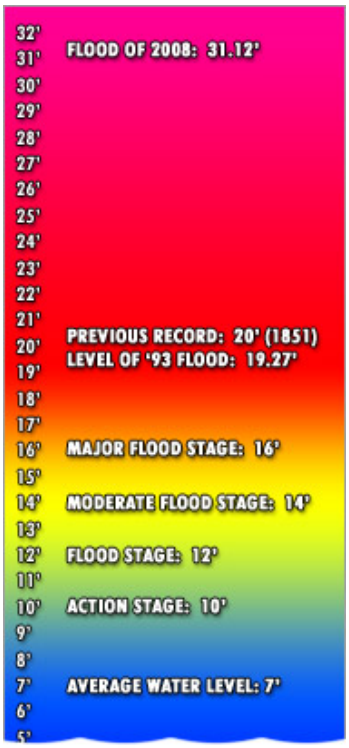
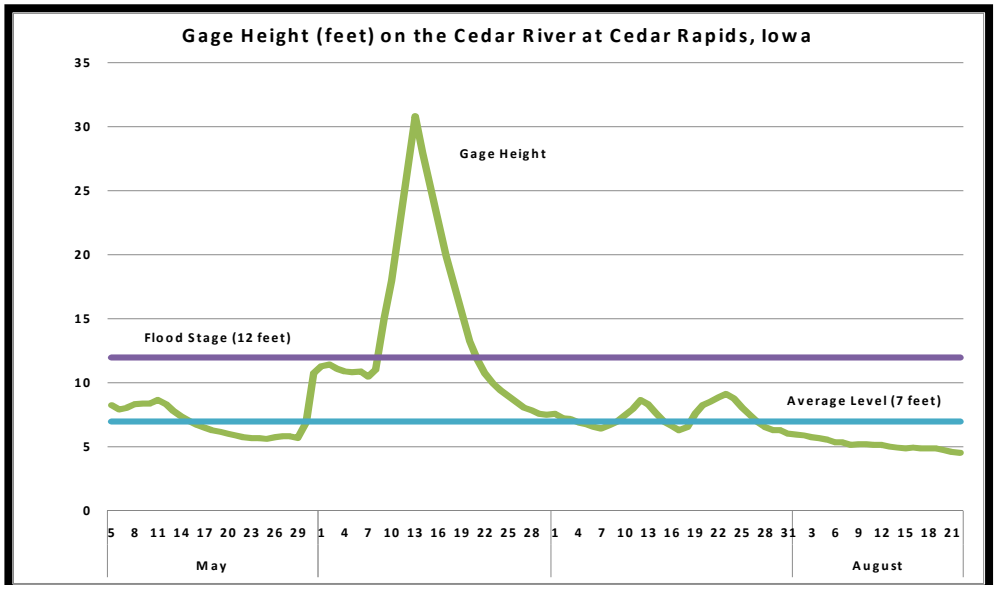
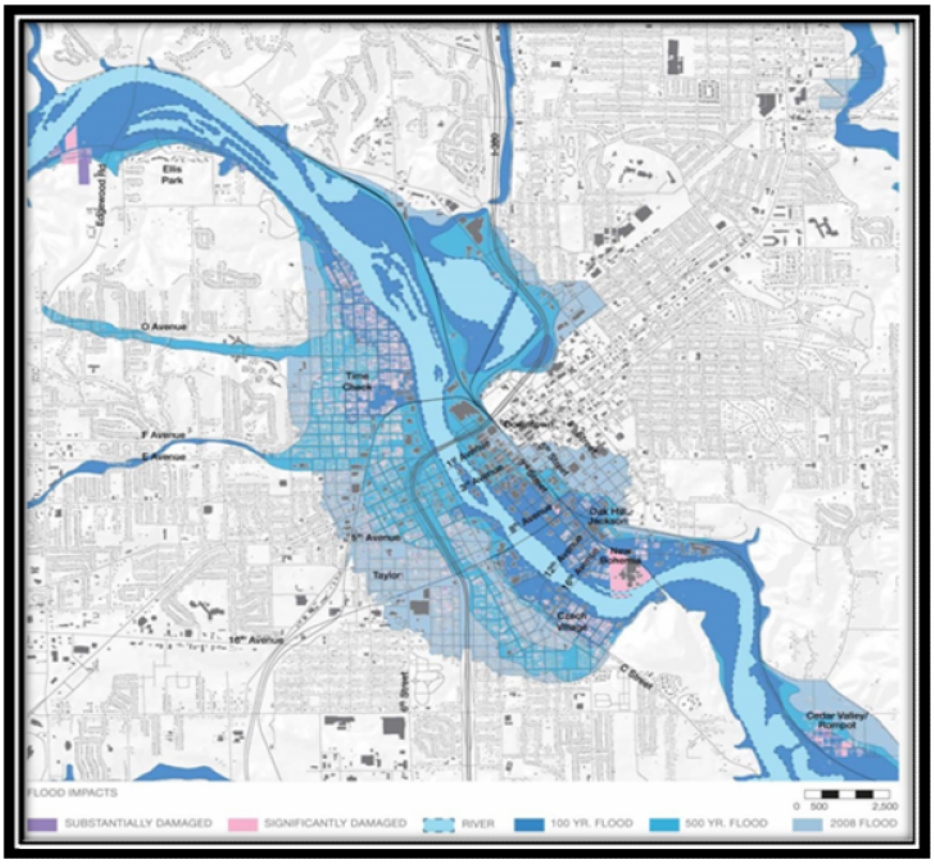


Figure 1: 2008 Cedar River Flooding Levels in Cedar Rapids, Iowa


Gage Height (feet) on the Cedar River at Cedar Rapids, Iowa
35
30
25
20
15
10
5
0
Gage Height
Flood Stage (12 feet)
Average Level (7 feet)
5 8 11 14 17 20 23 26 29 1 4 7 10 13 16 19 22 25 28 1 4 7 10 13 16 19 22 25 28 31 3 6 9 12 15 18 21
May
August


Ellis Park
O Avenue
Time Check
F Avenue
E Avenue
Oak Hill-Jackson
Taylor
16th Avenue
Czech Village
Center Valley/ Kenyon
FLOOD IMPACTS
SUBSTANTIALLY DAMAGED
SIGNIFICANTLY DAMAGED
RIVER
100 YR. FLOOD
500 YR. FLOOD
2008 FLOOD
0 500 2,500









Source: *CedarRapidsFloodStory.com*

2. Regional Economic Impacts of Floods

There are four types of regional economic impacts of floods that are discussed in this section of this report—(1) damages, (2) recovery effort effects, (3) business losses, and (4) changes in business productivity.

First, damages are the physical outcomes of flooding: houses destroyed, roads damaged, bridges washed out, households affected and businesses disrupted (as illustrated above for case of the 2008 Cedar Rapids Flood). The economic impacts of these damages are difficult to measure because it is hard to assess how much the regional and state economies are changed as a consequence of just these damages. Many types of damages are difficult to monetize due to the physical nature (especially environmental harms) because they are not valued in the marketplace. Direct losses are the financial value of the damages, to the extent that they can be determined. These are mainly the value of destroyed homes and personal belongings or the destruction of business machinery or inventories. Direct losses, however, are only known to the extent that individuals, businesses, or governments itemize those losses when seeking assistance.

Second, recovery efforts can have significant regional economic effects on the local economy to the extent that they create local spending. Insurance payments are designed to mitigate much of the personal and business direct losses caused by the damages. However, not all losses are compensated so there is a gap between the declared value of the losses and the value of the payments to households, businesses, and industries. Although the direct losses due to flooding can heavily impact individual businesses and households, the aggregate economy may not change much (Swenson, 2010).

Public assistance is intended to provide temporary aide to flood victims with shelter, food, clothing and other personal comfort items. Reconstruction of public infrastructure (such as flood protection facilities, roads, public buildings, etc.) will replace existing structures or provide future flood protection. The regional impacts of public assistance (including the re-construction of private and public facilities and infrastructure) related to the 2008 Cedar River Flood on the State of Iowa and Linn County has been computed by Swenson, et.al. (2008), Swenson (2010) and the U.S. Army Corps of Engineers (2010).

Third, local businesses located in the flood impact area will likely experience lost inventories, sales, productivity and profits. Many businesses may not be insured for losses due to flooding. There may also be business failures and job losses. As vital as many of these indicators are to the individual businesses (lost sales), they may not be the most appropriate economic impact measures. Some of these business losses are temporary that continue only as long as it takes for the businesses to recover while others will be permanent business losses due the closure of the affected firms. The losses sustained by households, businesses, and communities suggest dire direct and indirect economic consequences. When an economy is "impacted" changes in local industrial activity affect payments made to workers, owners, and investors. Ultimately, all economic activity finds its way into personal income, so loss in personal income.

The dollar value of lost sales overstates the impacts on the local economy because it does not include offsetting costs there are not incurred locally or are the losses of other local businesses. As a result, a better impact measure is "net operating losses". Operating losses can occur for a variety of reasons—reductions in revenues, inventory losses, delays in production due to damages in plant or equipment, transportation problems, absence of or stresses on employees, or other disruptions to normal business operations. Operating losses, in turn, reduce reduction in regional income. In the jargon of economic impact analysis, operating losses are referred to as reductions in "value added". Value added is defined as the sum of employment compensation (i.e., wages and salaries plus employer contributions to employee benefit programs such as social security, health insurance, etc.), proprietors' income, other property-type income (rents, dividends, profits), and indirect business taxes. Labor income is defined to the sum of employee compensation and proprietors' income.

Fourth, property that is flooded periodically and not protected through some type of mitigation facility (such as flood walls) will find that it is less productive in the future as firms and households seek locations that are more protected, other things being equal. During the time since the 2008 Flood existing firms and businesses looking to locate in Cedar Rapids have related to city staff and officials that they would be reluctant to undertake major investments as long as the major flood protection were not implemented. Without flood protection nearby firms would see increased costs due to periodic damages (see above) and the associated higher insurance rates. This business behavior is likely to affect locations both in and outside the flood impact area because the costs associated with major flooding affects businesses inside and outside the flood impact areas (see Appendix A).

3. The Economic Consequences of the 2008 Cedar Rapids Flood Due to Business Losses During the Recovery Period

Two types of economic effects of flood-related business losses are addressed herein. First, we evaluate the direct, indirect and induced economic impacts associated with the loss of business in the flood impact area caused by the 2008 Cedar Rapids Flood during the period of business recovery. The recovery times shown in Table 2 below indicate that the operations of firms in different kinds of industries were impacted for variable periods of time. The resulting economic effects on Linn County and the rest of Iowa are commuting in a cumulative manner—i.e., for the entire recovery period. In reality, the impacts will be most intense during the earlier stages of the recovery and less so later. Second, most of the firms in the first scenario have recovered and resumed their operations. Their workers have been recalled or rehired. As a consequence, the economic effects associated by their business losses will diminish over time. However, there are some firms that either have shut down their operations permanently or have left the Cedar Rapids area or even Iowa because of the 2008 Flood. In a recent report on the social effect of the 2008 Cedar Rapids Flood (City of Cedar Rapids, 2010) it was reported that

- Total number of businesses directly or indirectly impacted by the flood: 1,281
    - Number of businesses lost as a result of the flood: 131
    - Number of businesses that have reopened: 671
    - Number of businesses that reopened outside the city or flooded area: 143
- Number of jobs in the flood impacted area before the flood: 11,814

- Number of jobs lost as a result of the flood: 1,865
    - Permanent: 1,324
    - Temporary: 541

  Source: City of Cedar Rapids (2010)

We also address the permanent business loss of the 1,324 jobs.

We computed the local economic consequences of flooding on the economy of Linn County, Iowa (where Cedar Rapids is located). In addition, we also simultaneously evaluated the economic effects on the rest of the State of Iowa. We measure the economic effects using four economic impact variables—output (sales), jobs (person-years of employment), value added and labor income. All impacts are computed at the most detailed industrial level available (i.e., IMPLAN's 440 sectors) using monetary units expressed in 2008 dollars. After computing the impact estimates all monetary values have been re-expressed in thousands of 2010 dollars and then aggregated industrially to a 10-sector level.

A Flood Impact Survey of Cedar Rapids Businesses

There are two key indicators of how extensive an industry's impact will be due to flooding. One is the percentage of the industry's firms are located in the flood impact area. And, two is the length of time that the firms are shut down due to flooding. These data are not available from published or unpublished secondary data sources. They have to be collected via special surveys. Recently the City of Cedar Rapids conducted such a business impact survey for this study. The results of the survey are shown in Table 2.

The recovery time was calculated as the industry-specific (2-digit NAICS) average length of recovery time reported by individual firms weighted by the number of employees of each firm affected by the flooding.[1] On average, approximate 17.8 percent of Linn County's industry employment is located with the 2008 Flood impact area within Cedar Rapids and the businesses located there were out of business for 1.3 months due to flooding.

[1] There were two exceptions to the weighted average computations. First, NAICS 311230 was treated individually. Second, the remaining parts of manufacturing were handled as a single sector.

Employment and Business Survey Results			
Code	NAICS Sector	Linn County Employment Share Located in Flood Impact Area (%)	Recovery Time (months)
11	Agriculture, Forestry, Fishing and Hunting	0.0%	0.0
21	Mining, Quarrying, and Oil and Gas Extraction	0.0%	0.0
22	Utilities	52.2%	1.3
23	Construction	10.2%	1.6
31	Food, Textiles & Apparel Manufacturing	39.9%	1.7
32	Wood, Paper, Petroleum, Chemicals & Nonmetallic Goods Manufacturing	13.1%	1.7
33	Metals, Machinery, Equipment and Miscellaneous Product Manufacturing	10.4%	1.7
42	Wholesale Trade	8.5%	3.3
44	Motor Vehicle, Furniture, Food, Clothing & Gasoline Retail Stores	3.6%	2.9
45	Other Retial Stores	1.1%	2.9
48	Transportation	5.4%	1.0
49	Couriers, messengers and Warehousing	43.2%	1.3
51	Information	6.6%	6.0
52	Finance and Insurance	12.3%	2.4
53	Real Estate and Rental and Leasing	15.7%	7.6
54	Professional, Scientific, and Technical Services	16.7%	3.5
55	Management of Companies and Enterprises	11.4%	1.3
56	Administrative and Support and Waste Management and Remediation Services	12.6%	3.5
61	Educational Services	24.7%	6.0
62	Health Care and Social Assistance	41.8%	0.2
71	Arts, Entertainment, and Recreation	11.5%	15.5
72	Accommodation and Food Services	8.2%	9.6
81	Other Services (except Public Administration)	16.6%	8.8
92	Public Administration	35.1%	1.3
All Sector Average		17.8%	1.3

Direct Impacts in Linn County (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$0	0	$0	$0	$0	$0	$0
21	Mining	$0	0	$0	$0	$0	$0	$0
22	Utilities	$53,430	86	$11,060	$135	$22,610	$6,575	$40,380
23	Construction	$20,832	136	$7,793	$632	$709	$120	$9,254
31, 32 & 33	Manufacturing	$348,530	444	$39,205	$54	$34,121	$1,098	$74,477
42, 44 & 45	Wholesale & Retail Trade	$29,248	243	$10,712	$656	$3,791	$4,078	$19,237
48, 49 & 51	Transportation & Information	$67,993	272	$14,195	$288	$13,023	$2,319	$29,825
52 & 53	Finance, Insurance & Real Estate	$199,877	688	$27,375	$4,055	$79,937	$16,911	$128,278
54 - 81	Services	$289,384	3,514	$114,355	$17,213	$33,150	$7,958	$172,676
92	Public Administration	$6,638	40	$3,020	$0	$323	$0	$3,343
	Sector Total	$1,015,933	5,423	$227,714	$23,033	$187,665	$39,059	$477,471

2

2

Indirect Impacts in Linn County (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$988	4	$15	$70	$277	$23	$385
21	Mining	$5	0	$2	$0	$1	$0	$2
22	Utilities	$66,736	108	$13,813	$169	$28,228	$8,207	$50,417
23	Construction	$28,428	200	$11,342	$963	$1,590	$155	$14,050
31, 32 & 33	Manufacturing	$355,493	463	$40,433	$55	$34,617	$1,140	$76,245
42, 44 & 45	Wholesale & Retail Trade	$54,469	422	$19,904	$1,133	$7,120	$7,562	$35,719
48, 49 & 51	Transportation & Information	$120,200	511	$25,923	$661	$22,433	$3,891	$52,908
52 & 53	Finance, Insurance & Real Estate	$257,333	1,013	$41,476	$5,946	$97,260	$19,904	$164,586
54 - 81	Services	$357,962	4,342	$140,739	$21,450	$41,776	$9,390	$213,354
92	Public Administration	$11,781	74	$5,622	$0	$531	$0	$6,153
	Sector Total	$1,253,396	7,137	$299,268	$30,446	$233,833	$50,271	$613,820

Induced Impacts in Linn County (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$234	1	$8	$16	$64	$4	$93
21	Mining	$1	0	$0	$0	$0	$0	$0
22	Utilities	$5,853	9	$1,212	$15	$2,469	$717	$4,413
23	Construction	$1,838	16	$765	$104	$297	$7	$1,174
31, 32 & 33	Manufacturing	$4,010	8	$538	$0	$317	$19	$874
42, 44 & 45	Wholesale & Retail Trade	$39,167	550	$14,212	$1,648	$4,804	$5,649	$26,312
48, 49 & 51	Transportation & Information	$15,776	70	$3,498	$104	$2,711	$520	$6,833
52 & 53	Finance, Insurance & Real Estate	$64,139	190	$8,163	$1,133	$26,889	$5,207	$41,391
54 - 81	Services	$78,671	1,077	$33,253	$3,363	$7,023	$1,771	$45,409
92	Public Administration	$3,176	17	$1,254	$0	$186	$0	$1,439
	Sector Total	$212,865	1,939	$62,901	$6,383	$44,761	$13,894	$127,939

Total Impacts in Linn County (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$1,223	5	$24	$86	$341	$27	$478
21	Mining	$5	0	$2	$0	$1	$0	$3
22	Utilities	$126,019	204	$26,085	$319	$53,307	$15,499	$95,211
23	Construction	$51,098	351	$19,899	$1,699	$2,597	$282	$24,478
31, 32 & 33	Manufacturing	$708,033	915	$80,176	$109	$69,056	$2,256	$151,597
42, 44 & 45	Wholesale & Retail Trade	$122,884	1,215	$44,828	$3,437	$15,715	$17,288	$81,268
48, 49 & 51	Transportation & Information	$203,969	853	$43,616	$1,054	$38,167	$6,730	$89,567
52 & 53	Finance, Insurance & Real Estate	$521,349	1,892	$77,013	$11,133	$204,086	$42,022	$334,255
54 - 81	Services	$726,017	8,933	$288,346	$42,025	$81,948	$19,119	$431,438
92	Public Administration	$21,596	131	$9,895	$0	$1,040	$0	$10,935
	Sector Total	$2,482,193	14,499	$589,884	$59,862	$466,259	$103,224	$1,219,229

Indirect Impacts in Rest of Iowa (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$24,077	88	$307	$2,436	$7,375	$423	$10,541
21	Mining	$272	1	$36	$16	$33	$4	$88
22	Utilities	$2,607	4	$349	$37	$338	$85	$808
23	Construction	$111	1	$49	$6	$3	$1	$58
31, 32 & 33	Manufacturing	$18,135	36	$2,084	$252	$883	$80	$3,300
42, 44 & 45	Wholesale & Retail Trade	$4,072	25	$1,377	$161	$535	$551	$2,624
48, 49 & 51	Transportation & Information	$8,360	45	$2,114	$190	$1,303	$146	$3,753
52 & 53	Finance, Insurance & Real Estate	$13,244	71	$3,497	$502	$3,503	$240	$7,742
54 - 81	Services	$11,343	88	$4,146	$616	$1,309	$142	$6,212
92	Public Administration	$871	4	$286	$0	$57	$0	$342
	Sector Total	$83,092	363	$14,244	$4,214	$15,338	$1,671	$35,467

Induced Impacts in Rest of Iowa (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$1,229	5	$46	$63	$322	$21	$453
21	Mining	$34	0	$5	$2	$4	$0	$12
22	Utilities	$734	2	$123	$12	$108	$19	$263
23	Construction	$21	0	$7	$2	$2	$0	$11
31, 32 & 33	Manufacturing	$5,546	14	$743	$38	$336	$22	$1,139
42, 44 & 45	Wholesale & Retail Trade	$1,834	15	$639	$69	$230	$252	$1,190
48, 49 & 51	Transportation & Information	$1,949	12	$503	$44	$243	$30	$820
52 & 53	Finance, Insurance & Real Estate	$5,530	25	$1,114	$178	$1,340	$142	$2,775
54 - 81	Services	$5,365	73	$1,579	$250	$812	$241	$2,882
92	Public Administration	$546	3	$190	$0	$35	$0	$226
	Sector Total	$22,789	150	$4,950	$660	$3,432	$727	$9,770

Total Impacts in Rest of Iowa (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$25,307	93	$354	$2,499	$7,697	$444	$10,994
21	Mining	$306	1	$40	$18	$37	$4	$100
22	Utilities	$3,341	6	$472	$49	$446	$104	$1,071
23	Construction	$132	1	$56	$8	$5	$1	$69
31, 32 & 33	Manufacturing	$23,681	50	$2,827	$291	$1,218	$102	$4,438
42, 44 & 45	Wholesale & Retail Trade	$5,905	40	$2,016	$230	$765	$803	$3,814
48, 49 & 51	Transportation & Information	$10,309	57	$2,617	$234	$1,546	$176	$4,573
52 & 53	Finance, Insurance & Real Estate	$18,774	96	$4,611	$680	$4,844	$382	$10,517
54 - 81	Services	$16,708	162	$5,724	$866	$2,121	$383	$9,094
92	Public Administration	$1,417	7	$476	$0	$92	$0	$568
	Sector Total	$105,881	513	$19,194	$4,874	$18,770	$2,398	$45,236

Total Impacts in State of Iowa (monetary values in thousands of 2010 dollars)								
NAICS	Sector	Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$26,529	98	$377	$2,585	$8,038	$471	$11,471
21	Mining	$311	1	$42	$18	$38	$4	$103
22	Utilities	$129,360	210	$26,557	$368	$53,753	$15,603	$96,281
23	Construction	$51,230	353	$19,955	$1,707	$2,602	$283	$24,547
31, 32 & 33	Manufacturing	$731,715	965	$83,003	$399	$70,274	$2,358	$156,035
42, 44 & 45	Wholesale & Retail Trade	$128,789	1,256	$46,844	$3,667	$16,480	$18,091	$85,082
48, 49 & 51	Transportation & Information	$214,278	910	$46,233	$1,288	$39,712	$6,906	$94,139
52 & 53	Finance, Insurance & Real Estate	$540,124	1,988	$81,625	$11,814	$208,930	$42,404	$344,772
54 - 81	Services	$742,725	9,095	$294,071	$42,891	$84,069	$19,502	$440,532
92	Public Administration	$23,013	137	$10,371	$0	$1,132	$0	$11,503
	Sector Total	$2,588,074	15,012	$609,078	$64,736	$485,029	$105,622	$1,264,465

We estimate that the economic impacts due to the 2008 Cedar Rapids Flood generated losses in State of Iowa totaling

- Almost $2.6 billion in business sales over the flood recovery period,
- 15,000 work-years of employment and nearly $609 million employee compensation,
- $4.9 million in proprietor's income,
- $64.7 million in rents, dividends, profits, etc. were lost or not paid,
- $105.6 million in indirect business taxes, and
- $1.3 billion in gross domestic product (value added).

Graphical Comparisons of the Recovery Period Economic Impacts of the 2008 Cedar Rapids Flood on the Economies of Linn County and the Rest of Iowa

There are some interesting comparisons of the industrial structure of the impacts of the 2008 Cedar Rapids Flood on the economies of Linn County and the rest of Iowa. It is clear that the industrial patterns of the flood-related business loss direct, indirect and induced impacts on Lin County are similar but that the induced impacts are much smaller than either the direct or indirect impacts.

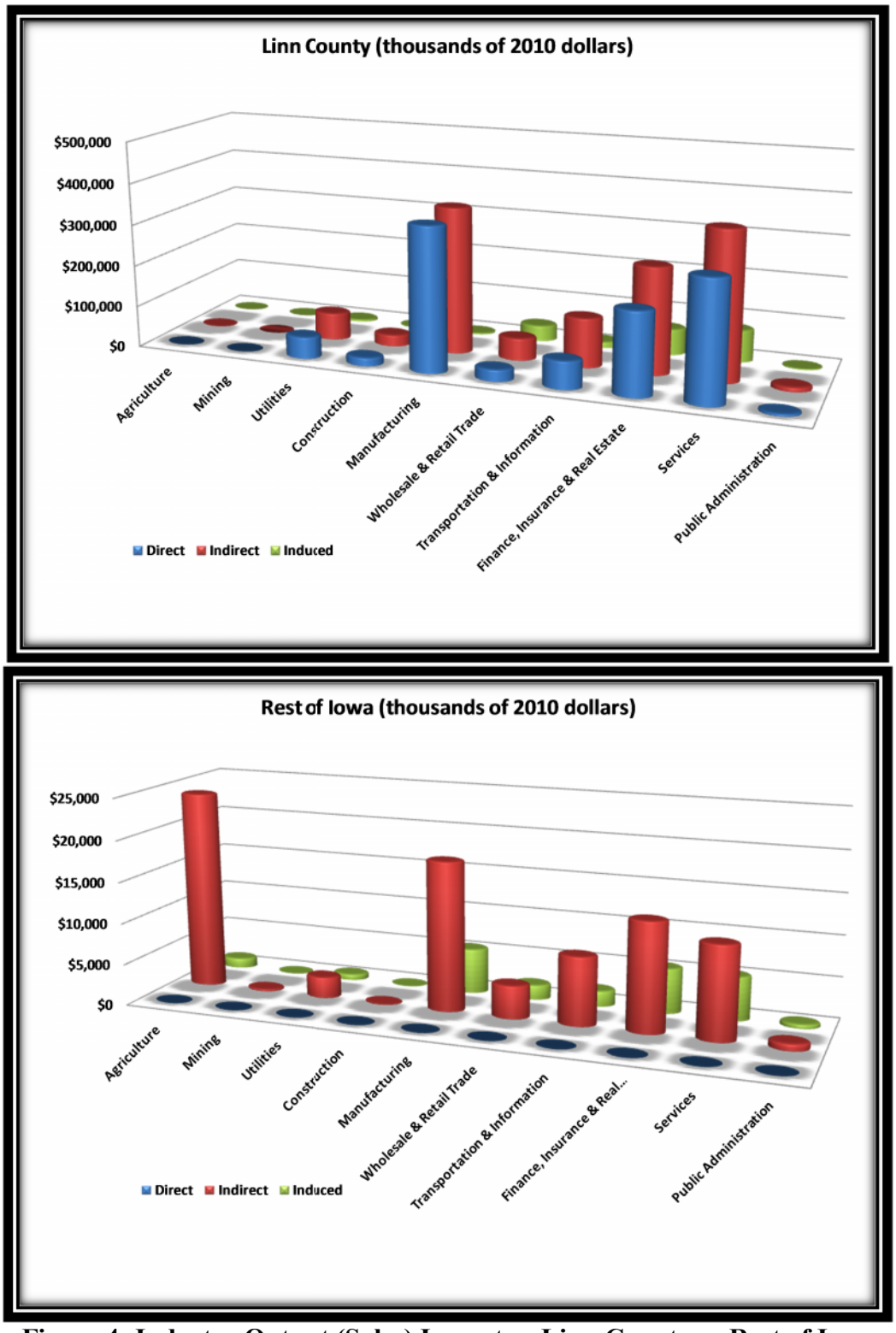


Figure 4: Industry Output (Sales) Impacts—Linn County vs Rest of Iowa

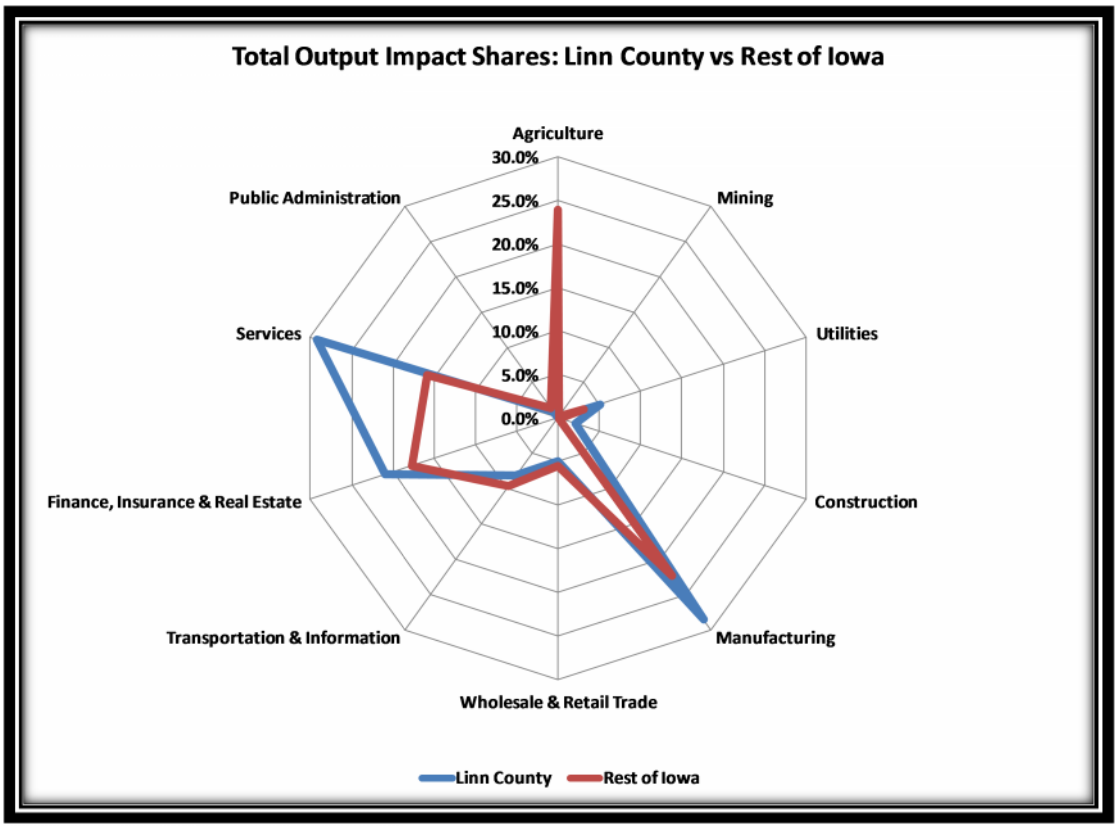


Figure 5: Industry Output Impact Shares: Linn County vs Rest of Iowa

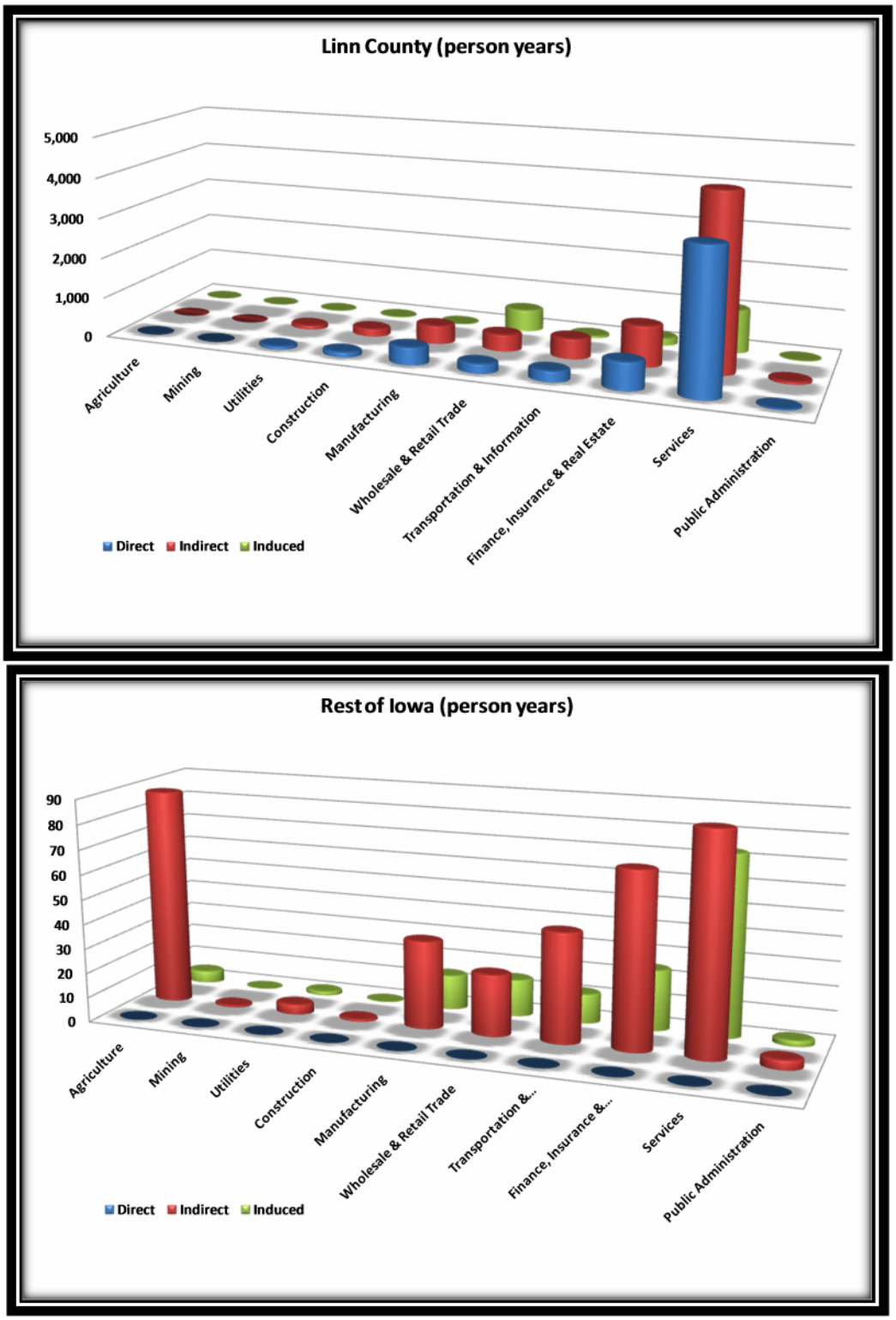


Figure 6: Industry Employment Impacts—Linn County vs Rest of Iowa

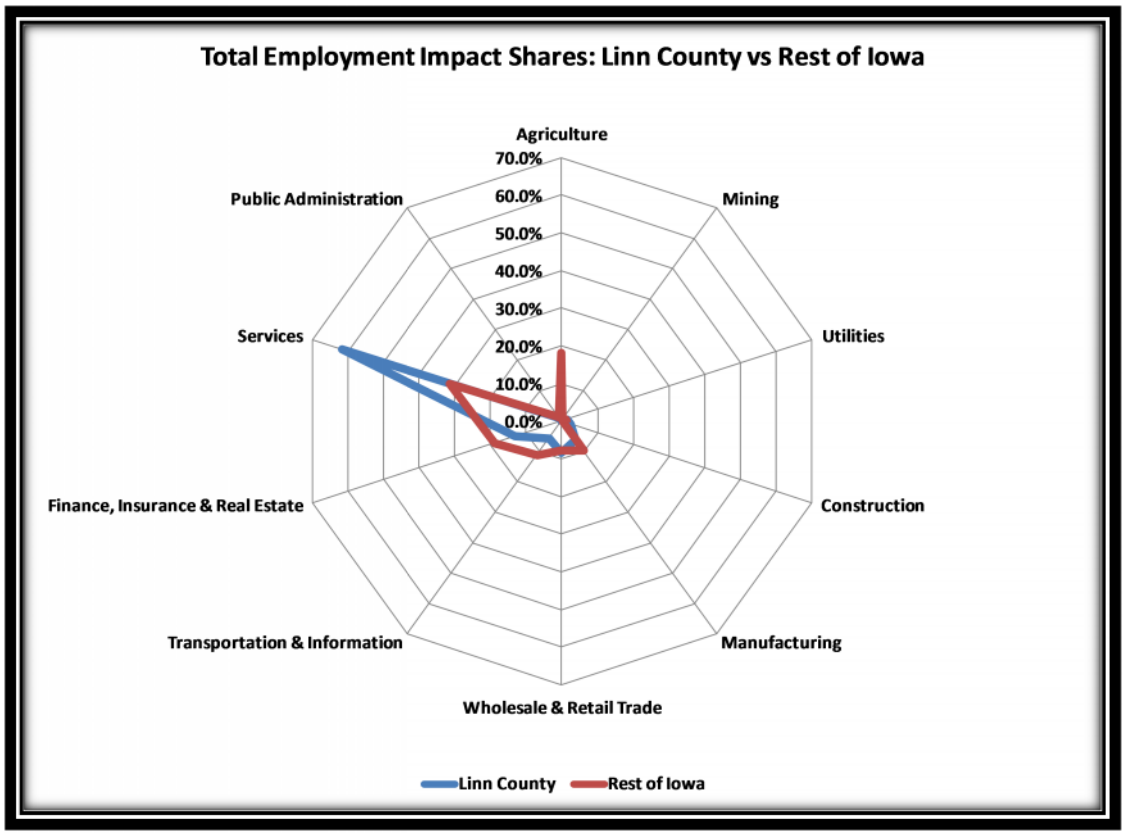


Figure 7: Industry Employment Impact Shares: Linn County vs Rest of Iowa

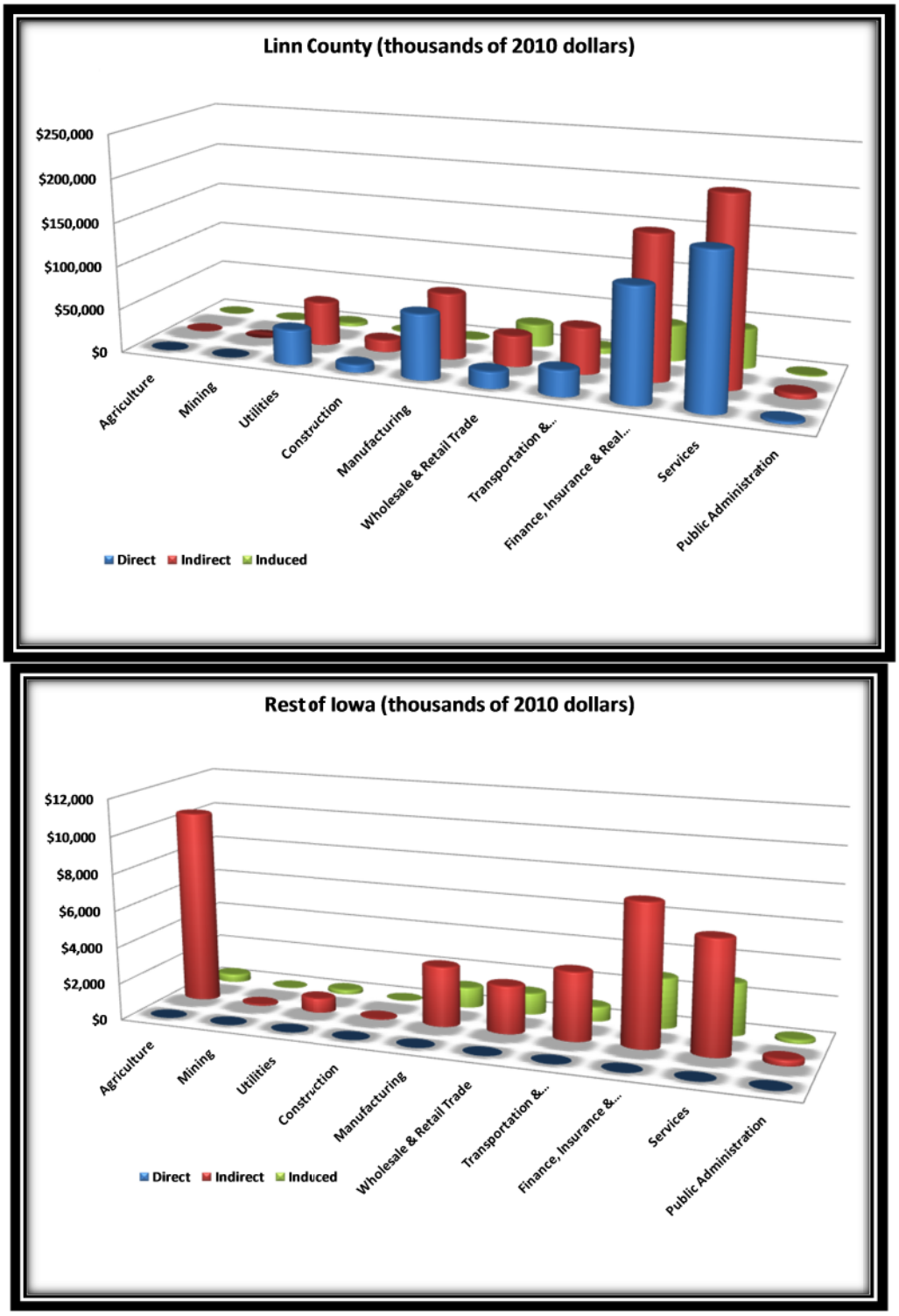


Figure 8: Industry Value Added Impacts—Linn County vs Rest of Iowa

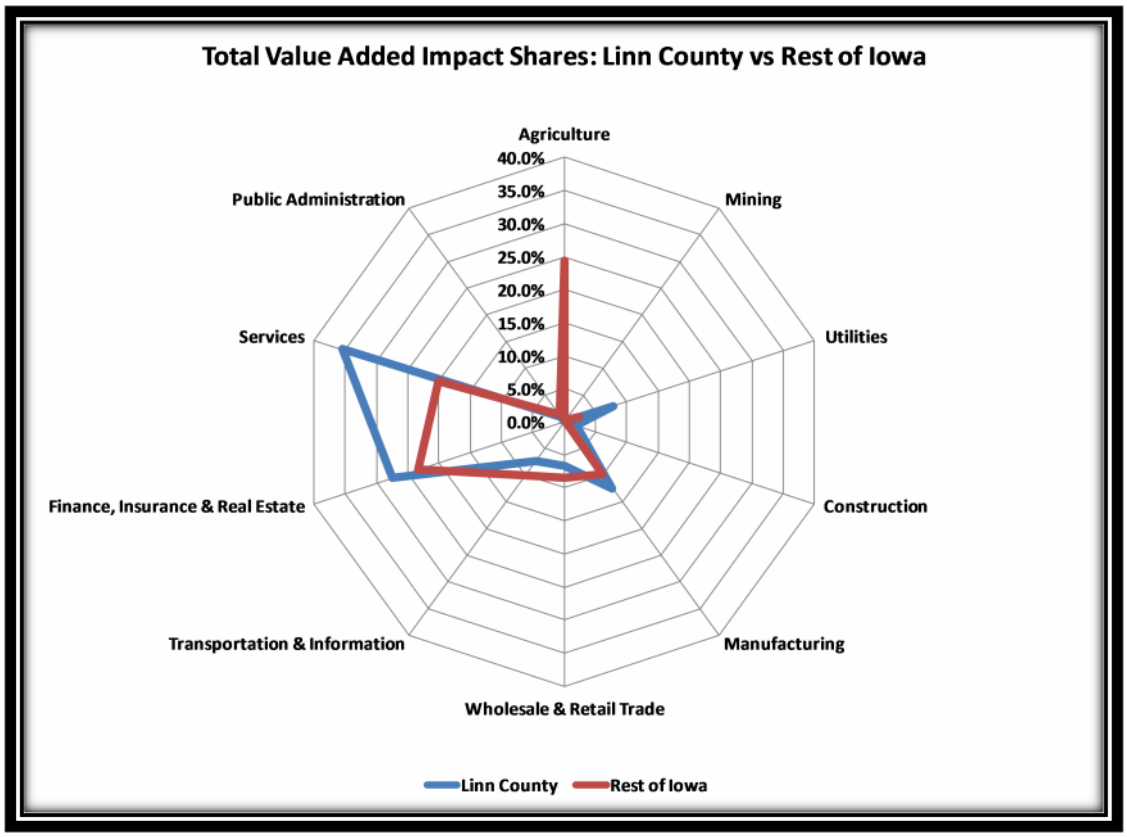


Figure 9: Industry Value Added Impact Shares: Linn County vs Rest of Iowa

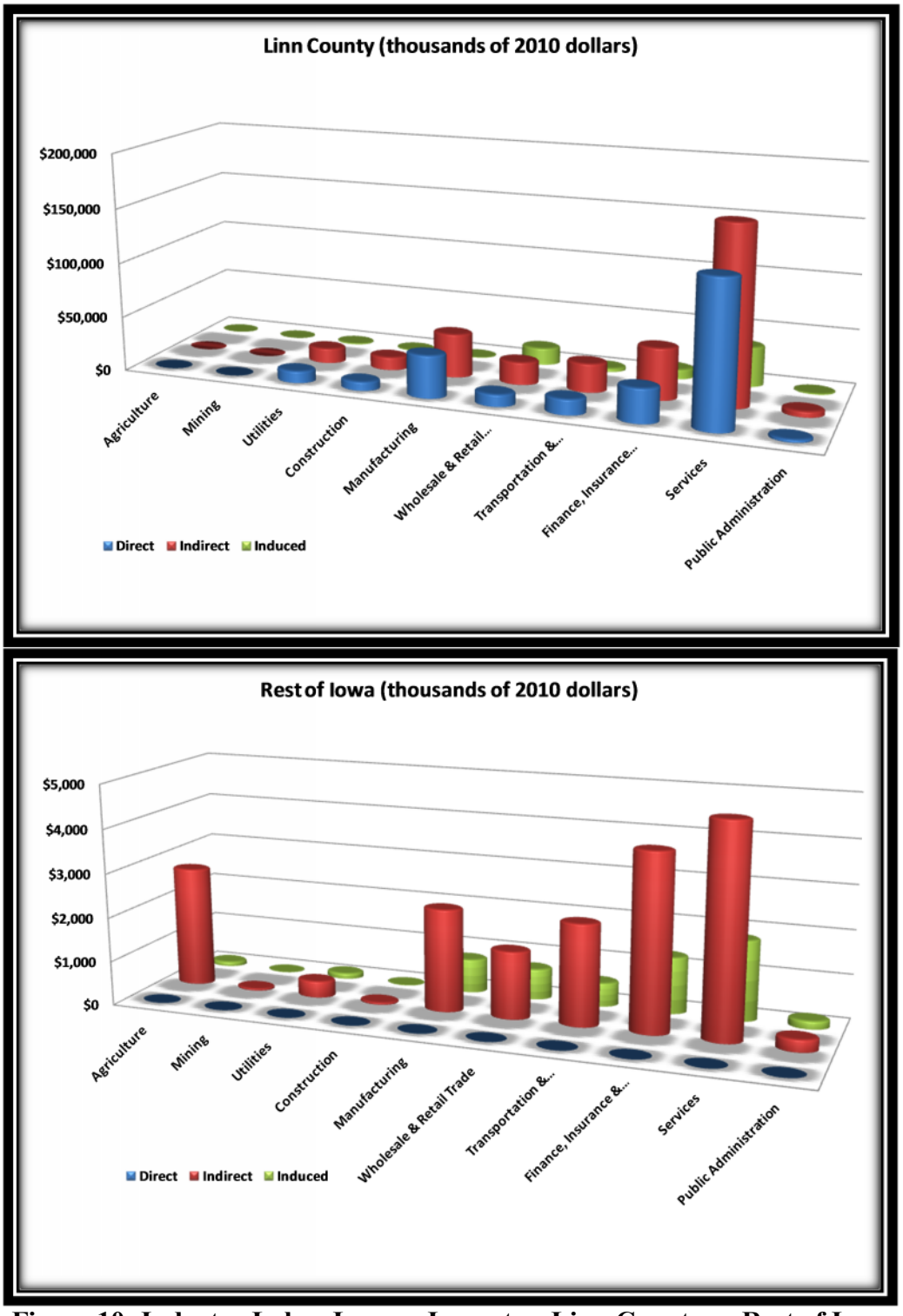


Figure 10: Industry Labor Income Impacts—Linn County vs Rest of Iowa

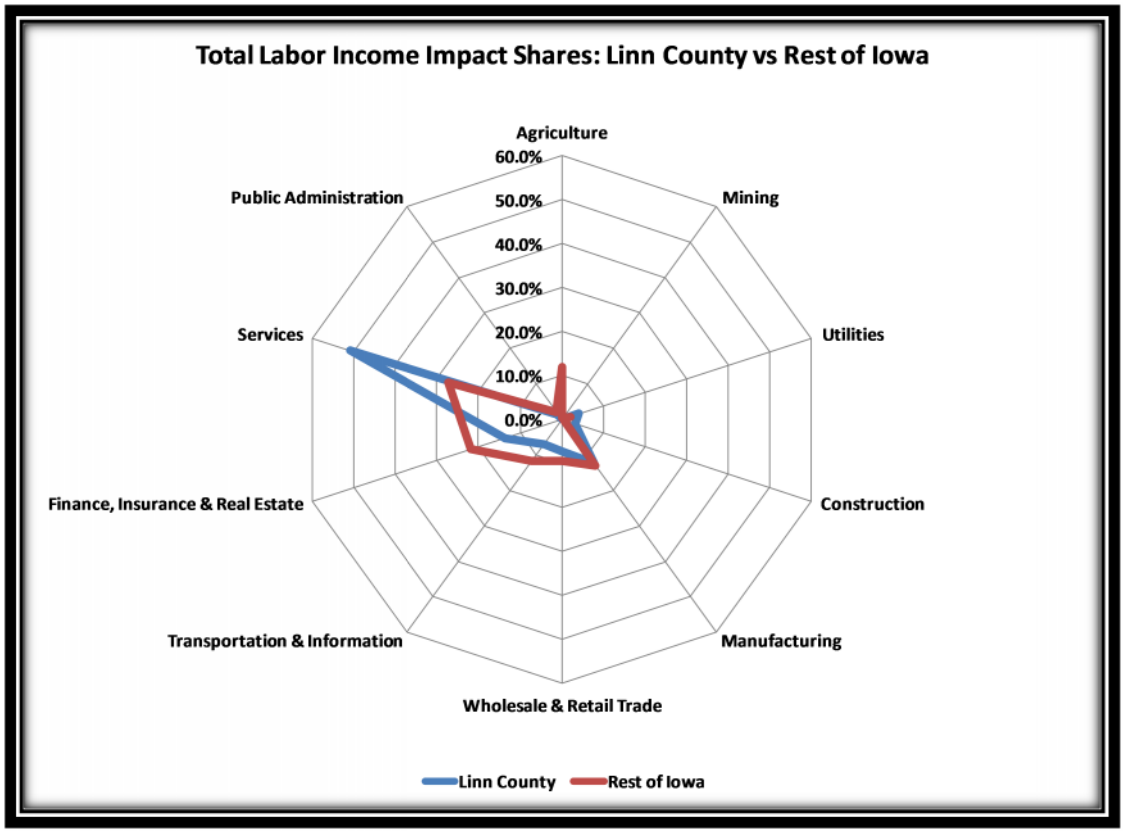


Figure 11: Industry Labor Income Impact Shares: Linn County vs Rest of Iowa

5. The Permanent Economic Consequences of the 2008 Cedar Rapids Flood Due to Business Losses

It is reported that 1,865 jobs were lost as a result of the 2008 Cedar Rapids Flood due to business losses within the flood impact area (1,324 permanently and 541 temporarily). Unlike most of direct employment consequences shown above (in Table 1),[3] the permanent job losses represent a shift in employment levels due to local business closures or firms moving out of Cedar Rapids area (and probably out of the State of Iowa).

Because we don't know accurately know the industrial distribution of the permanent job losses, the multiregional economic effects of the permanent job losses via an aggregate impact estimation process. We can first convert the permanent job losses into direct losses in business sales (or output) and value added via region-wide average output and value added to employee ratios based on the 2008 IMPLAN data base for Linn County (Table 9).[4]

[3] Again, the direct, indirect and induced employment effects estimated in the previous section are measured in person-years of employment lost over duration of the recovery period. A person-year of employment is one person work for one year.

[4] Linn County data are used for this calculation because Cedar Rapids is located within Linn County.

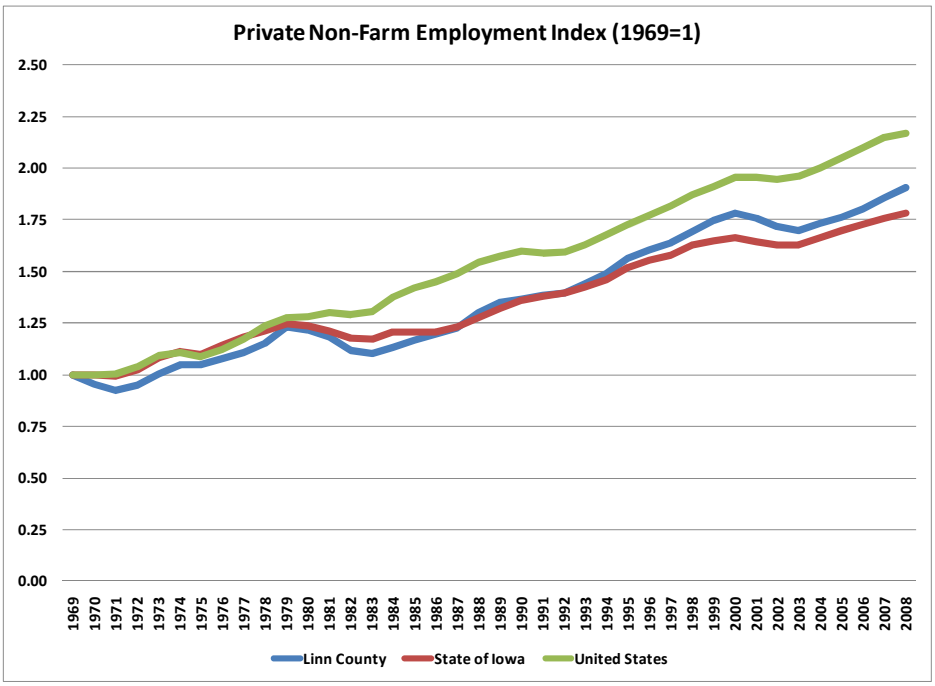
NAICS	Sector	Output	Employment (jobs)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$292	1,714	$7	$26	$81	$5	$119
21	Mining	$29	129	$9	$1	$7	$1	$17
22	Utilities	$907	1,482	$188	$2	$383	$111	$684
23	Construction	$1,401	9,808	$524	$43	$48	$8	$622
31, 32 & 33	Manufacturing	$10,221	18,536	$1,588	$2	$752	$40	$2,382
42, 44 & 45	Wholesale & Retail Trade	$2,183	27,983	$751	$85	$315	$310	$1,462
48, 49 & 51	Transportation & Information	$2,642	12,666	$610	$22	$464	$75	$1,171
52 & 53	Finance, Insurance & Real Est	$3,651	13,769	$730	$54	$1,132	$227	$2,143
54 - 81	Services	$3,992	52,575	$1,650	$205	$356	$90	$2,301
92	Public Administration	$165	1,012	$76	$0	$4	$0	$80
	Sector Total	$25,484	139,674	$6,131	$440	$3,542	$866	$10,980
Monetary values in millions of 2010 dollars.								
Source: 2008 IMPLAN data base for Linn County.								

NAICS	Sector	Output	Employment (jobs)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
11	Agriculture	$170,282	1	$3,987	$15,347	$47,188	$2,775	$69,296
21	Mining	$227,348	1	$66,210	$4,852	$53,566	$4,300	$128,928
22	Utilities	$612,381	1	$126,640	$1,543	$258,409	$75,060	$461,651
23	Construction	$142,851	1	$53,437	$4,333	$4,865	$821	$63,457
31, 32 & 33	Manufacturing	$551,408	1	$85,660	$101	$40,565	$2,165	$128,491
42, 44 & 45	Wholesale & Retail Trade	$78,014	1	$26,842	$3,034	$11,274	$11,088	$52,238
48, 49 & 51	Transportation & Information	$208,574	1	$48,166	$1,721	$36,650	$5,904	$92,441
52 & 53	Finance, Insurance & Real Est	$265,166	1	$52,990	$3,939	$82,246	$16,451	$155,626
54 - 81	Services	$75,935	1	$31,381	$3,907	$6,766	$1,707	$43,761
92	Public Administration	$163,332	1	$74,869	$0	$4,077	$0	$78,945
	All Sectors	$182,454	1	$43,898	$3,150	$25,361	$6,200	$78,609
All values in 2010 dollars per employee (except employment)								

Output	Employment (person years of work)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
$241,752	1,325	$58,165	$4,174	$33,604	$8,215	$104,157

Implicit Multipliers	Output	Employment (jobs)	Employee Compensation	Proprietors' Income	Other Property-Type Income	Indirect Business Taxes	Value Added
Linn County	2.443	2.674	2.590	2.599	2.485	2.643	2.554
Rest of Iowa	0.104	0.095	0.084	0.212	0.100	0.061	0.095
State of Iowa	2.547	2.768	2.675	2.811	2.585	2.704	2.648

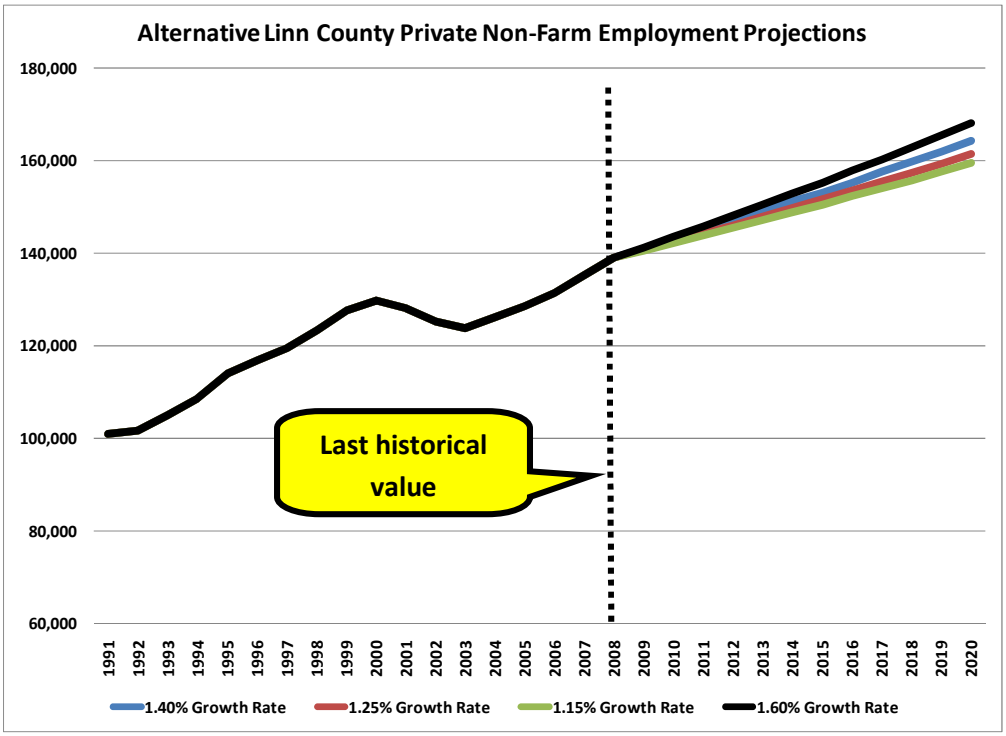
	Output	Employment (jobs)	Value Added	Labor Income
Linn County	$590,665	3,543	$265,967	$161,520
Rest of Iowa	$25,195	125	$9,868	$5,786
State of Iowa	$615,860	3,668	$275,835	$167,306
Monetary impacts in thousands of 2010 dollars				


Private Non-Farm Employment Index (1969=1)
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Linn County
State of Iowa
United States

5

5

	Private Non-Farm Employment		
	Average Annual Percentage Change		
	1997-2007	2002-07	2005-07
Area	10-year	5-year	2-year
Linn County	1.26%	1.58%	2.61%
State of Iowa	1.07%	1.51%	1.77%
United States	1.68%	1.99%	2.34%
Source: U.S. Bureau of Economic Analysis			



	Private Non-Farm Employment Projections				Employment Differences with the 1.60% Projection		
	Average Annual Growth Rates				Average Annual Growth Rates		
	1.60%	1.40%	1.25%	1.15%	1.40%	1.25%	1.15%
2009	141,270	140,992	140,783	140,644	278	487	626
2010	143,530	142,966	142,543	142,261	565	987	1,269
2011	145,827	144,967	144,325	143,897	859	1,502	1,929
2012	148,160	146,997	146,129	145,552	1,163	2,031	2,607
2013	150,530	149,055	147,955	147,226	1,476	2,575	3,304
2014	152,939	151,141	149,805	148,919	1,797	3,134	4,020
2015	155,386	153,257	151,677	150,632	2,129	3,708	4,754
2016	157,872	155,403	153,573	152,364	2,469	4,299	5,508
2017	160,398	157,579	155,493	154,116	2,819	4,905	6,282
2018	162,964	159,785	157,437	155,889	3,180	5,528	7,076
2019	165,572	162,022	159,405	157,681	3,550	6,167	7,890
2020	168,221	164,290	161,397	159,495	3,931	6,824	8,726
Author's calculations							

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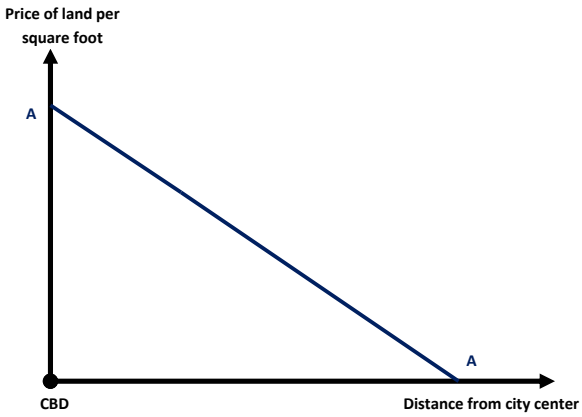
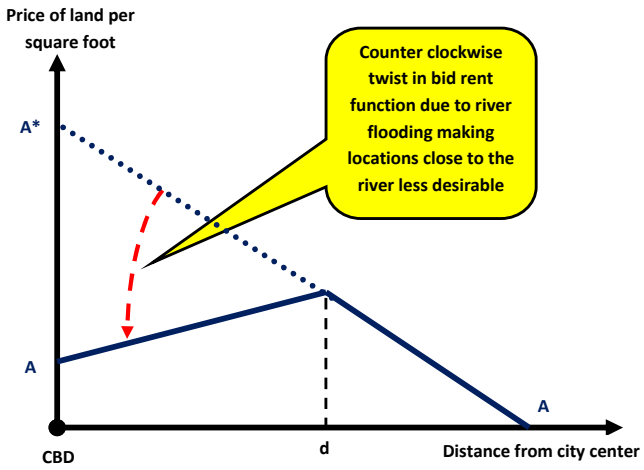

Price of land per
square foot
A
A
CBD
Distance from city center


Price of land per square foot
A*
A
A
CBD
d
Distance from city center
Counter clockwise twist in bid rent function due to river flooding making locations close to the river less desirable

Appendix B
Multiregional Economic Multiplier Effects and Multipliers

Regional Economic Multiplier Process

To introduce the regional economic multiplier, one can think of a household with one wage earner. Obviously, the household's income and its standard-of-living increases and decreases as the wages earned by the head fluctuate. Just like the household, one can envision a local economy that has a great dependence on external sources of demand for the level of its internal welfare; in other words, it is an "open" economy. The regional economic multiplier process provides a simple framework in which to analyze such situations. Local economic activity can be split into two general categories; either into an export or into a service sector. The export sector includes those firms that sell their products to businesses and households outside the boundaries of the local economy. In addition, establishments within the local economy which cause funds to flow into the study area by their activities (such as tourist activities and federal government facilities) are also considered part of the export sector. The local service sector, in contrast, is made up of those firms that sell their goods and services within the local economy; either to firms in the export sector or to the local populace.

The model works to the extent that, external changes resulting in increases (decreases) in export activity cause increases (decreases) in the payroll of export firms which are then transmitted to the local service sector establishments. Furthermore, the inflow or outflow of money causes activity in local services to change by a multiple of the original change (i.e., the regional economic multiplier) as the influx of funds is spent and re-spent in the local economy or as the initial withdrawal of funds causes decreases in local sales which, in turn, causes further decreases in local sales as payrolls and employment shrink. For expansions, recirculation continues until the leakages from the system (such as imports, savings, and taxes) exhaust the amount of initial influx. In cases of decreases in export activity, the cumulative decline is halted by decreases in imports, savings, and taxes. Note that export base models predict that, without "new" injections of funds to the local economy through its export sector, the local economy will stagnate because service activities can only respond to changes in local economic conditions.

The discussion above focused on a type of regional economic impact analysis that is called “economic base” analysis in that it splits an economy into two types of activities—base or export activities and service activities. The result of such an analysis will be that all types of impact scenarios will be analyzed using just one multiplier for a region. In most cases this is inadequate because different scenarios are thought to affect the economy differently to the extent that the combinations of sectors initially affected by the scenarios are different.

To address this issue most regional economic impact analysts use regional input-output analysis. In regional input-output analysis the economy is composed to a myriad if industrial sectors—each producing goods or services to be sold to customers both locally and other places. Using regional economic impact analysis an impact scenario is addressed by combinations of directly affected industrial sectors (weighted by their respective changes in sales).

However, it is not possible to use regional economic impact analysis to analyzed impact scenarios that involve scenario effects that occur in more than one area at a time or the effect that

an impact scenario will have on places not located near the impact site (for example, the impact that a flood will have on places within Iowa that are outside Cedar Rapids or Linn County). This is called a multiregional input-output analysis because it explicitly considers the interrelationships between industrial sectors and among the regions of an economy (such as Linn County and the State of Iowa).

Until very recently, multiregional input-output analyses were rarely done due to the time and expense of creating and implementing the necessary multiregional input-output models. The introduction of IMPLAN, Version 3.0 has allowed regional economic impact analysts to implement multiregional input-output analysis for any multi-county area within the United States.

Multiregional Economic Impact Multiplier Effects and Multipliers

There are many types of multipliers depending on the model you use and what you are trying to measure. In this report we compute and use four types of regional economic impact effects and multipliers. Impact effects are the direct, indirect and induced consequences of a scenario measured relative to the direct output or sales changes. Impact multipliers are the direct, indirect and induced consequences of a scenario measured relative to the direct change in the impact variable being considered (i.e., jobs or employment).

Note that the multipliers and multiplier effects shown directly below are highly aggregated industrially and are not the ones used in this report to compute economic impacts. The multipliers and multiplier effects shown here are shown only for illustrative purposes. The detailed multiregional multipliers and multiplier effects that are used in this report are given in Tables B9 to B12.

Output or Sales Effects and Multipliers: Sales multipliers show a change in total sales for one industry will change total sales in other industries. Output is the broadest measure of industrial activity since it covers all business costs. The direct effect is the initial change in sales. The indirect effects are the consequences that occur due to the suppliers spending and re-spending. The induced effects are the extra interactions created by including workers earning their incomes and consuming goods and services. Table B1 shows the calculated average multiregional input-output output or sales effects for Linn County. The effects include not only the multiplier effects on the Linn County economy but also the interregional multiplier effects on the rest of Iowa. The multiregional multiplier effects on the State of Iowa economy are found by summing the Linn County effects and rest of Iowa effects.

Average Multiregional Column Output Effects												
	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	1.000	0.228	0.117	1.345	0.000	0.089	0.014	0.103	1.000	0.317	0.131	1.448
Mining	1.000	0.184	0.244	1.428	0.000	0.081	0.024	0.105	1.000	0.265	0.267	1.532
Utilities	1.000	0.056	0.147	1.202	0.000	0.016	0.013	0.029	1.000	0.071	0.160	1.231
Construction	1.000	0.228	0.320	1.548	0.000	0.074	0.023	0.098	1.000	0.303	0.343	1.646
Manufacturing	1.000	0.197	0.145	1.341	0.000	0.062	0.012	0.074	1.000	0.259	0.156	1.415
Wholesale & Retail Trade	1.000	0.238	0.302	1.540	0.000	0.035	0.029	0.065	1.000	0.273	0.332	1.605
Transportation & Information	1.000	0.361	0.228	1.589	0.000	0.046	0.023	0.069	1.000	0.407	0.251	1.658
Finance, Insurance & Real Estate	1.000	0.268	0.202	1.470	0.000	0.065	0.022	0.087	1.000	0.333	0.224	1.557
Services	1.000	0.261	0.361	1.621	0.000	0.043	0.031	0.074	1.000	0.304	0.392	1.695
Public Administration	1.000	0.261	0.355	1.616	0.000	0.053	0.028	0.081	1.000	0.314	0.383	1.697
All Sector Average	1.000	0.228	0.231	1.459	0.000	0.056	0.022	0.077	1.000	0.284	0.252	1.536
Average based on output weights (2010 = 1): author's calculation												

6

Average Multiregional Column Output Multipliers												
	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	1.000	0.228	0.117	1.345	0.000	0.089	0.014	0.103	1.000	0.317	0.131	1.448
Mining	1.000	0.184	0.244	1.428	0.000	0.081	0.024	0.105	1.000	0.265	0.267	1.532
Utilities	1.000	0.056	0.147	1.202	0.000	0.016	0.013	0.029	1.000	0.071	0.160	1.231
Construction	1.000	0.228	0.320	1.548	0.000	0.074	0.023	0.098	1.000	0.303	0.343	1.646
Manufacturing	1.000	0.197	0.145	1.341	0.000	0.062	0.012	0.074	1.000	0.259	0.156	1.415
Wholesale & Retail Trade	1.000	0.238	0.302	1.540	0.000	0.035	0.029	0.065	1.000	0.273	0.332	1.605
Transportation & Information	1.000	0.361	0.228	1.589	0.000	0.046	0.023	0.069	1.000	0.407	0.251	1.658
Finance, Insurance & Real Estate	1.000	0.268	0.202	1.470	0.000	0.065	0.022	0.087	1.000	0.333	0.224	1.557
Services	1.000	0.261	0.361	1.621	0.000	0.043	0.031	0.074	1.000	0.304	0.392	1.695
Public Administration	1.000	0.261	0.355	1.616	0.000	0.053	0.028	0.081	1.000	0.314	0.383	1.697
All Sector Average	1.000	0.228	0.231	1.459	0.000	0.056	0.022	0.077	1.000	0.284	0.252	1.536
Average based on output weights (2010 = 1): author's calculation												

6

Average Multiregional Column Employment Effects

	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	11.400	1.105	1.745	14.250	0.000	0.570	0.111	0.680	11.400	1.675	1.856	14.930
Mining	4.574	1.120	2.392	8.086	0.000	0.252	0.168	0.420	4.574	1.372	2.560	8.506
Utilities	1.640	0.446	1.394	3.480	0.000	0.044	0.089	0.132	1.640	0.490	1.483	3.613
Construction	7.102	2.114	3.066	12.282	0.000	0.336	0.125	0.461	7.102	2.449	3.191	12.743
Manufacturing	2.845	1.457	1.770	6.073	0.000	0.195	0.084	0.279	2.845	1.653	1.854	6.352
Wholesale & Retail Trade	16.952	1.921	2.889	21.763	0.000	0.221	0.167	0.388	16.952	2.142	3.056	22.150
Transportation & Information	7.355	2.410	2.541	12.306	0.000	0.274	0.163	0.438	7.355	2.684	2.704	12.744
Finance, Insurance & Real Estate	5.952	1.882	2.290	10.124	0.000	0.434	0.154	0.589	5.952	2.316	2.444	10.712
Services	19.544	2.166	3.522	25.233	0.000	0.234	0.185	0.419	19.544	2.401	3.708	25.652
Public Administration	7.444	1.876	3.973	13.293	0.000	0.183	0.184	0.366	7.444	2.058	4.157	13.660
All Sector Average	13.407	1.813	3.078	18.298	0.000	0.243	0.176	0.418	13.407	2.056	3.254	18.717
Average based on employment weights: author's calculation												

Average Multiregional Column Employment Multipliers

	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	1.000	0.097	0.153	1.250	0.000	0.050	0.010	0.060	1.000	0.147	0.163	1.310
Mining	1.000	0.245	0.523	1.768	0.000	0.055	0.037	0.092	1.000	0.300	0.560	1.860
Utilities	1.000	0.272	0.850	2.122	0.000	0.027	0.054	0.081	1.000	0.299	0.904	2.202
Construction	1.000	0.298	0.432	1.729	0.000	0.047	0.018	0.065	1.000	0.345	0.449	1.794
Manufacturing	1.000	0.512	0.622	2.134	0.000	0.069	0.029	0.098	1.000	0.581	0.652	2.232
Wholesale & Retail Trade	1.000	0.113	0.170	1.284	0.000	0.013	0.010	0.023	1.000	0.126	0.180	1.307
Transportation & Information	1.000	0.328	0.345	1.673	0.000	0.037	0.022	0.059	1.000	0.365	0.368	1.733
Finance, Insurance & Real Estate	1.000	0.316	0.385	1.701	0.000	0.073	0.026	0.099	1.000	0.389	0.411	1.800
Services	1.000	0.111	0.180	1.291	0.000	0.012	0.009	0.021	1.000	0.123	0.190	1.313
Public Administration	1.000	0.252	0.534	1.786	0.000	0.025	0.025	0.049	1.000	0.276	0.558	1.835
All Sector Average	1.000	0.135	0.230	1.365	0.000	0.018	0.013	0.031	1.000	0.153	0.243	1.396
Average based on employment weights: author's calculation												

Average Multiregional Column Value Added Effects

	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0.4438	0.1025	0.0763	0.6226	0.0000	0.0344	0.0060	0.0404	0.4438	0.1368	0.0823	0.6630
Mining	0.6033	0.1001	0.1510	0.8543	0.0000	0.0236	0.0118	0.0354	0.6033	0.1237	0.1628	0.8897
Utilities	0.7577	0.0312	0.0879	0.8767	0.0000	0.0041	0.0054	0.0095	0.7577	0.0352	0.0933	0.8862
Construction	0.4559	0.1311	0.1937	0.7807	0.0000	0.0265	0.0080	0.0345	0.4559	0.1575	0.2017	0.8152
Manufacturing	0.2933	0.1088	0.0991	0.5013	0.0000	0.0176	0.0056	0.0232	0.2933	0.1264	0.1048	0.5245
Wholesale & Retail Trade	0.6717	0.1387	0.1805	0.9909	0.0000	0.0171	0.0108	0.0279	0.6717	0.1558	0.1913	1.0187
Transportation & Information	0.4640	0.1819	0.1416	0.7874	0.0000	0.0165	0.0091	0.0256	0.4640	0.1984	0.1506	0.8130
Finance, Insurance & Real Estate	0.6121	0.1475	0.1150	0.8745	0.0000	0.0283	0.0081	0.0364	0.6121	0.1757	0.1231	0.9109
Services	0.5968	0.1432	0.2206	0.9606	0.0000	0.0149	0.0115	0.0264	0.5968	0.1581	0.2321	0.9870
Public Administration	0.5444	0.1359	0.2408	0.9210	0.0000	0.0167	0.0114	0.0281	0.5444	0.1526	0.2522	0.9492
All Sector Average	0.5617	0.1233	0.1613	0.8462	0.0000	0.0186	0.0099	0.0285	0.5617	0.1418	0.1712	0.8747
Average based on value added weights (2010 = 1): author's calculation												

Average Multiregional Column Value Added Multipliers

	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	1.000	0.231	0.172	1.403	0.000	0.077	0.014	0.091	1.000	0.308	0.185	1.494
Mining	1.000	0.166	0.250	1.416	0.000	0.039	0.020	0.059	1.000	0.205	0.270	1.475
Utilities	1.000	0.041	0.116	1.157	0.000	0.005	0.007	0.012	1.000	0.046	0.123	1.170
Construction	1.000	0.288	0.425	1.712	0.000	0.058	0.018	0.076	1.000	0.346	0.443	1.788
Manufacturing	1.000	0.371	0.338	1.709	0.000	0.060	0.019	0.079	1.000	0.431	0.357	1.788
Wholesale & Retail Trade	1.000	0.207	0.269	1.475	0.000	0.025	0.016	0.041	1.000	0.232	0.285	1.517
Transportation & Information	1.000	0.392	0.305	1.697	0.000	0.036	0.020	0.055	1.000	0.427	0.325	1.752
Finance, Insurance & Real Estate	1.000	0.241	0.188	1.429	0.000	0.046	0.013	0.059	1.000	0.287	0.201	1.488
Services	1.000	0.240	0.370	1.609	0.000	0.025	0.019	0.044	1.000	0.265	0.389	1.654
Public Administration	1.000	0.250	0.442	1.692	0.000	0.031	0.021	0.052	1.000	0.280	0.463	1.743
All Sector Average	1.000	0.219	0.287	1.507	0.000	0.033	0.018	0.051	1.000	0.253	0.305	1.557
Average based on value added weights (2010 = 1): author's calculation												

Average Multiregional Column Labor Income Effects

	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0.2705	0.0433	0.0741	0.3879	0.0000	0.0164	0.0045	0.0209	0.2705	0.0596	0.0786	0.4088
Mining	0.3380	0.0582	0.0824	0.4786	0.0000	0.0126	0.0071	0.0197	0.3380	0.0708	0.0895	0.4983
Utilities	0.2096	0.0197	0.0473	0.2766	0.0000	0.0022	0.0032	0.0054	0.2096	0.0219	0.0505	0.2820
Construction	0.4151	0.0865	0.1048	0.6064	0.0000	0.0176	0.0045	0.0222	0.4151	0.1041	0.1093	0.6285
Manufacturing	0.2179	0.0724	0.0599	0.3502	0.0000	0.0102	0.0031	0.0133	0.2179	0.0826	0.0630	0.3634
Wholesale & Retail Trade	0.4068	0.0796	0.1018	0.5883	0.0000	0.0112	0.0066	0.0179	0.4068	0.0908	0.1085	0.6061
Transportation & Information	0.2981	0.1036	0.0834	0.4851	0.0000	0.0107	0.0060	0.0167	0.2981	0.1142	0.0894	0.5017
Finance, Insurance & Real Estate	0.2969	0.0937	0.0812	0.4718	0.0000	0.0300	0.0067	0.0367	0.2969	0.1236	0.0879	0.5085
Services	0.5105	0.0830	0.1248	0.7183	0.0000	0.0093	0.0072	0.0165	0.5105	0.0923	0.1320	0.7348
Public Administration	0.5831	0.0809	0.1368	0.8009	0.0000	0.0093	0.0071	0.0164	0.5831	0.0903	0.1439	0.8173
All Sector Average	0.4115	0.0740	0.1011	0.5867	0.0000	0.0112	0.0067	0.0179	0.4115	0.0852	0.1079	0.6046

Average based on labor income weights (2010 = 1): author's calculation

Average Multiregional Column Labor Income Multipliers

	Linn County				Rest of Iowa				State of Iowa			
Linn County Sector	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	1.000	0.160	0.274	1.434	0.000	0.061	0.017	0.077	1.000	0.220	0.291	1.511
Mining	1.000	0.172	0.244	1.416	0.000	0.037	0.021	0.058	1.000	0.210	0.265	1.474
Utilities	1.000	0.094	0.226	1.320	0.000	0.010	0.015	0.026	1.000	0.105	0.241	1.345
Construction	1.000	0.208	0.252	1.461	0.000	0.042	0.011	0.053	1.000	0.251	0.263	1.514
Manufacturing	1.000	0.332	0.275	1.607	0.000	0.047	0.014	0.061	1.000	0.379	0.289	1.668
Wholesale & Retail Trade	1.000	0.196	0.250	1.446	0.000	0.028	0.016	0.044	1.000	0.223	0.267	1.490
Transportation & Information	1.000	0.347	0.280	1.627	0.000	0.036	0.020	0.056	1.000	0.383	0.300	1.683
Finance, Insurance & Real Estate	1.000	0.315	0.274	1.589	0.000	0.101	0.023	0.124	1.000	0.416	0.296	1.713
Services	1.000	0.163	0.244	1.407	0.000	0.018	0.014	0.032	1.000	0.181	0.259	1.439
Public Administration	1.000	0.139	0.235	1.373	0.000	0.016	0.012	0.028	1.000	0.155	0.247	1.402
All Sector Average	1.000	0.180	0.246	1.426	0.000	0.027	0.016	0.044	1.000	0.207	0.262	1.469

Average based on labor income weights (2010 = 1): author's calculation

Table B9
Multiregional Output Multiplier Effects and Multipliers

Code	IMPLAN Sector	Output Multiplier Effects			Output Multipliers		
		Linn County	Rest of Iowa	State of Iowa	Linn County	Rest of Iowa	State of Iowa
1	Oilseed farming	1.292	0.119	1.410	1.292	0.119	1.410
2	Grain farming	1.242	0.092	1.334	1.242	0.092	1.334
3	Vegetable and melon farming	1.374	0.137	1.511	1.374	0.137	1.511
4	Fruit farming	1.387	0.193	1.580	1.387	0.193	1.580
5	Tree nut farming	1.304	0.098	1.402	1.304	0.098	1.402
6	Greenhouse, nursery, and floriculture production	1.386	0.106	1.492	1.386	0.106	1.492
7	Tobacco farming	1.000	0.000	1.000	1.000	0.000	1.000
8	Cotton farming	1.000	0.000	1.000	1.000	0.000	1.000
9	Sugarcane and sugar beet farming	1.000	0.000	1.000	1.000	0.000	1.000
10	All other crop farming	1.361	0.124	1.485	1.361	0.124	1.485
11	Cattle ranching and farming	1.592	0.073	1.665	1.592	0.073	1.665
12	Dairy cattle and milk production	1.425	0.091	1.516	1.425	0.091	1.516
13	Poultry and egg production	1.596	0.185	1.780	1.596	0.185	1.780
14	Animal production, except cattle and poultry and eggs	1.305	0.104	1.408	1.305	0.104	1.408
15	Forest nurseries, forest products, and timber tracts	1.000	0.000	1.000	1.000	0.000	1.000
16	Logging	1.000	0.000	1.000	1.000	0.000	1.000
17	Fishing	1.000	0.000	1.000	1.000	0.000	1.000
18	Hunting and trapping	1.472	0.071	1.542	1.472	0.071	1.542
19	Support activities for agriculture and forestry	1.797	0.102	1.899	1.797	0.102	1.899
20	Oil and gas extraction	1.425	0.162	1.588	1.425	0.162	1.588
21	Coal mining	1.000	0.000	1.000	1.000	0.000	1.000
22	Iron ore mining	1.000	0.000	1.000	1.000	0.000	1.000
23	Copper, nickel, lead, and zinc mining	1.000	0.000	1.000	1.000	0.000	1.000
24	Gold, silver, and other metal ore mining	1.000	0.000	1.000	1.000	0.000	1.000
25	Stone mining and quarrying	1.428	0.076	1.504	1.428	0.076	1.504
26	Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	1.458	0.079	1.538	1.458	0.079	1.538
27	Other nonmetallic mineral mining and quarrying	1.000	0.000	1.000	1.000	0.000	1.000
28	Drilling oil and gas wells	1.230	0.059	1.288	1.230	0.059	1.288
29	Support activities for oil and gas operations	1.000	0.000	1.000	1.000	0.000	1.000
30	Support activities for other mining	1.000	0.000	1.000	1.000	0.000	1.000
31	Electric power generation, transmission, and distribution	1.203	0.032	1.235	1.203	0.032	1.235
32	Natural gas distribution	1.000	0.000	1.000	1.000	0.000	1.000
33	Water, sewage and other systems	1.530	0.047	1.577	1.530	0.047	1.577
34	Construction of new nonresidential commercial and health care structures	1.502	0.094	1.596	1.502	0.094	1.596
35	Construction of new nonresidential manufacturing structures	1.453	0.073	1.527	1.453	0.073	1.527
36	Construction of other new nonresidential structures	1.562	0.092	1.654	1.562	0.092	1.654
37	Construction of new residential permanent	1.609	0.115	1.724	1.609	0.115	1.724

	site single- and multi-family structures						
38	Construction of other new residential structures	1.600	0.110	1.711	1.600	0.110	1.711
39	Maintenance and repair construction of nonresidential maintenance and repair	1.596	0.086	1.682	1.596	0.086	1.682
40	Maintenance and repair construction of residential structures	1.463	0.098	1.560	1.463	0.098	1.560
41	Dog and cat food manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
42	Other animal food manufacturing	1.355	0.193	1.548	1.355	0.193	1.548
43	Flour milling and malt manufacturing	1.398	0.186	1.584	1.398	0.186	1.584
44	Wet corn milling	1.378	0.202	1.580	1.378	0.202	1.580
45	Soybean and other oilseed processing	1.164	0.355	1.519	1.164	0.355	1.519
46	Fats and oils refining and blending	1.000	0.000	1.000	1.000	0.000	1.000
47	Breakfast cereal manufacturing	1.239	0.135	1.373	1.239	0.135	1.373
48	Sugar cane mills and refining	1.000	0.000	1.000	1.000	0.000	1.000
49	Beet sugar manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
50	Chocolate and confectionery manufacturing from cacao beans	1.000	0.000	1.000	1.000	0.000	1.000
51	Confectionery manufacturing from purchased chocolate	1.331	0.160	1.490	1.331	0.160	1.490
52	Nonchocolate confectionery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
53	Frozen food manufacturing	1.393	0.195	1.587	1.393	0.195	1.587
54	Fruit and vegetable canning, pickling, and drying	1.000	0.000	1.000	1.000	0.000	1.000
55	Fluid milk and butter manufacturing	1.646	0.240	1.885	1.646	0.240	1.885
56	Cheese manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
57	Dry, condensed, and evaporated dairy product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
58	Ice cream and frozen dessert manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
59	Animal (except poultry) slaughtering, rendering, and processing	1.000	0.000	1.000	1.000	0.000	1.000
60	Poultry processing	1.000	0.000	1.000	1.000	0.000	1.000
61	Seafood product preparation and packaging	1.000	0.000	1.000	1.000	0.000	1.000
62	Bread and bakery product manufacturing	1.482	0.144	1.625	1.482	0.144	1.625
63	Cookie, cracker, and pasta manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
64	Tortilla manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
65	Snack food manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
66	Coffee and tea manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
67	Flavoring syrup and concentrate manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
68	Seasoning and dressing manufacturing	1.338	0.149	1.487	1.338	0.149	1.487
69	All other food manufacturing	1.455	0.140	1.595	1.455	0.140	1.595
70	Soft drink and ice manufacturing	1.270	0.149	1.419	1.270	0.149	1.419
71	Breweries	1.000	0.000	1.000	1.000	0.000	1.000
72	Wineries	1.000	0.000	1.000	1.000	0.000	1.000
73	Distilleries	1.000	0.000	1.000	1.000	0.000	1.000
74	Tobacco product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
75	Fiber, yarn, and thread mills	1.000	0.000	1.000	1.000	0.000	1.000
76	Broadwoven fabric mills	1.000	0.000	1.000	1.000	0.000	1.000
77	Narrow fabric mills and schiffli machine embroidery	1.000	0.000	1.000	1.000	0.000	1.000

78	Nonwoven fabric mills	1.000	0.000	1.000	1.000	0.000	1.000
79	Knit fabric mills	1.000	0.000	1.000	1.000	0.000	1.000
80	Textile and fabric finishing mills	1.361	0.074	1.434	1.361	0.074	1.434
81	Fabric coating mills	1.000	0.000	1.000	1.000	0.000	1.000
82	Carpet and rug mills	1.000	0.000	1.000	1.000	0.000	1.000
83	Curtain and linen mills	1.316	0.045	1.361	1.316	0.045	1.361
84	Textile bag and canvas mills	1.385	0.065	1.450	1.385	0.065	1.450
85	All other textile product mills	1.323	0.063	1.386	1.323	0.063	1.386
86	Apparel knitting mills	1.000	0.000	1.000	1.000	0.000	1.000
87	Cut and sew apparel contractors	1.000	0.000	1.000	1.000	0.000	1.000
88	Men's and boys' cut and sew apparel manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
89	Women's and girls' cut and sew apparel manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
90	Other cut and sew apparel manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
91	Apparel accessories and other apparel manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
92	Leather and hide tanning and finishing	1.000	0.000	1.000	1.000	0.000	1.000
93	Footwear manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
94	Other leather and allied product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
95	Sawmills and wood preservation	1.437	0.401	1.838	1.437	0.401	1.838
96	Veneer and plywood manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
97	Engineered wood member and truss manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
98	Reconstituted wood product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
99	Wood windows and doors and millwork	1.451	0.181	1.632	1.451	0.181	1.632
100	Wood container and pallet manufacturing	1.391	0.153	1.544	1.391	0.153	1.544
101	Manufactured home (mobile home) manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
102	Prefabricated wood building manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
103	All other miscellaneous wood product manufacturing	1.491	0.201	1.692	1.491	0.201	1.692
104	Pulp mills	1.000	0.000	1.000	1.000	0.000	1.000
105	Paper mills	1.000	0.000	1.000	1.000	0.000	1.000
106	Paperboard Mills	1.000	0.000	1.000	1.000	0.000	1.000
107	Paperboard container manufacturing	1.382	0.064	1.446	1.382	0.064	1.446
108	Coated and laminated paper, packaging paper and plastics film manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
109	All other paper bag and coated and treated paper manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
110	Stationery product manufacturing	1.389	0.079	1.468	1.389	0.079	1.468
111	Sanitary paper product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
112	All other converted paper product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
113	Printing	1.446	0.065	1.511	1.446	0.065	1.511
114	Support activities for printing	1.580	0.069	1.649	1.580	0.069	1.649
115	Petroleum refineries	1.000	0.000	1.000	1.000	0.000	1.000
116	Asphalt paving mixture and block manufacturing	1.229	0.076	1.305	1.229	0.076	1.305
117	Asphalt shingle and coating materials manufacturing	1.000	0.000	1.000	1.000	0.000	1.000

118	Petroleum lubricating oil and grease manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
119	All other petroleum and coal products manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
120	Petrochemical manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
121	Industrial gas manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
122	Synthetic dye and pigment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
123	Alkalies and chlorine manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
124	Carbon black manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
125	All other basic inorganic chemical manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
126	Other basic organic chemical manufacturing	1.180	0.070	1.251	1.180	0.070	1.251
127	Plastics material and resin manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
128	Synthetic rubber manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
129	Artificial and synthetic fibers and filaments manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
130	Fertilizer manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
131	Pesticide and other agricultural chemical manufacturing	1.208	0.100	1.309	1.208	0.100	1.309
132	Medicinal and botanical manufacturing	1.316	0.104	1.420	1.316	0.104	1.420
133	Pharmaceutical preparation manufacturing	1.296	0.094	1.391	1.296	0.094	1.391
134	In-vitro diagnostic substance manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
135	Biological product (except diagnostic) manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
136	Paint and coating manufacturing	1.237	0.088	1.325	1.237	0.088	1.325
137	Adhesive manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
138	Soap and cleaning compound manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
139	Toilet preparation manufacturing	1.303	0.100	1.403	1.303	0.100	1.403
140	Printing ink manufacturing	1.194	0.088	1.282	1.194	0.088	1.282
141	All other chemical product and preparation manufacturing	1.247	0.107	1.354	1.247	0.107	1.354
142	Plastics packaging materials and unlaminated film and sheet manufacturing	1.228	0.053	1.281	1.228	0.053	1.281
143	Unlaminated plastics profile shape manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
144	Plastics pipe and pipe fitting manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
145	Laminated plastics plate, sheet (except packaging), and shape manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
146	Polystyrene foam product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
147	Urethane and other foam product (except polystyrene) manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
148	Plastics bottle manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
149	Other plastics product manufacturing	1.318	0.066	1.384	1.318	0.066	1.384
150	Tire manufacturing	1.388	0.062	1.450	1.388	0.062	1.450
151	Rubber and plastics hoses and belting manufacturing	1.328	0.066	1.394	1.328	0.066	1.394
152	Other rubber product manufacturing	1.349	0.077	1.426	1.349	0.077	1.426
153	Pottery, ceramics, and plumbing fixture manufacturing	1.421	0.114	1.536	1.421	0.114	1.536
154	Brick, tile, and other structural clay product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
155	Clay and nonclay refractory manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
156	Flat glass manufacturing	1.000	0.000	1.000	1.000	0.000	1.000

157	Other pressed and blown glass and glassware manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
158	Glass container manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
159	Glass product manufacturing made of purchased glass	1.000	0.000	1.000	1.000	0.000	1.000
160	Cement manufacturing	1.419	0.086	1.506	1.419	0.086	1.506
161	Ready-mix concrete manufacturing	1.451	0.157	1.609	1.451	0.157	1.609
162	Concrete pipe, brick, and block manufacturing	1.401	0.112	1.512	1.401	0.112	1.512
163	Other concrete product manufacturing	1.421	0.128	1.549	1.421	0.128	1.549
164	Lime and gypsum product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
165	Abrasive product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
166	Cut stone and stone product manufacturing	1.537	0.092	1.630	1.537	0.092	1.630
167	Ground or treated mineral and earth manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
168	Mineral wool manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
169	Miscellaneous nonmetallic mineral products	1.000	0.000	1.000	1.000	0.000	1.000
170	Iron and steel mills and ferroalloy manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
171	Steel product manufacturing from purchased steel	1.000	0.000	1.000	1.000	0.000	1.000
172	Alumina refining and primary aluminum production	1.000	0.000	1.000	1.000	0.000	1.000
173	Secondary smelting and alloying of aluminum	1.000	0.000	1.000	1.000	0.000	1.000
174	Aluminum product manufacturing from purchased aluminum	1.000	0.000	1.000	1.000	0.000	1.000
175	Primary smelting and refining of copper	1.000	0.000	1.000	1.000	0.000	1.000
176	Primary smelting and refining of nonferrous metal (except copper and aluminum)	1.000	0.000	1.000	1.000	0.000	1.000
177	Copper rolling, drawing, extruding and alloying	1.267	0.034	1.301	1.267	0.034	1.301
178	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	1.000	0.000	1.000	1.000	0.000	1.000
179	Ferrous metal foundries	1.000	0.000	1.000	1.000	0.000	1.000
180	Nonferrous metal foundries	1.000	0.000	1.000	1.000	0.000	1.000
181	All other forging, stamping, and sintering	1.392	0.112	1.503	1.392	0.112	1.503
182	Custom roll forming	1.000	0.000	1.000	1.000	0.000	1.000
183	Crown and closure manufacturing and metal stamping	1.392	0.109	1.500	1.392	0.109	1.500
184	Cutlery, utensil, pot, and pan manufacturing	1.295	0.079	1.374	1.295	0.079	1.374
185	Handtool manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
186	Plate work and fabricated structural product manufacturing	1.368	0.114	1.481	1.368	0.114	1.481
187	Ornamental and architectural metal products manufacturing	1.410	0.112	1.523	1.410	0.112	1.523
188	Power boiler and heat exchanger manufacturing	1.345	0.093	1.438	1.345	0.093	1.438
189	Metal tank (heavy gauge) manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
190	Metal can, box, and other metal container (light gauge) manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
191	Ammunition manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
192	Arms, ordnance, and accessories manufacturing	1.000	0.000	1.000	1.000	0.000	1.000

193	Hardware manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
194	Spring and wire product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
195	Machine shops	1.462	0.090	1.552	1.462	0.090	1.552
196	Turned product and screw, nut, and bolt manufacturing	1.385	0.093	1.478	1.385	0.093	1.478
197	Coating, engraving, heat treating and allied activities	1.366	0.089	1.455	1.366	0.089	1.455
198	Valve and fittings other than plumbing	1.336	0.077	1.412	1.336	0.077	1.412
199	Plumbing fixture fitting and trim manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
200	Ball and roller bearing manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
201	Fabricated pipe and pipe fitting manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
202	Other fabricated metal manufacturing	1.338	0.101	1.438	1.338	0.101	1.438
203	Farm machinery and equipment manufacturing	1.315	0.106	1.421	1.315	0.106	1.421
204	Lawn and garden equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
205	Construction machinery manufacturing	1.290	0.114	1.405	1.290	0.114	1.405
206	Mining and oil and gas field machinery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
207	Other industrial machinery manufacturing	1.403	0.099	1.502	1.403	0.099	1.502
208	Plastics and rubber industry machinery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
209	Semiconductor machinery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
210	Vending, commercial, industrial, and office machinery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
211	Optical instrument and lens manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
212	Photographic and photocopying equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
213	Other commercial and service industry machinery manufacturing	1.356	0.081	1.437	1.356	0.081	1.437
214	Air purification and ventilation equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
215	Heating equipment (except warm air furnaces) manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
216	Air conditioning, refrigeration, and warm air heating equipment manufacturing	1.319	0.098	1.417	1.319	0.098	1.417
217	Industrial mold manufacturing	1.530	0.099	1.629	1.530	0.099	1.629
218	Metal cutting and forming machine tool manufacturing	1.436	0.097	1.533	1.436	0.097	1.533
219	Special tool, die, jig, and fixture manufacturing	1.494	0.106	1.600	1.494	0.106	1.600
220	Cutting tool and machine tool accessory manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
221	Rolling mill and other metalworking machinery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
222	Turbine and turbine generator set units manufacturing	1.356	0.082	1.438	1.356	0.082	1.438
223	Speed changer, industrial high-speed drive, and gear manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
224	Mechanical power transmission equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
225	Other engine equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
226	Pump and pumping equipment manufacturing	1.357	0.097	1.454	1.357	0.097	1.454
227	Air and gas compressor manufacturing	1.000	0.000	1.000	1.000	0.000	1.000

228	Material handling equipment manufacturing	1.356	0.116	1.472	1.356	0.116	1.472
229	Power-driven handtool manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
230	Other general purpose machinery manufacturing	1.381	0.092	1.473	1.381	0.092	1.473
231	Packaging machinery manufacturing	1.436	0.083	1.520	1.436	0.083	1.520
232	Industrial process furnace and oven manufacturing	1.402	0.115	1.517	1.402	0.115	1.517
233	Fluid power process machinery	1.375	0.107	1.482	1.375	0.107	1.482
234	Electronic computer manufacturing	1.225	0.047	1.272	1.225	0.047	1.272
235	Computer storage device manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
236	Computer terminals and other computer peripheral equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
237	Telephone apparatus manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
238	Broadcast and wireless communications equipment	1.359	0.067	1.425	1.359	0.067	1.425
239	Other communications equipment manufacturing	1.344	0.089	1.433	1.344	0.089	1.433
240	Audio and video equipment manufacturing	1.384	0.071	1.454	1.384	0.071	1.454
241	Electron tube manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
242	Bare printed circuit board manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
243	Semiconductor and related device manufacturing	1.470	0.135	1.605	1.470	0.135	1.605
244	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
245	Electronic connector manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
246	Printed circuit assembly (electronic assembly) manufacturing	1.262	0.054	1.315	1.262	0.054	1.315
247	Other electronic component manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
248	Electromedical and electrotherapeutic apparatus manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
249	Search, detection, and navigation instruments manufacturing	1.461	0.095	1.556	1.461	0.095	1.556
250	Automatic environmental control manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
251	Industrial process variable instruments manufacturing	1.458	0.109	1.567	1.458	0.109	1.567
252	Totalizing fluid meters and counting devices manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
253	Electricity and signal testing instruments manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
254	Analytical laboratory instrument manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
255	Irradiation apparatus manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
256	Watch, clock, and other measuring and controlling device manufacturing	1.384	0.099	1.483	1.384	0.099	1.483
257	Software, audio, and video media reproducing	1.000	0.000	1.000	1.000	0.000	1.000
258	Magnetic and optical recording media manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
259	Electric lamp bulb and part manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
260	Lighting fixture manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
261	Small electrical appliance manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
262	Household cooking appliance manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
263	Household refrigerator and home freezer	1.000	0.000	1.000	1.000	0.000	1.000

	manufacturing						
264	Household laundry equipment manufacturing	1.292	0.091	1.383	1.292	0.091	1.383
265	Other major household appliance manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
266	Power, distribution, and specialty transformer manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
267	Motor and generator manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
268	Switchgear and switchboard apparatus manufacturing	1.290	0.066	1.356	1.290	0.066	1.356
269	Relay and industrial control manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
270	Storage battery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
271	Primary battery manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
272	Communication and energy wire and cable manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
273	Wiring device manufacturing	1.306	0.076	1.382	1.306	0.076	1.382
274	Carbon and graphite product manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
275	All other miscellaneous electrical equipment and component manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
276	Automobile manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
277	Light truck and utility vehicle manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
278	Heavy duty truck manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
279	Motor vehicle body manufacturing	1.301	0.116	1.417	1.301	0.116	1.417
280	Truck trailer manufacturing	1.379	0.138	1.517	1.379	0.138	1.517
281	Motor home manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
282	Travel trailer and camper manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
283	Motor vehicle parts manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
284	Aircraft manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
285	Aircraft engine and engine parts manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
286	Other aircraft parts and auxiliary equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
287	Guided missile and space vehicle manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
288	Propulsion units and parts for space vehicles and guided missiles	1.000	0.000	1.000	1.000	0.000	1.000
289	Railroad rolling stock manufacturing	1.257	0.089	1.346	1.257	0.089	1.346
290	Ship building and repairing	1.000	0.000	1.000	1.000	0.000	1.000
291	Boat building	1.000	0.000	1.000	1.000	0.000	1.000
292	Motorcycle, bicycle, and parts manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
293	Military armored vehicle, tank, and tank component manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
294	All other transportation equipment manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
295	Wood kitchen cabinet and countertop manufacturing	1.616	0.106	1.721	1.616	0.106	1.721
296	Upholstered household furniture manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
297	Nonupholstered wood household furniture manufacturing	1.430	0.102	1.533	1.430	0.102	1.533
298	Metal and other household furniture (except wood) manufacturing1	1.336	0.090	1.426	1.336	0.090	1.426
299	Institutional furniture manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
300	Wood television, radio, and sewing machine cabinet manufacturing1	1.388	0.061	1.449	1.388	0.061	1.449

301	Office furniture and custom architectural woodwork and millwork manufacturing1	1.383	0.083	1.466	1.383	0.083	1.466
302	Showcase, partition, shelving, and locker manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
303	Mattress manufacturing	1.340	0.076	1.416	1.340	0.076	1.416
304	Blind and shade manufacturing	1.395	0.118	1.513	1.395	0.118	1.513
305	Surgical and medical instrument manufacturing	1.457	0.077	1.534	1.457	0.077	1.534
306	Surgical appliance and supplies manufacturing	1.430	0.087	1.517	1.430	0.087	1.517
307	Dental equipment and supplies manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
308	Ophthalmic goods manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
309	Dental laboratories	1.575	0.074	1.649	1.575	0.074	1.649
310	Jewelry and silverware manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
311	Sporting and athletic goods manufacturing	1.433	0.099	1.532	1.433	0.099	1.532
312	Doll, toy, and game manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
313	Office supplies (except paper) manufacturing	1.404	0.073	1.477	1.404	0.073	1.477
314	Sign manufacturing	1.515	0.082	1.597	1.515	0.082	1.597
315	Gasket, packing, and sealing device manufacturing	1.461	0.079	1.540	1.461	0.079	1.540
316	Musical instrument manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
317	All other miscellaneous manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
318	Broom, brush, and mop manufacturing	1.000	0.000	1.000	1.000	0.000	1.000
319	Wholesale trade	1.533	0.068	1.601	1.533	0.068	1.601
320	Retail - Motor vehicle and parts	1.617	0.067	1.683	1.617	0.067	1.683
321	Retail - Furniture and home furnishings	1.587	0.067	1.654	1.587	0.067	1.654
322	Retail - Electronics and appliances	1.637	0.072	1.709	1.637	0.072	1.709
323	Retail - Building material and garden supply	1.577	0.064	1.641	1.577	0.064	1.641
324	Retail - Food and beverage	1.601	0.068	1.669	1.601	0.068	1.669
325	Retail - Health and personal care	1.557	0.057	1.614	1.557	0.057	1.614
326	Retail - Gasoline stations	1.483	0.052	1.535	1.483	0.052	1.535
327	Retail - Clothing and clothing accessories	1.525	0.057	1.582	1.525	0.057	1.582
328	Retail - Sporting goods, hobby, book and music	1.606	0.060	1.667	1.606	0.060	1.667
329	Retail - General merchandise	1.599	0.067	1.666	1.599	0.067	1.666
330	Retail - Miscellaneous	1.598	0.057	1.655	1.598	0.057	1.655
331	Retail - Nonstore	1.417	0.045	1.462	1.417	0.045	1.462
332	Air transportation	1.406	0.055	1.462	1.406	0.055	1.462
333	Rail transportation	1.461	0.048	1.509	1.461	0.048	1.509
334	Water transportation	1.429	0.106	1.535	1.429	0.106	1.535
335	Truck transportation	1.566	0.058	1.624	1.566	0.058	1.624
336	Transit and ground passenger transportation	1.462	0.072	1.535	1.462	0.072	1.535
337	Pipeline transportation	1.000	0.000	1.000	1.000	0.000	1.000
338	Scenic and sightseeing transportation and support activities for transportation	1.540	0.055	1.595	1.540	0.055	1.595
339	Couriers and messengers	1.425	0.045	1.470	1.425	0.045	1.470
340	Warehousing and storage	1.534	0.058	1.592	1.534	0.058	1.592
341	Newspaper publishers	1.416	0.206	1.622	1.416	0.206	1.622
342	Periodical publishers	1.543	0.109	1.652	1.543	0.109	1.652

343	Book publishers	1.593	0.072	1.666	1.593	0.072	1.666
344	Directory, mailing list, and other publishers	1.454	0.053	1.506	1.454	0.053	1.506
345	Software publishers	1.634	0.078	1.712	1.634	0.078	1.712
346	Motion picture and video industries	1.666	0.115	1.781	1.666	0.115	1.781
347	Sound recording industries	1.835	0.058	1.893	1.835	0.058	1.893
348	Radio and television broadcasting	1.591	0.116	1.707	1.591	0.116	1.707
349	Cable and other subscription programming	1.000	0.000	1.000	1.000	0.000	1.000
350	Internet publishing and broadcasting	1.596	0.075	1.671	1.596	0.075	1.671
351	Telecommunications	1.678	0.052	1.730	1.678	0.052	1.730
352	Data processing, hosting, and related services	1.640	0.103	1.742	1.640	0.103	1.742
353	Other information services	1.000	0.000	1.000	1.000	0.000	1.000
354	Monetary authorities and depository credit intermediation	1.461	0.053	1.515	1.461	0.053	1.515
355	Nondepository credit intermediation and related activities	1.595	0.078	1.673	1.595	0.078	1.673
356	Securities, commodity contracts, investments, and related activities	1.807	0.117	1.924	1.807	0.117	1.924
357	Insurance carriers	1.500	0.177	1.677	1.500	0.177	1.677
358	Insurance agencies, brokerages, and related activities	1.637	0.113	1.751	1.637	0.113	1.751
359	Funds, trusts, and other financial vehicles	1.799	0.134	1.933	1.799	0.134	1.933
360	Real estate	1.318	0.025	1.343	1.318	0.025	1.343
361	Imputed rental value for owner-occupied dwellings	1.334	0.029	1.363	1.334	0.029	1.363
362	Automotive equipment rental and leasing	1.621	0.093	1.714	1.621	0.093	1.714
363	General and consumer goods rental except video tapes and discs	1.673	0.096	1.770	1.673	0.096	1.770
364	Video tape and disc rental	1.596	0.114	1.711	1.596	0.114	1.711
365	Commercial and industrial machinery and equipment rental and leasing	1.652	0.107	1.760	1.652	0.107	1.760
366	Lessors of nonfinancial intangible assets	1.398	0.040	1.438	1.398	0.040	1.438
367	Legal services	1.672	0.060	1.732	1.672	0.060	1.732
368	Accounting, tax preparation, bookkeeping, and payroll services	1.667	0.065	1.732	1.667	0.065	1.732
369	Architectural, engineering, and related services	1.734	0.064	1.799	1.734	0.064	1.799
370	Specialized design services	1.629	0.059	1.688	1.629	0.059	1.688
371	Custom computer programming services	1.780	0.054	1.834	1.780	0.054	1.834
372	Computer systems design services	1.811	0.078	1.889	1.811	0.078	1.889
373	Other computer related services, including facilities management	1.616	0.062	1.678	1.616	0.062	1.678
374	Management, scientific, and technical consulting services	1.708	0.078	1.786	1.708	0.078	1.786
375	Environmental and other technical consulting services	1.679	0.067	1.746	1.679	0.067	1.746
376	Scientific research and development services	1.743	0.083	1.826	1.743	0.083	1.826
377	Advertising and related services	1.712	0.080	1.792	1.712	0.080	1.792
378	Photographic services	1.625	0.060	1.685	1.625	0.060	1.685
379	Veterinary services	1.534	0.074	1.608	1.534	0.074	1.608
380	All other miscellaneous professional, scientific, and technical services	1.511	0.071	1.583	1.511	0.071	1.583

381	Management of companies and enterprises	1.701	0.075	1.776	1.701	0.075	1.776
382	Employment services	1.680	0.070	1.750	1.680	0.070	1.750
383	Travel arrangement and reservation services	1.601	0.061	1.662	1.601	0.061	1.662
384	Office administrative services	1.617	0.057	1.674	1.617	0.057	1.674
385	Facilities support services	1.711	0.086	1.798	1.711	0.086	1.798
386	Business support services	1.657	0.059	1.716	1.657	0.059	1.716
387	Investigation and security services	1.650	0.059	1.709	1.650	0.059	1.709
388	Services to buildings and dwellings	1.512	0.045	1.557	1.512	0.045	1.557
389	Other support services	1.500	0.050	1.550	1.500	0.050	1.550
390	Waste management and remediation services	1.574	0.092	1.666	1.574	0.092	1.666
391	Elementary and secondary schools	1.663	0.061	1.724	1.663	0.061	1.724
392	Junior colleges, colleges, universities, and professional schools	1.653	0.090	1.743	1.653	0.090	1.743
393	Other educational services	1.678	0.078	1.756	1.678	0.078	1.756
394	Offices of physicians, dentists, and other health practitioners	1.609	0.057	1.666	1.609	0.057	1.666
395	Home health care services	1.571	0.054	1.625	1.571	0.054	1.625
396	Medical and diagnostic labs and outpatient and other ambulatory care services	1.514	0.049	1.563	1.514	0.049	1.563
397	Hospitals	1.623	0.071	1.694	1.623	0.071	1.694
398	Nursing and residential care facilities	1.645	0.072	1.717	1.645	0.072	1.717
399	Child day care services	1.532	0.087	1.620	1.532	0.087	1.620
400	Individual and family services	1.630	0.088	1.718	1.630	0.088	1.718
401	Community food, housing, and other relief services, including rehabilitation services	1.772	0.088	1.860	1.772	0.088	1.860
402	Performing arts companies	1.708	0.108	1.816	1.708	0.108	1.816
403	Spectator sports	1.634	0.160	1.793	1.634	0.160	1.793
404	Promoters of performing arts and sports and agents for public figures	1.760	0.094	1.854	1.760	0.094	1.854
405	Independent artists, writers, and performers	1.629	0.065	1.695	1.629	0.065	1.695
406	Museums, historical sites, zoos, and parks	1.669	0.075	1.744	1.669	0.075	1.744
407	Fitness and recreational sports centers	1.708	0.096	1.804	1.708	0.096	1.804
408	Bowling centers	1.724	0.090	1.814	1.724	0.090	1.814
409	Amusement parks, arcades, and gambling industries	1.573	0.068	1.641	1.573	0.068	1.641
410	Other amusement and recreation industries	1.639	0.085	1.724	1.639	0.085	1.724
411	Hotels and motels, including casino hotels	1.591	0.068	1.659	1.591	0.068	1.659
412	Other accommodations	1.656	0.082	1.738	1.656	0.082	1.738
413	Food services and drinking places	1.538	0.108	1.645	1.538	0.108	1.645
414	Automotive repair and maintenance, except car washes	1.499	0.072	1.572	1.499	0.072	1.572
415	Car washes	1.528	0.064	1.592	1.528	0.064	1.592
416	Electronic and precision equipment repair and maintenance	1.434	0.047	1.481	1.434	0.047	1.481
417	Commercial and industrial machinery and equipment repair and maintenance	1.394	0.053	1.447	1.394	0.053	1.447
418	Personal and household goods repair and maintenance	1.455	0.062	1.517	1.455	0.062	1.517
419	Personal care services	1.600	0.063	1.663	1.600	0.063	1.663
420	Death care services	1.607	0.114	1.721	1.607	0.114	1.721

421	Dry-cleaning and laundry services	1.501	0.056	1.557	1.501	0.056	1.557
422	Other personal services	1.582	0.045	1.627	1.582	0.045	1.627
423	Religious organizations	1.520	0.148	1.668	1.520	0.148	1.668
424	Grantmaking, giving, and social advocacy organizations	2.003	0.128	2.132	2.003	0.128	2.132
425	Civic, social, professional, and similar organizations	1.938	0.120	2.058	1.938	0.120	2.058
426	Private households	1.558	0.055	1.612	1.558	0.055	1.612
427	Postal service	1.682	0.072	1.755	1.682	0.072	1.755
428	Federal electric utilities	1.000	0.000	1.000	1.000	0.000	1.000
429	Other Federal Government enterprises	1.613	0.059	1.672	1.613	0.059	1.672
430	State and local government passenger transit	1.648	0.070	1.718	1.648	0.070	1.718
431	State and local government electric utilities	1.161	0.043	1.203	1.161	0.043	1.203
432	Other state and local government enterprises	1.574	0.086	1.660	1.574	0.086	1.660

Table B10
Multiregional Employment Multiplier Effects and Multipliers

Code	IMPLAN Sector	Employment Multiplier Effects			Employment Multipliers		
		Linn County	Rest of Iowa	State of Iowa	Linn County	Rest of Iowa	State of Iowa
1	Oilseed farming	6.595	0.773	7.367	1.581	0.185	1.766
2	Grain farming	7.519	0.627	8.146	1.356	0.113	1.469
3	Vegetable and melon farming	4.710	1.180	5.891	2.963	0.743	3.706
4	Fruit farming	6.120	1.915	8.035	2.049	0.641	2.690
5	Tree nut farming	5.061	0.938	5.999	2.058	0.382	2.439
6	Greenhouse, nursery, and floriculture production	6.535	0.850	7.385	2.062	0.268	2.330
7	Tobacco farming	0.000	0.000	0.000	1.000	0.000	1.000
8	Cotton farming	0.000	0.000	0.000	1.000	0.000	1.000
9	Sugarcane and sugar beet farming	0.000	0.000	0.000	1.000	0.000	1.000
10	All other crop farming	4.486	0.981	5.467	2.682	0.586	3.269
11	Cattle ranching and farming	6.688	0.399	7.087	1.819	0.109	1.927
12	Dairy cattle and milk production	4.709	0.504	5.214	1.632	0.175	1.806
13	Poultry and egg production	3.204	0.687	3.891	4.471	0.959	5.430
14	Animal production, except cattle and poultry and eggs	14.399	0.859	15.258	1.147	0.068	1.215
15	Forest nurseries, forest products, and timber tracts	0.000	0.000	0.000	1.000	0.000	1.000
16	Logging	0.000	0.000	0.000	1.000	0.000	1.000
17	Fishing	0.000	0.000	0.000	1.000	0.000	1.000
18	Hunting and trapping	18.882	0.339	19.221	1.271	0.023	1.294
19	Support activities for agriculture and forestry	45.765	0.408	46.174	1.195	0.011	1.206
20	Oil and gas extraction	5.668	0.528	6.196	2.377	0.221	2.599
21	Coal mining	0.000	0.000	0.000	1.000	0.000	1.000
22	Iron ore mining	0.000	0.000	0.000	1.000	0.000	1.000
23	Copper, nickel, lead, and zinc mining	0.000	0.000	0.000	1.000	0.000	1.000
24	Gold, silver, and other metal ore mining	0.000	0.000	0.000	1.000	0.000	1.000
25	Stone mining and quarrying	7.914	0.399	8.313	1.792	0.090	1.883
26	Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	9.766	0.395	10.161	1.613	0.065	1.678
27	Other nonmetallic mineral mining and quarrying	0.000	0.000	0.000	1.000	0.000	1.000
28	Drilling oil and gas wells	3.448	0.213	3.661	2.170	0.134	2.304
29	Support activities for oil and gas operations	0.000	0.000	0.000	1.000	0.000	1.000
30	Support activities for other mining	0.000	0.000	0.000	1.000	0.000	1.000
31	Electric power generation, transmission, and distribution	3.468	0.135	3.603	2.136	0.083	2.219
32	Natural gas distribution	0.000	0.000	0.000	1.000	0.000	1.000
33	Water, sewage and other systems	11.132	0.250	11.382	1.738	0.039	1.777
34	Construction of new nonresidential commercial and health care structures	10.658	0.428	11.087	1.694	0.068	1.763
35	Construction of new nonresidential manufacturing structures	9.913	0.315	10.227	1.651	0.052	1.703
36	Construction of other new nonresidential structures	11.918	0.410	12.328	1.727	0.059	1.786
37	Construction of new residential permanent	13.587	0.567	14.154	1.854	0.077	1.932

	site single- and multi-family structures						
38	Construction of other new residential structures	13.882	0.495	14.377	1.830	0.065	1.896
39	Maintenance and repair construction of nonresidential maintenance and repair	13.808	0.440	14.248	1.682	0.054	1.735
40	Maintenance and repair construction of residential structures	14.883	0.534	15.417	1.453	0.052	1.505
41	Dog and cat food manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
42	Other animal food manufacturing	2.933	0.720	3.653	2.935	0.720	3.656
43	Flour milling and malt manufacturing	3.594	1.023	4.617	4.145	1.180	5.325
44	Wet corn milling	3.229	1.064	4.293	5.870	1.935	7.805
45	Soybean and other oilseed processing	1.450	1.659	3.110	4.972	5.688	10.660
46	Fats and oils refining and blending	0.000	0.000	0.000	1.000	0.000	1.000
47	Breakfast cereal manufacturing	2.836	0.524	3.360	2.734	0.505	3.239
48	Sugar cane mills and refining	0.000	0.000	0.000	1.000	0.000	1.000
49	Beet sugar manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
50	Chocolate and confectionery manufacturing from cacao beans	0.000	0.000	0.000	1.000	0.000	1.000
51	Confectionery manufacturing from purchased chocolate	5.596	0.558	6.154	1.725	0.172	1.897
52	Nonchocolate confectionery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
53	Frozen food manufacturing	5.971	0.703	6.674	1.971	0.232	2.203
54	Fruit and vegetable canning, pickling, and drying	0.000	0.000	0.000	1.000	0.000	1.000
55	Fluid milk and butter manufacturing	4.700	0.790	5.490	3.261	0.548	3.809
56	Cheese manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
57	Dry, condensed, and evaporated dairy product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
58	Ice cream and frozen dessert manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
59	Animal (except poultry) slaughtering, rendering, and processing	0.000	0.000	0.000	1.000	0.000	1.000
60	Poultry processing	0.000	0.000	0.000	1.000	0.000	1.000
61	Seafood product preparation and packaging	0.000	0.000	0.000	1.000	0.000	1.000
62	Bread and bakery product manufacturing	10.762	0.598	11.359	1.607	0.089	1.697
63	Cookie, cracker, and pasta manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
64	Tortilla manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
65	Snack food manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
66	Coffee and tea manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
67	Flavoring syrup and concentrate manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
68	Seasoning and dressing manufacturing	4.603	0.524	5.127	2.191	0.250	2.441
69	All other food manufacturing	6.563	0.653	7.215	2.166	0.215	2.382
70	Soft drink and ice manufacturing	3.571	0.409	3.980	2.316	0.265	2.581
71	Breweries	0.000	0.000	0.000	1.000	0.000	1.000
72	Wineries	0.000	0.000	0.000	1.000	0.000	1.000
73	Distilleries	0.000	0.000	0.000	1.000	0.000	1.000
74	Tobacco product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
75	Fiber, yarn, and thread mills	0.000	0.000	0.000	1.000	0.000	1.000
76	Broadwoven fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
77	Narrow fabric mills and schiffli machine embroidery	0.000	0.000	0.000	1.000	0.000	1.000

78	Nonwoven fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
79	Knit fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
80	Textile and fabric finishing mills	7.802	0.324	8.126	1.614	0.067	1.681
81	Fabric coating mills	0.000	0.000	0.000	1.000	0.000	1.000
82	Carpet and rug mills	0.000	0.000	0.000	1.000	0.000	1.000
83	Curtain and linen mills	9.534	0.257	9.791	1.389	0.037	1.426
84	Textile bag and canvas mills	10.981	0.461	11.442	1.420	0.060	1.479
85	All other textile product mills	10.507	0.417	10.924	1.352	0.054	1.405
86	Apparel knitting mills	0.000	0.000	0.000	1.000	0.000	1.000
87	Cut and sew apparel contractors	0.000	0.000	0.000	1.000	0.000	1.000
88	Men's and boys' cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
89	Women's and girls' cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
90	Other cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
91	Apparel accessories and other apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
92	Leather and hide tanning and finishing	0.000	0.000	0.000	1.000	0.000	1.000
93	Footwear manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
94	Other leather and allied product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
95	Sawmills and wood preservation	7.170	1.219	8.389	1.721	0.293	2.014
96	Veneer and plywood manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
97	Engineered wood member and truss manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
98	Reconstituted wood product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
99	Wood windows and doors and millwork	9.791	0.999	10.790	1.600	0.163	1.764
100	Wood container and pallet manufacturing	12.432	0.830	13.262	1.342	0.090	1.431
101	Manufactured home (mobile home) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
102	Prefabricated wood building manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
103	All other miscellaneous wood product manufacturing	13.722	1.044	14.766	1.398	0.106	1.504
104	Pulp mills	0.000	0.000	0.000	1.000	0.000	1.000
105	Paper mills	0.000	0.000	0.000	1.000	0.000	1.000
106	Paperboard Mills	0.000	0.000	0.000	1.000	0.000	1.000
107	Paperboard container manufacturing	5.866	0.328	6.195	2.171	0.121	2.292
108	Coated and laminated paper, packaging paper and plastics film manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
109	All other paper bag and coated and treated paper manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
110	Stationery product manufacturing	6.394	0.430	6.824	1.970	0.133	2.103
111	Sanitary paper product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
112	All other converted paper product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
113	Printing	10.602	0.344	10.946	1.603	0.052	1.655
114	Support activities for printing	15.759	0.406	16.166	1.506	0.039	1.544
115	Petroleum refineries	0.000	0.000	0.000	1.000	0.000	1.000
116	Asphalt paving mixture and block manufacturing	3.226	0.526	3.752	2.608	0.425	3.033
117	Asphalt shingle and coating materials manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

118	Petroleum lubricating oil and grease manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
119	All other petroleum and coal products manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
120	Petrochemical manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
121	Industrial gas manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
122	Synthetic dye and pigment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
123	Alkalies and chlorine manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
124	Carbon black manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
125	All other basic inorganic chemical manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
126	Other basic organic chemical manufacturing	1.855	0.222	2.077	4.365	0.522	4.887
127	Plastics material and resin manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
128	Synthetic rubber manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
129	Artificial and synthetic fibers and filaments manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
130	Fertilizer manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
131	Pesticide and other agricultural chemical manufacturing	2.204	0.419	2.623	3.760	0.714	4.474
132	Medicinal and botanical manufacturing	4.522	0.532	5.053	2.339	0.275	2.614
133	Pharmaceutical preparation manufacturing	3.185	0.505	3.690	3.526	0.559	4.086
134	In-vitro diagnostic substance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
135	Biological product (except diagnostic) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
136	Paint and coating manufacturing	3.573	0.368	3.941	2.163	0.223	2.386
137	Adhesive manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
138	Soap and cleaning compound manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
139	Toilet preparation manufacturing	3.847	0.498	4.345	3.075	0.398	3.473
140	Printing ink manufacturing	3.867	0.442	4.309	1.697	0.194	1.891
141	All other chemical product and preparation manufacturing	4.028	0.510	4.538	1.954	0.247	2.202
142	Plastics packaging materials and unlaminated film and sheet manufacturing	4.157	0.174	4.331	1.851	0.077	1.928
143	Unlaminated plastics profile shape manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
144	Plastics pipe and pipe fitting manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
145	Laminated plastics plate, sheet (except packaging), and shape manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
146	Polystyrene foam product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
147	Urethane and other foam product (except polystyrene) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
148	Plastics bottle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
149	Other plastics product manufacturing	7.134	0.265	7.399	1.598	0.059	1.658
150	Tire manufacturing	5.802	0.337	6.139	2.045	0.119	2.164
151	Rubber and plastics hoses and belting manufacturing	5.850	0.276	6.126	1.906	0.090	1.996
152	Other rubber product manufacturing	7.356	0.405	7.761	1.571	0.086	1.658
153	Pottery, ceramics, and plumbing fixture manufacturing	10.701	0.571	11.271	1.464	0.078	1.542
154	Brick, tile, and other structural clay product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
155	Clay and nonclay refractory manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
156	Flat glass manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

157	Other pressed and blown glass and glassware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
158	Glass container manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
159	Glass product manufacturing made of purchased glass	0.000	0.000	0.000	1.000	0.000	1.000
160	Cement manufacturing	4.534	0.299	4.833	2.815	0.186	3.000
161	Ready-mix concrete manufacturing	6.972	0.685	7.657	2.205	0.217	2.422
162	Concrete pipe, brick, and block manufacturing	7.028	0.544	7.573	1.962	0.152	2.114
163	Other concrete product manufacturing	9.884	0.574	10.458	1.577	0.092	1.669
164	Lime and gypsum product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
165	Abrasive product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
166	Cut stone and stone product manufacturing	13.759	0.521	14.279	1.504	0.057	1.561
167	Ground or treated mineral and earth manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
168	Mineral wool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
169	Miscellaneous nonmetallic mineral products	0.000	0.000	0.000	1.000	0.000	1.000
170	Iron and steel mills and ferroalloy manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
171	Steel product manufacturing from purchased steel	0.000	0.000	0.000	1.000	0.000	1.000
172	Alumina refining and primary aluminum production	0.000	0.000	0.000	1.000	0.000	1.000
173	Secondary smelting and alloying of aluminum	0.000	0.000	0.000	1.000	0.000	1.000
174	Aluminum product manufacturing from purchased aluminum	0.000	0.000	0.000	1.000	0.000	1.000
175	Primary smelting and refining of copper	0.000	0.000	0.000	1.000	0.000	1.000
176	Primary smelting and refining of nonferrous metal (except copper and aluminum)	0.000	0.000	0.000	1.000	0.000	1.000
177	Copper rolling, drawing, extruding and alloying	2.790	0.167	2.957	2.857	0.171	3.028
178	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	0.000	0.000	0.000	1.000	0.000	1.000
179	Ferrous metal foundries	0.000	0.000	0.000	1.000	0.000	1.000
180	Nonferrous metal foundries	0.000	0.000	0.000	1.000	0.000	1.000
181	All other forging, stamping, and sintering	6.005	0.324	6.329	2.222	0.120	2.342
182	Custom roll forming	0.000	0.000	0.000	1.000	0.000	1.000
183	Crown and closure manufacturing and metal stamping	7.993	0.328	8.321	1.692	0.069	1.762
184	Cutlery, utensil, pot, and pan manufacturing	5.778	0.280	6.058	1.792	0.087	1.879
185	Handtool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
186	Plate work and fabricated structural product manufacturing	6.303	0.366	6.669	2.108	0.122	2.230
187	Ornamental and architectural metal products manufacturing	8.176	0.373	8.549	1.728	0.079	1.807
188	Power boiler and heat exchanger manufacturing	6.492	0.313	6.805	1.833	0.088	1.922
189	Metal tank (heavy gauge) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
190	Metal can, box, and other metal container (light gauge) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
191	Ammunition manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
192	Arms, ordnance, and accessories manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

193	Hardware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
194	Spring and wire product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
195	Machine shops	9.722	0.396	10.118	1.721	0.070	1.792
196	Turned product and screw, nut, and bolt manufacturing	7.333	0.349	7.682	1.779	0.085	1.864
197	Coating, engraving, heat treating and allied activities	8.242	0.320	8.562	1.587	0.062	1.649
198	Valve and fittings other than plumbing	5.658	0.299	5.957	1.975	0.104	2.079
199	Plumbing fixture fitting and trim manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
200	Ball and roller bearing manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
201	Fabricated pipe and pipe fitting manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
202	Other fabricated metal manufacturing	6.975	0.322	7.298	1.674	0.077	1.751
203	Farm machinery and equipment manufacturing	4.370	0.378	4.748	2.453	0.212	2.665
204	Lawn and garden equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
205	Construction machinery manufacturing	3.818	0.379	4.197	2.929	0.291	3.220
206	Mining and oil and gas field machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
207	Other industrial machinery manufacturing	6.901	0.398	7.299	1.948	0.112	2.060
208	Plastics and rubber industry machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
209	Semiconductor machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
210	Vending, commercial, industrial, and office machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
211	Optical instrument and lens manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
212	Photographic and photocopying equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
213	Other commercial and service industry machinery manufacturing	6.247	0.354	6.601	1.843	0.105	1.948
214	Air purification and ventilation equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
215	Heating equipment (except warm air furnaces) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
216	Air conditioning, refrigeration, and warm air heating equipment manufacturing	5.575	0.403	5.978	1.835	0.133	1.968
217	Industrial mold manufacturing	10.380	0.412	10.792	1.786	0.071	1.857
218	Metal cutting and forming machine tool manufacturing	7.374	0.436	7.810	1.972	0.116	2.088
219	Special tool, die, jig, and fixture manufacturing	9.530	0.457	9.987	1.826	0.088	1.913
220	Cutting tool and machine tool accessory manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
221	Rolling mill and other metalworking machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
222	Turbine and turbine generator set units manufacturing	5.072	0.306	5.378	3.164	0.191	3.355
223	Speed changer, industrial high-speed drive, and gear manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
224	Mechanical power transmission equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
225	Other engine equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
226	Pump and pumping equipment manufacturing	5.099	0.365	5.464	2.358	0.169	2.526
227	Air and gas compressor manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

228	Material handling equipment manufacturing	5.368	0.424	5.792	2.216	0.175	2.391
229	Power-driven handtool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
230	Other general purpose machinery manufacturing	6.366	0.382	6.748	1.952	0.117	2.069
231	Packaging machinery manufacturing	7.170	0.388	7.558	2.032	0.110	2.142
232	Industrial process furnace and oven manufacturing	7.156	0.518	7.674	1.890	0.137	2.026
233	Fluid power process machinery	6.130	0.389	6.518	1.977	0.125	2.102
234	Electronic computer manufacturing	2.370	0.266	2.636	3.551	0.398	3.949
235	Computer storage device manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
236	Computer terminals and other computer peripheral equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
237	Telephone apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
238	Broadcast and wireless communications equipment	4.787	0.374	5.162	2.681	0.210	2.890
239	Other communications equipment manufacturing	5.224	0.464	5.688	2.121	0.189	2.310
240	Audio and video equipment manufacturing	4.576	0.383	4.958	3.010	0.252	3.261
241	Electron tube manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
242	Bare printed circuit board manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
243	Semiconductor and related device manufacturing	5.144	0.732	5.877	4.405	0.627	5.031
244	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
245	Electronic connector manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
246	Printed circuit assembly (electronic assembly) manufacturing	4.846	0.298	5.144	1.693	0.104	1.797
247	Other electronic component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
248	Electromedical and electrotherapeutic apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
249	Search, detection, and navigation instruments manufacturing	6.443	0.515	6.959	2.580	0.206	2.786
250	Automatic environmental control manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
251	Industrial process variable instruments manufacturing	6.469	0.532	7.002	2.622	0.216	2.838
252	Totalizing fluid meters and counting devices manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
253	Electricity and signal testing instruments manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
254	Analytical laboratory instrument manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
255	Irradiation apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
256	Watch, clock, and other measuring and controlling device manufacturing	6.173	0.506	6.679	2.070	0.170	2.240
257	Software, audio, and video media reproducing	0.000	0.000	0.000	1.000	0.000	1.000
258	Magnetic and optical recording media manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
259	Electric lamp bulb and part manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
260	Lighting fixture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
261	Small electrical appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
262	Household cooking appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
263	Household refrigerator and home freezer	0.000	0.000	0.000	1.000	0.000	1.000

	manufacturing						
264	Household laundry equipment manufacturing	5.336	0.323	5.659	1.861	0.113	1.974
265	Other major household appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
266	Power, distribution, and specialty transformer manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
267	Motor and generator manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
268	Switchgear and switchboard apparatus manufacturing	4.550	0.296	4.845	2.073	0.135	2.208
269	Relay and industrial control manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
270	Storage battery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
271	Primary battery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
272	Communication and energy wire and cable manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
273	Wiring device manufacturing	6.643	0.323	6.966	1.597	0.078	1.675
274	Carbon and graphite product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
275	All other miscellaneous electrical equipment and component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
276	Automobile manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
277	Light truck and utility vehicle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
278	Heavy duty truck manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
279	Motor vehicle body manufacturing	5.626	0.424	6.050	1.794	0.135	1.929
280	Truck trailer manufacturing	7.302	0.448	7.750	1.765	0.108	1.873
281	Motor home manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
282	Travel trailer and camper manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
283	Motor vehicle parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
284	Aircraft manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
285	Aircraft engine and engine parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
286	Other aircraft parts and auxiliary equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
287	Guided missile and space vehicle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
288	Propulsion units and parts for space vehicles and guided missiles	0.000	0.000	0.000	1.000	0.000	1.000
289	Railroad rolling stock manufacturing	3.604	0.363	3.967	2.319	0.233	2.553
290	Ship building and repairing	0.000	0.000	0.000	1.000	0.000	1.000
291	Boat building	0.000	0.000	0.000	1.000	0.000	1.000
292	Motorcycle, bicycle, and parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
293	Military armored vehicle, tank, and tank component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
294	All other transportation equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
295	Wood kitchen cabinet and countertop manufacturing	13.087	0.563	13.651	1.646	0.071	1.717
296	Upholstered household furniture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
297	Nonupholstered wood household furniture manufacturing	11.334	0.539	11.873	1.483	0.071	1.554
298	Metal and other household furniture (except wood) manufacturing1	7.675	0.384	8.059	1.549	0.077	1.626
299	Institutional furniture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
300	Wood television, radio, and sewing machine cabinet manufacturing1	16.867	0.337	17.205	1.269	0.025	1.295

301	Office furniture and custom architectural woodwork and millwork manufacturing1	7.537	0.369	7.906	1.825	0.089	1.915
302	Showcase, partition, shelving, and locker manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
303	Mattress manufacturing	5.882	0.422	6.304	1.885	0.135	2.020
304	Blind and shade manufacturing	11.457	0.596	12.052	1.361	0.071	1.432
305	Surgical and medical instrument manufacturing	8.355	0.395	8.749	1.865	0.088	1.954
306	Surgical appliance and supplies manufacturing	6.969	0.417	7.386	2.088	0.125	2.213
307	Dental equipment and supplies manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
308	Ophthalmic goods manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
309	Dental laboratories	19.507	0.434	19.941	1.359	0.030	1.389
310	Jewelry and silverware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
311	Sporting and athletic goods manufacturing	7.432	0.462	7.894	1.928	0.120	2.048
312	Doll, toy, and game manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
313	Office supplies (except paper) manufacturing	9.263	0.349	9.611	1.587	0.060	1.647
314	Sign manufacturing	11.676	0.401	12.077	1.621	0.056	1.676
315	Gasket, packing, and sealing device manufacturing	9.142	0.380	9.522	1.767	0.073	1.840
316	Musical instrument manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
317	All other miscellaneous manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
318	Broom, brush, and mop manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
319	Wholesale trade	10.384	0.435	10.819	1.860	0.078	1.938
320	Retail - Motor vehicle and parts	20.408	0.407	20.815	1.372	0.027	1.399
321	Retail - Furniture and home furnishings	15.790	0.418	16.208	1.480	0.039	1.519
322	Retail - Electronics and appliances	19.456	0.436	19.893	1.415	0.032	1.447
323	Retail - Building material and garden supply	17.136	0.397	17.533	1.418	0.033	1.451
324	Retail - Food and beverage	22.031	0.415	22.446	1.316	0.025	1.340
325	Retail - Health and personal care	23.099	0.338	23.437	1.274	0.019	1.293
326	Retail - Gasoline stations	16.517	0.316	16.833	1.343	0.026	1.369
327	Retail - Clothing and clothing accessories	21.131	0.343	21.475	1.277	0.021	1.298
328	Retail - Sporting goods, hobby, book and music	31.681	0.357	32.038	1.203	0.014	1.217
329	Retail - General merchandise	23.071	0.412	23.483	1.296	0.023	1.319
330	Retail - Miscellaneous	43.403	0.326	43.729	1.144	0.009	1.152
331	Retail - Nonstore	23.217	0.280	23.497	1.191	0.014	1.205
332	Air transportation	8.223	0.462	8.685	1.822	0.102	1.924
333	Rail transportation	6.496	0.270	6.766	2.505	0.104	2.609
334	Water transportation	5.576	0.938	6.514	3.493	0.588	4.081
335	Truck transportation	14.142	0.372	14.514	1.666	0.044	1.710
336	Transit and ground passenger transportation	14.510	0.474	14.984	1.419	0.046	1.465
337	Pipeline transportation	0.000	0.000	0.000	1.000	0.000	1.000
338	Scenic and sightseeing transportation and support activities for transportation	23.009	0.357	23.366	1.296	0.020	1.316
339	Couriers and messengers	22.033	0.290	22.323	1.233	0.016	1.249
340	Warehousing and storage	17.383	0.384	17.768	1.404	0.031	1.435
341	Newspaper publishers	11.104	0.638	11.742	1.508	0.087	1.594
342	Periodical publishers	8.701	0.485	9.186	2.209	0.123	2.332

343	Book publishers	8.806	0.450	9.256	2.286	0.117	2.403
344	Directory, mailing list, and other publishers	7.155	0.315	7.471	2.169	0.096	2.265
345	Software publishers	8.882	0.466	9.348	3.271	0.171	3.442
346	Motion picture and video industries	15.568	0.997	16.564	1.583	0.101	1.684
347	Sound recording industries	7.779	0.388	8.167	4.971	0.248	5.219
348	Radio and television broadcasting	13.597	1.398	14.995	1.682	0.173	1.855
349	Cable and other subscription programming	0.000	0.000	0.000	1.000	0.000	1.000
350	Internet publishing and broadcasting	4.825	0.374	5.200	3.033	0.235	3.269
351	Telecommunications	6.794	0.309	7.103	3.009	0.137	3.145
352	Data processing, hosting, and related services	9.096	0.575	9.671	2.402	0.152	2.554
353	Other information services	0.000	0.000	0.000	1.000	0.000	1.000
354	Monetary authorities and depository credit intermediation	8.652	0.322	8.974	1.859	0.069	1.928
355	Nondepository credit intermediation and related activities	11.765	0.494	12.259	1.771	0.074	1.846
356	Securities, commodity contracts, investments, and related activities	12.721	0.716	13.436	2.067	0.116	2.183
357	Insurance carriers	7.268	1.240	8.507	2.194	0.374	2.568
358	Insurance agencies, brokerages, and related activities	12.916	0.727	13.643	1.881	0.106	1.987
359	Funds, trusts, and other financial vehicles	8.601	0.818	9.419	3.027	0.288	3.315
360	Real estate	11.592	0.136	11.727	1.320	0.015	1.336
361	Imputed rental value for owner-occupied dwellings	2.965	0.172	3.137	#DIV/0!	#DIV/0!	#DIV/0!
362	Automotive equipment rental and leasing	10.365	0.552	10.917	2.001	0.107	2.107
363	General and consumer goods rental except video tapes and discs	18.660	0.583	19.243	1.463	0.046	1.509
364	Video tape and disc rental	25.758	0.646	26.405	1.227	0.031	1.258
365	Commercial and industrial machinery and equipment rental and leasing	8.776	0.644	9.420	2.909	0.213	3.123
366	Lessors of nonfinancial intangible assets	5.008	0.199	5.207	2.783	0.111	2.894
367	Legal services	15.582	0.349	15.932	1.658	0.037	1.695
368	Accounting, tax preparation, bookkeeping, and payroll services	15.641	0.385	16.026	1.647	0.041	1.687
369	Architectural, engineering, and related services	14.283	0.355	14.638	1.941	0.048	1.989
370	Specialized design services	16.239	0.348	16.588	1.609	0.035	1.644
371	Custom computer programming services	15.269	0.294	15.563	1.813	0.035	1.848
372	Computer systems design services	22.552	0.461	23.012	1.516	0.031	1.547
373	Other computer related services, including facilities management	12.973	0.382	13.355	1.822	0.054	1.876
374	Management, scientific, and technical consulting services	14.055	0.429	14.484	1.912	0.058	1.971
375	Environmental and other technical consulting services	11.823	0.398	12.221	2.224	0.075	2.299
376	Scientific research and development services	16.814	0.465	17.278	1.703	0.047	1.750
377	Advertising and related services	18.084	0.610	18.695	1.516	0.051	1.567
378	Photographic services	18.900	0.373	19.274	1.456	0.029	1.485
379	Veterinary services	19.488	0.343	19.831	1.325	0.023	1.348
380	All other miscellaneous professional, scientific, and technical services	7.165	0.426	7.592	2.884	0.172	3.055

381	Management of companies and enterprises	10.972	0.434	11.405	2.143	0.085	2.228
382	Employment services	33.806	0.409	34.215	1.243	0.015	1.258
383	Travel arrangement and reservation services	15.625	0.360	15.985	1.491	0.034	1.525
384	Office administrative services	13.336	0.332	13.668	1.792	0.045	1.837
385	Facilities support services	25.835	0.463	26.298	1.378	0.025	1.402
386	Business support services	23.658	0.339	23.997	1.361	0.020	1.381
387	Investigation and security services	35.556	0.334	35.890	1.198	0.011	1.209
388	Services to buildings and dwellings	23.880	0.239	24.119	1.242	0.012	1.254
389	Other support services	11.688	0.287	11.975	1.688	0.041	1.729
390	Waste management and remediation services	10.914	0.520	11.433	1.851	0.088	1.940
391	Elementary and secondary schools	50.195	0.327	50.522	1.139	0.007	1.147
392	Junior colleges, colleges, universities, and professional schools	20.093	0.350	20.442	1.359	0.024	1.383
393	Other educational services	21.205	0.418	21.623	1.386	0.027	1.414
394	Offices of physicians, dentists, and other health practitioners	13.325	0.312	13.637	1.746	0.041	1.787
395	Home health care services	25.842	0.303	26.145	1.270	0.015	1.285
396	Medical and diagnostic labs and outpatient and other ambulatory care services	12.807	0.261	13.067	1.610	0.033	1.643
397	Hospitals	15.225	0.351	15.575	1.600	0.037	1.637
398	Nursing and residential care facilities	29.940	0.364	30.303	1.251	0.015	1.267
399	Child day care services	27.739	0.473	28.213	1.207	0.021	1.228
400	Individual and family services	27.157	0.525	27.683	1.268	0.025	1.293
401	Community food, housing, and other relief services, including rehabilitation services	43.545	0.442	43.986	1.200	0.012	1.212
402	Performing arts companies	38.319	1.090	39.409	1.223	0.035	1.258
403	Spectator sports	42.395	2.802	45.196	1.179	0.078	1.257
404	Promoters of performing arts and sports and agents for public figures	37.970	0.735	38.704	1.272	0.025	1.297
405	Independent artists, writers, and performers	28.694	0.569	29.263	1.321	0.026	1.348
406	Museums, historical sites, zoos, and parks	23.787	0.493	24.280	1.331	0.028	1.359
407	Fitness and recreational sports centers	31.919	0.590	32.509	1.237	0.023	1.260
408	Bowling centers	28.218	0.447	28.666	1.237	0.020	1.257
409	Amusement parks, arcades, and gambling industries	12.164	0.391	12.556	1.660	0.053	1.713
410	Other amusement and recreation industries	14.080	0.478	14.558	1.651	0.056	1.707
411	Hotels and motels, including casino hotels	20.255	0.376	20.630	1.342	0.025	1.367
412	Other accommodations	17.795	0.447	18.241	1.512	0.038	1.550
413	Food services and drinking places	24.730	0.441	25.171	1.221	0.022	1.243
414	Automotive repair and maintenance, except car washes	14.624	0.378	15.003	1.478	0.038	1.516
415	Car washes	26.640	0.337	26.977	1.204	0.015	1.219
416	Electronic and precision equipment repair and maintenance	11.133	0.282	11.415	1.607	0.041	1.647
417	Commercial and industrial machinery and equipment repair and maintenance	9.117	0.268	9.385	1.619	0.048	1.667
418	Personal and household goods repair and maintenance	11.620	0.296	11.916	1.546	0.039	1.585
419	Personal care services	26.665	0.379	27.045	1.275	0.018	1.293
420	Death care services	19.188	0.590	19.779	1.398	0.043	1.441

421	Dry-cleaning and laundry services	27.893	0.325	28.218	1.197	0.014	1.211
422	Other personal services	14.516	0.324	14.839	1.606	0.036	1.642
423	Religious organizations	7.771	0.971	8.742	2.314	0.289	2.603
424	Grantmaking, giving, and social advocacy organizations	33.398	0.775	34.173	1.376	0.032	1.408
425	Civic, social, professional, and similar organizations	29.361	0.619	29.980	1.386	0.029	1.415
426	Private households	171.615	0.322	171.937	1.032	0.002	1.034
427	Postal service	16.078	0.370	16.447	1.670	0.038	1.708
428	Federal electric utilities	0.000	0.000	0.000	1.000	0.000	1.000
429	Other Federal Government enterprises	12.439	0.312	12.752	1.799	0.045	1.844
430	State and local government passenger transit	24.844	0.357	25.201	1.292	0.019	1.310
431	State and local government electric utilities	3.658	0.134	3.792	1.624	0.059	1.683
432	Other state and local government enterprises	8.652	0.366	9.018	2.276	0.096	2.372

Table B11
Multiregional Value Added Multiplier Effects and Multipliers

Code	IMPLAN Sector	Value Added Multiplier Effects			Value Added Multipliers		
		Linn County	Rest of Iowa	State of Iowa	Linn County	Rest of Iowa	State of Iowa
1	Oilseed farming	0.585	0.048	0.633	1.462	0.120	1.581
2	Grain farming	0.633	0.035	0.668	1.321	0.074	1.395
3	Vegetable and melon farming	0.639	0.057	0.695	1.566	0.139	1.705
4	Fruit farming	0.536	0.086	0.622	1.794	0.287	2.081
5	Tree nut farming	0.833	0.042	0.875	1.287	0.065	1.352
6	Greenhouse, nursery, and floriculture production	0.700	0.046	0.746	1.501	0.099	1.600
7	Tobacco farming	0.000	0.000	0.000	1.000	0.000	1.000
8	Cotton farming	0.000	0.000	0.000	1.000	0.000	1.000
9	Sugarcane and sugar beet farming	0.000	0.000	0.000	1.000	0.000	1.000
10	All other crop farming	0.509	0.051	0.560	1.795	0.181	1.976
11	Cattle ranching and farming	0.392	0.028	0.420	2.273	0.165	2.437
12	Dairy cattle and milk production	0.540	0.035	0.575	1.429	0.092	1.521
13	Poultry and egg production	0.396	0.058	0.454	2.043	0.298	2.341
14	Animal production, except cattle and poultry and eggs	0.635	0.045	0.680	1.275	0.091	1.366
15	Forest nurseries, forest products, and timber tracts	0.000	0.000	0.000	1.000	0.000	1.000
16	Logging	0.000	0.000	0.000	1.000	0.000	1.000
17	Fishing	0.000	0.000	0.000	1.000	0.000	1.000
18	Hunting and trapping	0.450	0.023	0.473	2.293	0.115	2.408
19	Support activities for agriculture and forestry	1.217	0.031	1.248	1.634	0.041	1.675
20	Oil and gas extraction	0.333	0.078	0.412	4.315	1.012	5.327
21	Coal mining	0.000	0.000	0.000	1.000	0.000	1.000
22	Iron ore mining	0.000	0.000	0.000	1.000	0.000	1.000
23	Copper, nickel, lead, and zinc mining	0.000	0.000	0.000	1.000	0.000	1.000
24	Gold, silver, and other metal ore mining	0.000	0.000	0.000	1.000	0.000	1.000
25	Stone mining and quarrying	0.871	0.034	0.905	1.405	0.055	1.459
26	Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	0.791	0.032	0.822	1.525	0.061	1.586
27	Other nonmetallic mineral mining and quarrying	0.000	0.000	0.000	1.000	0.000	1.000
28	Drilling oil and gas wells	0.709	0.019	0.729	1.232	0.034	1.266
29	Support activities for oil and gas operations	0.000	0.000	0.000	1.000	0.000	1.000
30	Support activities for other mining	0.000	0.000	0.000	1.000	0.000	1.000
31	Electric power generation, transmission, and distribution	0.879	0.010	0.889	1.157	0.013	1.170
32	Natural gas distribution	0.000	0.000	0.000	1.000	0.000	1.000
33	Water, sewage and other systems	1.061	0.018	1.078	1.428	0.024	1.452
34	Construction of new nonresidential commercial and health care structures	0.715	0.033	0.748	1.696	0.078	1.774
35	Construction of new nonresidential manufacturing structures	0.696	0.025	0.721	1.620	0.059	1.679
36	Construction of other new nonresidential structures	0.760	0.032	0.792	1.768	0.075	1.844
37	Construction of new residential permanent	0.787	0.042	0.829	1.871	0.099	1.970

	site single- and multi-family structures						
38	Construction of other new residential structures	0.707	0.039	0.745	2.057	0.113	2.170
39	Maintenance and repair construction of nonresidential maintenance and repair	0.970	0.032	1.003	1.574	0.052	1.626
40	Maintenance and repair construction of residential structures	0.935	0.037	0.972	1.422	0.057	1.479
41	Dog and cat food manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
42	Other animal food manufacturing	0.291	0.062	0.353	2.183	0.468	2.651
43	Flour milling and malt manufacturing	0.361	0.092	0.453	2.986	0.759	3.745
44	Wet corn milling	0.319	0.091	0.411	3.511	1.004	4.515
45	Soybean and other oilseed processing	0.136	0.144	0.280	3.381	3.593	6.975
46	Fats and oils refining and blending	0.000	0.000	0.000	1.000	0.000	1.000
47	Breakfast cereal manufacturing	0.471	0.046	0.517	1.414	0.139	1.553
48	Sugar cane mills and refining	0.000	0.000	0.000	1.000	0.000	1.000
49	Beet sugar manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
50	Chocolate and confectionery manufacturing from cacao beans	0.000	0.000	0.000	1.000	0.000	1.000
51	Confectionery manufacturing from purchased chocolate	0.432	0.050	0.482	1.751	0.202	1.953
52	Nonchocolate confectionery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
53	Frozen food manufacturing	0.462	0.058	0.520	1.957	0.244	2.201
54	Fruit and vegetable canning, pickling, and drying	0.000	0.000	0.000	1.000	0.000	1.000
55	Fluid milk and butter manufacturing	0.411	0.073	0.484	3.397	0.604	4.001
56	Cheese manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
57	Dry, condensed, and evaporated dairy product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
58	Ice cream and frozen dessert manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
59	Animal (except poultry) slaughtering, rendering, and processing	0.000	0.000	0.000	1.000	0.000	1.000
60	Poultry processing	0.000	0.000	0.000	1.000	0.000	1.000
61	Seafood product preparation and packaging	0.000	0.000	0.000	1.000	0.000	1.000
62	Bread and bakery product manufacturing	0.543	0.050	0.593	2.029	0.187	2.216
63	Cookie, cracker, and pasta manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
64	Tortilla manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
65	Snack food manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
66	Coffee and tea manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
67	Flavoring syrup and concentrate manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
68	Seasoning and dressing manufacturing	0.322	0.045	0.367	2.347	0.328	2.675
69	All other food manufacturing	0.536	0.051	0.587	1.931	0.182	2.113
70	Soft drink and ice manufacturing	0.251	0.036	0.287	2.359	0.336	2.695
71	Breweries	0.000	0.000	0.000	1.000	0.000	1.000
72	Wineries	0.000	0.000	0.000	1.000	0.000	1.000
73	Distilleries	0.000	0.000	0.000	1.000	0.000	1.000
74	Tobacco product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
75	Fiber, yarn, and thread mills	0.000	0.000	0.000	1.000	0.000	1.000
76	Broadwoven fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
77	Narrow fabric mills and schiffli machine embroidery	0.000	0.000	0.000	1.000	0.000	1.000

78	Nonwoven fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
79	Knit fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
80	Textile and fabric finishing mills	0.472	0.025	0.497	1.832	0.098	1.930
81	Fabric coating mills	0.000	0.000	0.000	1.000	0.000	1.000
82	Carpet and rug mills	0.000	0.000	0.000	1.000	0.000	1.000
83	Curtain and linen mills	0.522	0.018	0.540	1.554	0.055	1.608
84	Textile bag and canvas mills	0.537	0.030	0.567	1.724	0.097	1.821
85	All other textile product mills	0.396	0.027	0.423	1.923	0.130	2.053
86	Apparel knitting mills	0.000	0.000	0.000	1.000	0.000	1.000
87	Cut and sew apparel contractors	0.000	0.000	0.000	1.000	0.000	1.000
88	Men's and boys' cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
89	Women's and girls' cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
90	Other cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
91	Apparel accessories and other apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
92	Leather and hide tanning and finishing	0.000	0.000	0.000	1.000	0.000	1.000
93	Footwear manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
94	Other leather and allied product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
95	Sawmills and wood preservation	0.470	0.078	0.548	1.936	0.321	2.257
96	Veneer and plywood manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
97	Engineered wood member and truss manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
98	Reconstituted wood product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
99	Wood windows and doors and millwork	0.595	0.065	0.660	1.752	0.191	1.943
100	Wood container and pallet manufacturing	0.531	0.053	0.584	1.730	0.174	1.904
101	Manufactured home (mobile home) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
102	Prefabricated wood building manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
103	All other miscellaneous wood product manufacturing	0.508	0.066	0.573	2.206	0.285	2.491
104	Pulp mills	0.000	0.000	0.000	1.000	0.000	1.000
105	Paper mills	0.000	0.000	0.000	1.000	0.000	1.000
106	Paperboard Mills	0.000	0.000	0.000	1.000	0.000	1.000
107	Paperboard container manufacturing	0.476	0.028	0.504	1.911	0.110	2.021
108	Coated and laminated paper, packaging paper and plastics film manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
109	All other paper bag and coated and treated paper manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
110	Stationery product manufacturing	0.459	0.034	0.493	2.009	0.151	2.159
111	Sanitary paper product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
112	All other converted paper product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
113	Printing	0.701	0.026	0.727	1.606	0.059	1.665
114	Support activities for printing	0.937	0.029	0.965	1.583	0.049	1.632
115	Petroleum refineries	0.000	0.000	0.000	1.000	0.000	1.000
116	Asphalt paving mixture and block manufacturing	0.471	0.034	0.506	1.408	0.102	1.510
117	Asphalt shingle and coating materials manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

118	Petroleum lubricating oil and grease manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
119	All other petroleum and coal products manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
120	Petrochemical manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
121	Industrial gas manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
122	Synthetic dye and pigment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
123	Alkalies and chlorine manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
124	Carbon black manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
125	All other basic inorganic chemical manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
126	Other basic organic chemical manufacturing	0.176	0.020	0.196	2.605	0.302	2.907
127	Plastics material and resin manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
128	Synthetic rubber manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
129	Artificial and synthetic fibers and filaments manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
130	Fertilizer manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
131	Pesticide and other agricultural chemical manufacturing	0.355	0.036	0.391	1.523	0.153	1.677
132	Medicinal and botanical manufacturing	0.458	0.040	0.498	1.707	0.148	1.855
133	Pharmaceutical preparation manufacturing	0.390	0.040	0.430	1.772	0.180	1.952
134	In-vitro diagnostic substance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
135	Biological product (except diagnostic) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
136	Paint and coating manufacturing	0.336	0.032	0.368	1.682	0.160	1.842
137	Adhesive manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
138	Soap and cleaning compound manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
139	Toilet preparation manufacturing	0.409	0.039	0.448	1.741	0.165	1.906
140	Printing ink manufacturing	0.233	0.036	0.269	1.947	0.301	2.248
141	All other chemical product and preparation manufacturing	0.294	0.042	0.335	1.974	0.280	2.254
142	Plastics packaging materials and unlaminated film and sheet manufacturing	0.499	0.015	0.514	1.374	0.042	1.416
143	Unlaminated plastics profile shape manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
144	Plastics pipe and pipe fitting manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
145	Laminated plastics plate, sheet (except packaging), and shape manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
146	Polystyrene foam product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
147	Urethane and other foam product (except polystyrene) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
148	Plastics bottle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
149	Other plastics product manufacturing	0.535	0.022	0.557	1.545	0.065	1.610
150	Tire manufacturing	0.567	0.023	0.590	1.620	0.067	1.687
151	Rubber and plastics hoses and belting manufacturing	0.650	0.022	0.672	1.422	0.049	1.471
152	Other rubber product manufacturing	0.457	0.029	0.486	1.784	0.113	1.897
153	Pottery, ceramics, and plumbing fixture manufacturing	0.600	0.041	0.640	1.713	0.116	1.829
154	Brick, tile, and other structural clay product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
155	Clay and nonclay refractory manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
156	Flat glass manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

157	Other pressed and blown glass and glassware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
158	Glass container manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
159	Glass product manufacturing made of purchased glass	0.000	0.000	0.000	1.000	0.000	1.000
160	Cement manufacturing	0.598	0.025	0.623	1.790	0.075	1.864
161	Ready-mix concrete manufacturing	0.536	0.069	0.605	1.909	0.245	2.154
162	Concrete pipe, brick, and block manufacturing	0.642	0.046	0.688	1.579	0.113	1.691
163	Other concrete product manufacturing	0.606	0.048	0.654	1.682	0.133	1.815
164	Lime and gypsum product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
165	Abrasive product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
166	Cut stone and stone product manufacturing	0.695	0.041	0.736	1.816	0.108	1.925
167	Ground or treated mineral and earth manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
168	Mineral wool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
169	Miscellaneous nonmetallic mineral products	0.000	0.000	0.000	1.000	0.000	1.000
170	Iron and steel mills and ferroalloy manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
171	Steel product manufacturing from purchased steel	0.000	0.000	0.000	1.000	0.000	1.000
172	Alumina refining and primary aluminum production	0.000	0.000	0.000	1.000	0.000	1.000
173	Secondary smelting and alloying of aluminum	0.000	0.000	0.000	1.000	0.000	1.000
174	Aluminum product manufacturing from purchased aluminum	0.000	0.000	0.000	1.000	0.000	1.000
175	Primary smelting and refining of copper	0.000	0.000	0.000	1.000	0.000	1.000
176	Primary smelting and refining of nonferrous metal (except copper and aluminum)	0.000	0.000	0.000	1.000	0.000	1.000
177	Copper rolling, drawing, extruding and alloying	0.254	0.015	0.268	2.287	0.132	2.419
178	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	0.000	0.000	0.000	1.000	0.000	1.000
179	Ferrous metal foundries	0.000	0.000	0.000	1.000	0.000	1.000
180	Nonferrous metal foundries	0.000	0.000	0.000	1.000	0.000	1.000
181	All other forging, stamping, and sintering	0.458	0.026	0.485	2.014	0.115	2.129
182	Custom roll forming	0.000	0.000	0.000	1.000	0.000	1.000
183	Crown and closure manufacturing and metal stamping	0.565	0.028	0.592	1.676	0.082	1.758
184	Cutlery, utensil, pot, and pan manufacturing	0.630	0.022	0.652	1.377	0.048	1.425
185	Handtool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
186	Plate work and fabricated structural product manufacturing	0.585	0.031	0.616	1.587	0.083	1.671
187	Ornamental and architectural metal products manufacturing	0.573	0.030	0.603	1.713	0.089	1.802
188	Power boiler and heat exchanger manufacturing	0.507	0.025	0.532	1.655	0.083	1.738
189	Metal tank (heavy gauge) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
190	Metal can, box, and other metal container (light gauge) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
191	Ammunition manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
192	Arms, ordnance, and accessories manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

193	Hardware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
194	Spring and wire product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
195	Machine shops	0.752	0.033	0.785	1.567	0.068	1.635
196	Turned product and screw, nut, and bolt manufacturing	0.678	0.029	0.708	1.499	0.065	1.564
197	Coating, engraving, heat treating and allied activities	0.553	0.025	0.579	1.649	0.075	1.724
198	Valve and fittings other than plumbing	0.605	0.025	0.630	1.478	0.061	1.539
199	Plumbing fixture fitting and trim manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
200	Ball and roller bearing manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
201	Fabricated pipe and pipe fitting manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
202	Other fabricated metal manufacturing	0.598	0.027	0.625	1.500	0.068	1.568
203	Farm machinery and equipment manufacturing	0.418	0.031	0.449	1.770	0.131	1.901
204	Lawn and garden equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
205	Construction machinery manufacturing	0.366	0.032	0.398	1.883	0.167	2.050
206	Mining and oil and gas field machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
207	Other industrial machinery manufacturing	0.567	0.034	0.601	1.721	0.103	1.824
208	Plastics and rubber industry machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
209	Semiconductor machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
210	Vending, commercial, industrial, and office machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
211	Optical instrument and lens manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
212	Photographic and photocopying equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
213	Other commercial and service industry machinery manufacturing	0.461	0.030	0.491	1.801	0.118	1.920
214	Air purification and ventilation equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
215	Heating equipment (except warm air furnaces) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
216	Air conditioning, refrigeration, and warm air heating equipment manufacturing	0.406	0.032	0.437	1.834	0.143	1.977
217	Industrial mold manufacturing	0.811	0.034	0.845	1.633	0.068	1.700
218	Metal cutting and forming machine tool manufacturing	0.614	0.035	0.649	1.710	0.097	1.808
219	Special tool, die, jig, and fixture manufacturing	0.822	0.037	0.859	1.550	0.070	1.620
220	Cutting tool and machine tool accessory manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
221	Rolling mill and other metalworking machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
222	Turbine and turbine generator set units manufacturing	0.467	0.023	0.490	1.777	0.087	1.864
223	Speed changer, industrial high-speed drive, and gear manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
224	Mechanical power transmission equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
225	Other engine equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
226	Pump and pumping equipment manufacturing	0.518	0.032	0.550	1.679	0.103	1.782
227	Air and gas compressor manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

228	Material handling equipment manufacturing	0.552	0.038	0.590	1.608	0.110	1.718
229	Power-driven handtool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
230	Other general purpose machinery manufacturing	0.507	0.034	0.541	1.782	0.118	1.899
231	Packaging machinery manufacturing	0.627	0.033	0.660	1.678	0.087	1.766
232	Industrial process furnace and oven manufacturing	0.626	0.046	0.672	1.596	0.116	1.712
233	Fluid power process machinery	0.500	0.034	0.534	1.787	0.122	1.908
234	Electronic computer manufacturing	0.245	0.024	0.268	2.212	0.213	2.425
235	Computer storage device manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
236	Computer terminals and other computer peripheral equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
237	Telephone apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
238	Broadcast and wireless communications equipment	0.332	0.031	0.364	2.719	0.256	2.975
239	Other communications equipment manufacturing	0.346	0.042	0.387	2.395	0.289	2.684
240	Audio and video equipment manufacturing	0.335	0.029	0.364	3.141	0.275	3.416
241	Electron tube manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
242	Bare printed circuit board manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
243	Semiconductor and related device manufacturing	0.650	0.062	0.712	1.755	0.168	1.922
244	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
245	Electronic connector manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
246	Printed circuit assembly (electronic assembly) manufacturing	0.254	0.026	0.280	2.592	0.263	2.854
247	Other electronic component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
248	Electromedical and electrotherapeutic apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
249	Search, detection, and navigation instruments manufacturing	0.534	0.044	0.578	2.021	0.168	2.189
250	Automatic environmental control manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
251	Industrial process variable instruments manufacturing	0.677	0.049	0.725	1.655	0.119	1.774
252	Totalizing fluid meters and counting devices manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
253	Electricity and signal testing instruments manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
254	Analytical laboratory instrument manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
255	Irradiation apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
256	Watch, clock, and other measuring and controlling device manufacturing	0.406	0.046	0.452	2.211	0.249	2.460
257	Software, audio, and video media reproducing	0.000	0.000	0.000	1.000	0.000	1.000
258	Magnetic and optical recording media manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
259	Electric lamp bulb and part manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
260	Lighting fixture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
261	Small electrical appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
262	Household cooking appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
263	Household refrigerator and home freezer	0.000	0.000	0.000	1.000	0.000	1.000

	manufacturing						
264	Household laundry equipment manufacturing	0.555	0.029	0.583	1.460	0.075	1.535
265	Other major household appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
266	Power, distribution, and specialty transformer manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
267	Motor and generator manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
268	Switchgear and switchboard apparatus manufacturing	0.646	0.026	0.672	1.364	0.054	1.418
269	Relay and industrial control manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
270	Storage battery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
271	Primary battery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
272	Communication and energy wire and cable manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
273	Wiring device manufacturing	0.520	0.026	0.546	1.530	0.077	1.607
274	Carbon and graphite product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
275	All other miscellaneous electrical equipment and component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
276	Automobile manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
277	Light truck and utility vehicle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
278	Heavy duty truck manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
279	Motor vehicle body manufacturing	0.423	0.037	0.460	1.718	0.150	1.867
280	Truck trailer manufacturing	0.461	0.037	0.497	1.894	0.150	2.044
281	Motor home manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
282	Travel trailer and camper manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
283	Motor vehicle parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
284	Aircraft manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
285	Aircraft engine and engine parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
286	Other aircraft parts and auxiliary equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
287	Guided missile and space vehicle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
288	Propulsion units and parts for space vehicles and guided missiles	0.000	0.000	0.000	1.000	0.000	1.000
289	Railroad rolling stock manufacturing	0.374	0.034	0.408	1.661	0.150	1.811
290	Ship building and repairing	0.000	0.000	0.000	1.000	0.000	1.000
291	Boat building	0.000	0.000	0.000	1.000	0.000	1.000
292	Motorcycle, bicycle, and parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
293	Military armored vehicle, tank, and tank component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
294	All other transportation equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
295	Wood kitchen cabinet and countertop manufacturing	0.678	0.038	0.716	2.049	0.115	2.164
296	Upholstered household furniture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
297	Nonupholstered wood household furniture manufacturing	0.731	0.037	0.769	1.519	0.078	1.597
298	Metal and other household furniture (except wood) manufacturing1	0.472	0.027	0.499	1.691	0.096	1.786
299	Institutional furniture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
300	Wood television, radio, and sewing machine cabinet manufacturing1	0.733	0.023	0.756	1.462	0.046	1.508

301	Office furniture and custom architectural woodwork and millwork manufacturing1	0.708	0.028	0.736	1.470	0.058	1.528
302	Showcase, partition, shelving, and locker manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
303	Mattress manufacturing	0.564	0.028	0.592	1.518	0.076	1.593
304	Blind and shade manufacturing	0.398	0.040	0.438	2.328	0.234	2.563
305	Surgical and medical instrument manufacturing	0.530	0.033	0.563	2.014	0.127	2.141
306	Surgical appliance and supplies manufacturing	0.737	0.034	0.771	1.509	0.069	1.578
307	Dental equipment and supplies manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
308	Ophthalmic goods manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
309	Dental laboratories	1.005	0.032	1.037	1.510	0.048	1.558
310	Jewelry and silverware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
311	Sporting and athletic goods manufacturing	0.652	0.036	0.688	1.612	0.088	1.700
312	Doll, toy, and game manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
313	Office supplies (except paper) manufacturing	0.683	0.027	0.711	1.521	0.060	1.581
314	Sign manufacturing	0.840	0.032	0.872	1.556	0.059	1.615
315	Gasket, packing, and sealing device manufacturing	0.741	0.031	0.772	1.577	0.066	1.644
316	Musical instrument manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
317	All other miscellaneous manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
318	Broom, brush, and mop manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
319	Wholesale trade	0.963	0.030	0.993	1.485	0.047	1.532
320	Retail - Motor vehicle and parts	1.095	0.027	1.122	1.503	0.037	1.541
321	Retail - Furniture and home furnishings	0.984	0.029	1.013	1.545	0.045	1.591
322	Retail - Electronics and appliances	1.093	0.030	1.123	1.529	0.042	1.571
323	Retail - Building material and garden supply	0.993	0.027	1.020	1.525	0.042	1.566
324	Retail - Food and beverage	0.997	0.029	1.026	1.555	0.045	1.600
325	Retail - Health and personal care	1.058	0.023	1.081	1.454	0.032	1.486
326	Retail - Gasoline stations	0.976	0.022	0.998	1.415	0.032	1.447
327	Retail - Clothing and clothing accessories	0.967	0.024	0.991	1.474	0.037	1.511
328	Retail - Sporting goods, hobby, book and music	0.973	0.025	0.998	1.584	0.041	1.625
329	Retail - General merchandise	1.005	0.028	1.033	1.546	0.044	1.589
330	Retail - Miscellaneous	1.101	0.023	1.124	1.477	0.030	1.507
331	Retail - Nonstore	0.956	0.019	0.976	1.350	0.027	1.377
332	Air transportation	0.456	0.028	0.484	2.004	0.122	2.126
333	Rail transportation	0.852	0.019	0.871	1.454	0.032	1.487
334	Water transportation	0.640	0.058	0.698	1.683	0.153	1.835
335	Truck transportation	0.805	0.025	0.831	1.728	0.054	1.782
336	Transit and ground passenger transportation	0.987	0.031	1.018	1.382	0.043	1.426
337	Pipeline transportation	0.000	0.000	0.000	1.000	0.000	1.000
338	Scenic and sightseeing transportation and support activities for transportation	1.215	0.022	1.237	1.364	0.024	1.389
339	Couriers and messengers	0.982	0.019	1.001	1.352	0.026	1.378
340	Warehousing and storage	1.129	0.025	1.154	1.405	0.031	1.437
341	Newspaper publishers	0.733	0.045	0.779	1.500	0.093	1.593
342	Periodical publishers	0.669	0.037	0.706	1.888	0.105	1.993

343	Book publishers	0.705	0.032	0.737	1.930	0.088	2.018
344	Directory, mailing list, and other publishers	0.700	0.024	0.723	1.598	0.054	1.652
345	Software publishers	0.815	0.035	0.850	1.835	0.080	1.915
346	Motion picture and video industries	0.592	0.043	0.635	2.541	0.184	2.725
347	Sound recording industries	0.421	0.021	0.443	7.369	0.372	7.742
348	Radio and television broadcasting	0.707	0.041	0.748	1.802	0.104	1.907
349	Cable and other subscription programming	0.000	0.000	0.000	1.000	0.000	1.000
350	Internet publishing and broadcasting	0.358	0.026	0.384	2.678	0.193	2.871
351	Telecommunications	0.759	0.019	0.778	1.866	0.047	1.913
352	Data processing, hosting, and related services	0.813	0.042	0.855	1.765	0.092	1.857
353	Other information services	0.000	0.000	0.000	1.000	0.000	1.000
354	Monetary authorities and depository credit intermediation	0.983	0.025	1.007	1.373	0.035	1.407
355	Nondepository credit intermediation and related activities	0.968	0.037	1.004	1.564	0.059	1.623
356	Securities, commodity contracts, investments, and related activities	0.846	0.055	0.901	2.168	0.140	2.308
357	Insurance carriers	0.773	0.091	0.864	1.577	0.187	1.764
358	Insurance agencies, brokerages, and related activities	0.934	0.053	0.988	1.679	0.096	1.776
359	Funds, trusts, and other financial vehicles	0.446	0.068	0.514	14.691	2.249	16.939
360	Real estate	0.983	0.010	0.993	1.247	0.013	1.259
361	Imputed rental value for owner-occupied dwellings	0.894	0.014	0.908	1.293	0.020	1.314
362	Automotive equipment rental and leasing	0.850	0.044	0.894	1.731	0.089	1.820
363	General and consumer goods rental except video tapes and discs	1.063	0.043	1.106	1.593	0.064	1.657
364	Video tape and disc rental	0.861	0.056	0.917	1.736	0.113	1.849
365	Commercial and industrial machinery and equipment rental and leasing	0.814	0.053	0.868	1.906	0.125	2.031
366	Lessors of nonfinancial intangible assets	0.841	0.014	0.855	1.393	0.023	1.416
367	Legal services	1.023	0.024	1.047	1.627	0.038	1.665
368	Accounting, tax preparation, bookkeeping, and payroll services	1.030	0.027	1.057	1.611	0.042	1.653
369	Architectural, engineering, and related services	1.009	0.025	1.033	1.747	0.043	1.790
370	Specialized design services	0.876	0.023	0.899	1.720	0.045	1.765
371	Custom computer programming services	1.084	0.020	1.105	1.729	0.033	1.761
372	Computer systems design services	1.236	0.030	1.265	1.634	0.040	1.673
373	Other computer related services, including facilities management	1.128	0.025	1.153	1.473	0.032	1.505
374	Management, scientific, and technical consulting services	0.964	0.031	0.995	1.753	0.056	1.809
375	Environmental and other technical consulting services	1.020	0.028	1.047	1.651	0.045	1.696
376	Scientific research and development services	0.831	0.032	0.863	2.101	0.081	2.182
377	Advertising and related services	0.805	0.034	0.838	1.972	0.083	2.054
378	Photographic services	0.826	0.024	0.850	1.784	0.052	1.836
379	Veterinary services	0.730	0.025	0.755	1.736	0.059	1.794
380	All other miscellaneous professional, scientific, and technical services	0.783	0.032	0.815	1.593	0.065	1.657

381	Management of companies and enterprises	0.962	0.030	0.992	1.689	0.053	1.741
382	Employment services	1.156	0.029	1.184	1.528	0.038	1.565
383	Travel arrangement and reservation services	0.902	0.024	0.926	1.580	0.042	1.621
384	Office administrative services	1.072	0.023	1.095	1.509	0.032	1.541
385	Facilities support services	0.888	0.032	0.920	1.909	0.069	1.978
386	Business support services	0.987	0.023	1.010	1.627	0.038	1.665
387	Investigation and security services	1.053	0.022	1.076	1.554	0.033	1.587
388	Services to buildings and dwellings	0.832	0.016	0.848	1.560	0.031	1.591
389	Other support services	0.939	0.019	0.958	1.443	0.030	1.473
390	Waste management and remediation services	0.734	0.039	0.773	1.774	0.093	1.867
391	Elementary and secondary schools	0.984	0.021	1.004	1.667	0.035	1.701
392	Junior colleges, colleges, universities, and professional schools	0.906	0.026	0.933	1.728	0.050	1.778
393	Other educational services	0.899	0.029	0.928	1.734	0.056	1.790
394	Offices of physicians, dentists, and other health practitioners	1.056	0.022	1.078	1.521	0.031	1.552
395	Home health care services	1.072	0.021	1.093	1.467	0.029	1.495
396	Medical and diagnostic labs and outpatient and other ambulatory care services	0.932	0.019	0.951	1.491	0.030	1.522
397	Hospitals	0.872	0.025	0.898	1.771	0.051	1.823
398	Nursing and residential care facilities	1.130	0.025	1.154	1.517	0.033	1.550
399	Child day care services	0.932	0.032	0.964	1.489	0.052	1.541
400	Individual and family services	1.007	0.034	1.041	1.584	0.054	1.638
401	Community food, housing, and other relief services, including rehabilitation services	0.961	0.031	0.992	1.934	0.062	1.996
402	Performing arts companies	0.984	0.052	1.035	1.719	0.090	1.809
403	Spectator sports	0.732	0.065	0.797	1.904	0.169	2.073
404	Promoters of performing arts and sports and agents for public figures	0.736	0.044	0.781	2.318	0.139	2.457
405	Independent artists, writers, and performers	1.132	0.026	1.158	1.458	0.033	1.491
406	Museums, historical sites, zoos, and parks	1.045	0.031	1.076	1.628	0.048	1.676
407	Fitness and recreational sports centers	0.936	0.040	0.977	1.819	0.078	1.897
408	Bowling centers	0.777	0.032	0.808	2.192	0.089	2.282
409	Amusement parks, arcades, and gambling industries	0.783	0.026	0.808	1.708	0.056	1.764
410	Other amusement and recreation industries	0.732	0.034	0.766	2.054	0.096	2.150
411	Hotels and motels, including casino hotels	0.930	0.026	0.956	1.571	0.043	1.614
412	Other accommodations	0.900	0.033	0.933	1.753	0.065	1.818
413	Food services and drinking places	0.777	0.033	0.810	1.667	0.071	1.739
414	Automotive repair and maintenance, except car washes	0.888	0.025	0.913	1.505	0.043	1.548
415	Car washes	0.887	0.024	0.911	1.541	0.042	1.583
416	Electronic and precision equipment repair and maintenance	0.911	0.019	0.930	1.400	0.029	1.429
417	Commercial and industrial machinery and equipment repair and maintenance	0.882	0.019	0.901	1.357	0.030	1.386
418	Personal and household goods repair and maintenance	0.844	0.021	0.865	1.463	0.037	1.500
419	Personal care services	0.972	0.025	0.997	1.577	0.041	1.618
420	Death care services	0.914	0.041	0.955	1.637	0.073	1.710

421	Dry-cleaning and laundry services	1.046	0.022	1.068	1.400	0.030	1.430
422	Other personal services	0.809	0.018	0.827	1.722	0.039	1.761
423	Religious organizations	0.860	0.070	0.930	1.531	0.125	1.656
424	Grantmaking, giving, and social advocacy organizations	0.807	0.050	0.858	3.527	0.219	3.746
425	Civic, social, professional, and similar organizations	0.905	0.049	0.954	2.578	0.139	2.716
426	Private households	1.333	0.020	1.353	1.333	0.020	1.353
427	Postal service	1.100	0.027	1.127	1.581	0.039	1.620
428	Federal electric utilities	0.000	0.000	0.000	1.000	0.000	1.000
429	Other Federal Government enterprises	1.207	0.020	1.227	1.424	0.024	1.448
430	State and local government passenger transit	0.418	0.024	0.442	14.168	0.820	14.987
431	State and local government electric utilities	0.372	0.009	0.381	1.337	0.034	1.370
432	Other state and local government enterprises	0.681	0.030	0.711	2.002	0.088	2.090

Table B12
Multiregional Labor Income Multiplier Effects and Multipliers

Code	IMPLAN Sector	Labor Income Multiplier Effects			Labor Income Multipliers		
		Linn County	Rest of Iowa	State of Iowa	Linn County	Rest of Iowa	State of Iowa
1	Oilseed farming	0.200	0.025	0.225	1.780	0.222	2.001
2	Grain farming	0.168	0.020	0.188	1.742	0.204	1.947
3	Vegetable and melon farming	0.351	0.036	0.387	1.492	0.154	1.646
4	Fruit farming	0.353	0.056	0.409	1.532	0.243	1.775
5	Tree nut farming	0.354	0.028	0.381	1.373	0.108	1.481
6	Greenhouse, nursery, and floriculture production	0.456	0.029	0.485	1.372	0.087	1.459
7	Tobacco farming	0.000	0.000	0.000	1.000	0.000	1.000
8	Cotton farming	0.000	0.000	0.000	1.000	0.000	1.000
9	Sugarcane and sugar beet farming	0.000	0.000	0.000	1.000	0.000	1.000
10	All other crop farming	0.266	0.031	0.297	1.689	0.194	1.883
11	Cattle ranching and farming	0.125	0.014	0.139	3.740	0.412	4.153
12	Dairy cattle and milk production	0.109	0.017	0.127	4.144	0.657	4.802
13	Poultry and egg production	0.209	0.026	0.235	2.204	0.275	2.479
14	Animal production, except cattle and poultry and eggs	0.116	0.018	0.134	2.359	0.358	2.717
15	Forest nurseries, forest products, and timber tracts	0.000	0.000	0.000	1.000	0.000	1.000
16	Logging	0.000	0.000	0.000	1.000	0.000	1.000
17	Fishing	0.000	0.000	0.000	1.000	0.000	1.000
18	Hunting and trapping	0.213	0.014	0.227	4.049	0.266	4.314
19	Support activities for agriculture and forestry	1.223	0.016	1.239	1.263	0.017	1.280
20	Oil and gas extraction	0.197	0.026	0.223	6.858	0.910	7.768
21	Coal mining	0.000	0.000	0.000	1.000	0.000	1.000
22	Iron ore mining	0.000	0.000	0.000	1.000	0.000	1.000
23	Copper, nickel, lead, and zinc mining	0.000	0.000	0.000	1.000	0.000	1.000
24	Gold, silver, and other metal ore mining	0.000	0.000	0.000	1.000	0.000	1.000
25	Stone mining and quarrying	0.474	0.020	0.494	1.417	0.061	1.478
26	Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	0.531	0.018	0.549	1.387	0.048	1.435
27	Other nonmetallic mineral mining and quarrying	0.000	0.000	0.000	1.000	0.000	1.000
28	Drilling oil and gas wells	0.169	0.012	0.181	1.897	0.135	2.032
29	Support activities for oil and gas operations	0.000	0.000	0.000	1.000	0.000	1.000
30	Support activities for other mining	0.000	0.000	0.000	1.000	0.000	1.000
31	Electric power generation, transmission, and distribution	0.277	0.006	0.283	1.320	0.027	1.347
32	Natural gas distribution	0.000	0.000	0.000	1.000	0.000	1.000
33	Water, sewage and other systems	0.631	0.010	0.641	1.454	0.024	1.477
34	Construction of new nonresidential commercial and health care structures	0.543	0.021	0.564	1.471	0.057	1.528
35	Construction of new nonresidential manufacturing structures	0.507	0.016	0.523	1.438	0.045	1.483
36	Construction of other new nonresidential structures	0.602	0.020	0.622	1.485	0.050	1.535
37	Construction of new residential permanent	0.625	0.027	0.652	1.514	0.066	1.581

	site single- and multi-family structures						
38	Construction of other new residential structures	0.536	0.025	0.561	1.653	0.077	1.731
39	Maintenance and repair construction of nonresidential maintenance and repair	0.791	0.020	0.812	1.342	0.034	1.376
40	Maintenance and repair construction of residential structures	0.561	0.023	0.584	1.391	0.056	1.447
41	Dog and cat food manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
42	Other animal food manufacturing	0.165	0.025	0.190	2.172	0.333	2.505
43	Flour milling and malt manufacturing	0.199	0.036	0.235	2.942	0.529	3.472
44	Wet corn milling	0.175	0.033	0.208	3.367	0.637	4.004
45	Soybean and other oilseed processing	0.076	0.054	0.131	3.251	2.312	5.563
46	Fats and oils refining and blending	0.000	0.000	0.000	1.000	0.000	1.000
47	Breakfast cereal manufacturing	0.180	0.025	0.204	1.757	0.242	1.999
48	Sugar cane mills and refining	0.000	0.000	0.000	1.000	0.000	1.000
49	Beet sugar manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
50	Chocolate and confectionery manufacturing from cacao beans	0.000	0.000	0.000	1.000	0.000	1.000
51	Confectionery manufacturing from purchased chocolate	0.241	0.032	0.273	1.728	0.227	1.955
52	Nonchocolate confectionery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
53	Frozen food manufacturing	0.310	0.032	0.342	1.697	0.173	1.870
54	Fruit and vegetable canning, pickling, and drying	0.000	0.000	0.000	1.000	0.000	1.000
55	Fluid milk and butter manufacturing	0.194	0.030	0.224	2.565	0.398	2.963
56	Cheese manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
57	Dry, condensed, and evaporated dairy product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
58	Ice cream and frozen dessert manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
59	Animal (except poultry) slaughtering, rendering, and processing	0.000	0.000	0.000	1.000	0.000	1.000
60	Poultry processing	0.000	0.000	0.000	1.000	0.000	1.000
61	Seafood product preparation and packaging	0.000	0.000	0.000	1.000	0.000	1.000
62	Bread and bakery product manufacturing	0.387	0.031	0.418	1.678	0.134	1.812
63	Cookie, cracker, and pasta manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
64	Tortilla manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
65	Snack food manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
66	Coffee and tea manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
67	Flavoring syrup and concentrate manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
68	Seasoning and dressing manufacturing	0.221	0.027	0.248	1.912	0.235	2.147
69	All other food manufacturing	0.355	0.027	0.382	1.648	0.126	1.774
70	Soft drink and ice manufacturing	0.179	0.022	0.201	1.864	0.228	2.093
71	Breweries	0.000	0.000	0.000	1.000	0.000	1.000
72	Wineries	0.000	0.000	0.000	1.000	0.000	1.000
73	Distilleries	0.000	0.000	0.000	1.000	0.000	1.000
74	Tobacco product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
75	Fiber, yarn, and thread mills	0.000	0.000	0.000	1.000	0.000	1.000
76	Broadwoven fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
77	Narrow fabric mills and schiffli machine embroidery	0.000	0.000	0.000	1.000	0.000	1.000

78	Nonwoven fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
79	Knit fabric mills	0.000	0.000	0.000	1.000	0.000	1.000
80	Textile and fabric finishing mills	0.333	0.015	0.348	1.559	0.072	1.632
81	Fabric coating mills	0.000	0.000	0.000	1.000	0.000	1.000
82	Carpet and rug mills	0.000	0.000	0.000	1.000	0.000	1.000
83	Curtain and linen mills	0.348	0.011	0.359	1.427	0.046	1.473
84	Textile bag and canvas mills	0.376	0.018	0.394	1.504	0.071	1.575
85	All other textile product mills	0.278	0.015	0.293	1.607	0.087	1.694
86	Apparel knitting mills	0.000	0.000	0.000	1.000	0.000	1.000
87	Cut and sew apparel contractors	0.000	0.000	0.000	1.000	0.000	1.000
88	Men's and boys' cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
89	Women's and girls' cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
90	Other cut and sew apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
91	Apparel accessories and other apparel manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
92	Leather and hide tanning and finishing	0.000	0.000	0.000	1.000	0.000	1.000
93	Footwear manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
94	Other leather and allied product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
95	Sawmills and wood preservation	0.319	0.043	0.363	1.642	0.224	1.866
96	Veneer and plywood manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
97	Engineered wood member and truss manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
98	Reconstituted wood product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
99	Wood windows and doors and millwork	0.437	0.044	0.482	1.499	0.152	1.651
100	Wood container and pallet manufacturing	0.348	0.035	0.383	1.582	0.159	1.741
101	Manufactured home (mobile home) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
102	Prefabricated wood building manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
103	All other miscellaneous wood product manufacturing	0.315	0.043	0.357	2.052	0.280	2.332
104	Pulp mills	0.000	0.000	0.000	1.000	0.000	1.000
105	Paper mills	0.000	0.000	0.000	1.000	0.000	1.000
106	Paperboard Mills	0.000	0.000	0.000	1.000	0.000	1.000
107	Paperboard container manufacturing	0.363	0.017	0.380	1.542	0.071	1.613
108	Coated and laminated paper, packaging paper and plastics film manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
109	All other paper bag and coated and treated paper manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
110	Stationery product manufacturing	0.332	0.021	0.353	1.636	0.103	1.739
111	Sanitary paper product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
112	All other converted paper product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
113	Printing	0.468	0.016	0.484	1.475	0.051	1.526
114	Support activities for printing	0.711	0.019	0.730	1.387	0.036	1.423
115	Petroleum refineries	0.000	0.000	0.000	1.000	0.000	1.000
116	Asphalt paving mixture and block manufacturing	0.292	0.019	0.311	1.343	0.088	1.431
117	Asphalt shingle and coating materials manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

118	Petroleum lubricating oil and grease manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
119	All other petroleum and coal products manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
120	Petrochemical manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
121	Industrial gas manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
122	Synthetic dye and pigment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
123	Alkalies and chlorine manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
124	Carbon black manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
125	All other basic inorganic chemical manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
126	Other basic organic chemical manufacturing	0.102	0.012	0.114	2.509	0.285	2.794
127	Plastics material and resin manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
128	Synthetic rubber manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
129	Artificial and synthetic fibers and filaments manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
130	Fertilizer manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
131	Pesticide and other agricultural chemical manufacturing	0.127	0.022	0.149	2.295	0.395	2.690
132	Medicinal and botanical manufacturing	0.293	0.025	0.318	1.589	0.135	1.725
133	Pharmaceutical preparation manufacturing	0.183	0.026	0.210	2.271	0.327	2.598
134	In-vitro diagnostic substance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
135	Biological product (except diagnostic) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
136	Paint and coating manufacturing	0.226	0.020	0.245	1.530	0.133	1.663
137	Adhesive manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
138	Soap and cleaning compound manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
139	Toilet preparation manufacturing	0.181	0.026	0.207	2.343	0.335	2.678
140	Printing ink manufacturing	0.177	0.021	0.198	1.587	0.189	1.776
141	All other chemical product and preparation manufacturing	0.198	0.025	0.223	1.735	0.222	1.957
142	Plastics packaging materials and unlaminated film and sheet manufacturing	0.264	0.009	0.273	1.383	0.049	1.432
143	Unlaminated plastics profile shape manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
144	Plastics pipe and pipe fitting manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
145	Laminated plastics plate, sheet (except packaging), and shape manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
146	Polystyrene foam product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
147	Urethane and other foam product (except polystyrene) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
148	Plastics bottle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
149	Other plastics product manufacturing	0.337	0.014	0.351	1.438	0.059	1.497
150	Tire manufacturing	0.347	0.014	0.361	1.523	0.060	1.583
151	Rubber and plastics hoses and belting manufacturing	0.397	0.014	0.411	1.362	0.048	1.410
152	Other rubber product manufacturing	0.274	0.017	0.291	1.670	0.103	1.773
153	Pottery, ceramics, and plumbing fixture manufacturing	0.398	0.026	0.424	1.524	0.101	1.625
154	Brick, tile, and other structural clay product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
155	Clay and nonclay refractory manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
156	Flat glass manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

157	Other pressed and blown glass and glassware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
158	Glass container manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
159	Glass product manufacturing made of purchased glass	0.000	0.000	0.000	1.000	0.000	1.000
160	Cement manufacturing	0.241	0.015	0.256	2.197	0.135	2.332
161	Ready-mix concrete manufacturing	0.342	0.039	0.381	1.791	0.205	1.996
162	Concrete pipe, brick, and block manufacturing	0.375	0.028	0.403	1.562	0.115	1.677
163	Other concrete product manufacturing	0.408	0.029	0.438	1.516	0.109	1.625
164	Lime and gypsum product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
165	Abrasive product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
166	Cut stone and stone product manufacturing	0.526	0.025	0.551	1.505	0.072	1.577
167	Ground or treated mineral and earth manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
168	Mineral wool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
169	Miscellaneous nonmetallic mineral products	0.000	0.000	0.000	1.000	0.000	1.000
170	Iron and steel mills and ferroalloy manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
171	Steel product manufacturing from purchased steel	0.000	0.000	0.000	1.000	0.000	1.000
172	Alumina refining and primary aluminum production	0.000	0.000	0.000	1.000	0.000	1.000
173	Secondary smelting and alloying of aluminum	0.000	0.000	0.000	1.000	0.000	1.000
174	Aluminum product manufacturing from purchased aluminum	0.000	0.000	0.000	1.000	0.000	1.000
175	Primary smelting and refining of copper	0.000	0.000	0.000	1.000	0.000	1.000
176	Primary smelting and refining of nonferrous metal (except copper and aluminum)	0.000	0.000	0.000	1.000	0.000	1.000
177	Copper rolling, drawing, extruding and alloying	0.148	0.009	0.157	2.161	0.130	2.291
178	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	0.000	0.000	0.000	1.000	0.000	1.000
179	Ferrous metal foundries	0.000	0.000	0.000	1.000	0.000	1.000
180	Nonferrous metal foundries	0.000	0.000	0.000	1.000	0.000	1.000
181	All other forging, stamping, and sintering	0.300	0.016	0.316	1.776	0.095	1.871
182	Custom roll forming	0.000	0.000	0.000	1.000	0.000	1.000
183	Crown and closure manufacturing and metal stamping	0.390	0.016	0.406	1.469	0.061	1.530
184	Cutlery, utensil, pot, and pan manufacturing	0.298	0.014	0.312	1.488	0.069	1.557
185	Handtool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
186	Plate work and fabricated structural product manufacturing	0.351	0.019	0.370	1.552	0.083	1.635
187	Ornamental and architectural metal products manufacturing	0.380	0.019	0.399	1.557	0.076	1.633
188	Power boiler and heat exchanger manufacturing	0.307	0.016	0.323	1.594	0.081	1.675
189	Metal tank (heavy gauge) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
190	Metal can, box, and other metal container (light gauge) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
191	Ammunition manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
192	Arms, ordnance, and accessories manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

193	Hardware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
194	Spring and wire product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
195	Machine shops	0.518	0.020	0.539	1.414	0.055	1.469
196	Turned product and screw, nut, and bolt manufacturing	0.410	0.018	0.428	1.433	0.064	1.497
197	Coating, engraving, heat treating and allied activities	0.335	0.015	0.351	1.536	0.070	1.607
198	Valve and fittings other than plumbing	0.313	0.015	0.328	1.546	0.075	1.621
199	Plumbing fixture fitting and trim manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
200	Ball and roller bearing manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
201	Fabricated pipe and pipe fitting manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
202	Other fabricated metal manufacturing	0.353	0.017	0.370	1.449	0.069	1.518
203	Farm machinery and equipment manufacturing	0.230	0.019	0.249	1.848	0.149	1.997
204	Lawn and garden equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
205	Construction machinery manufacturing	0.207	0.020	0.228	1.928	0.190	2.118
206	Mining and oil and gas field machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
207	Other industrial machinery manufacturing	0.407	0.021	0.429	1.496	0.079	1.575
208	Plastics and rubber industry machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
209	Semiconductor machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
210	Vending, commercial, industrial, and office machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
211	Optical instrument and lens manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
212	Photographic and photocopying equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
213	Other commercial and service industry machinery manufacturing	0.306	0.019	0.324	1.611	0.099	1.710
214	Air purification and ventilation equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
215	Heating equipment (except warm air furnaces) manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
216	Air conditioning, refrigeration, and warm air heating equipment manufacturing	0.247	0.019	0.266	1.748	0.137	1.885
217	Industrial mold manufacturing	0.628	0.021	0.649	1.392	0.047	1.439
218	Metal cutting and forming machine tool manufacturing	0.442	0.022	0.465	1.492	0.075	1.567
219	Special tool, die, jig, and fixture manufacturing	0.640	0.024	0.664	1.336	0.050	1.386
220	Cutting tool and machine tool accessory manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
221	Rolling mill and other metalworking machinery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
222	Turbine and turbine generator set units manufacturing	0.240	0.015	0.255	2.168	0.132	2.300
223	Speed changer, industrial high-speed drive, and gear manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
224	Mechanical power transmission equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
225	Other engine equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
226	Pump and pumping equipment manufacturing	0.324	0.020	0.344	1.584	0.099	1.683
227	Air and gas compressor manufacturing	0.000	0.000	0.000	1.000	0.000	1.000

228	Material handling equipment manufacturing	0.378	0.024	0.402	1.453	0.093	1.546
229	Power-driven handtool manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
230	Other general purpose machinery manufacturing	0.340	0.021	0.361	1.590	0.099	1.689
231	Packaging machinery manufacturing	0.467	0.020	0.487	1.437	0.063	1.500
232	Industrial process furnace and oven manufacturing	0.431	0.030	0.461	1.432	0.101	1.533
233	Fluid power process machinery	0.326	0.022	0.348	1.637	0.109	1.746
234	Electronic computer manufacturing	0.168	0.016	0.184	1.878	0.177	2.055
235	Computer storage device manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
236	Computer terminals and other computer peripheral equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
237	Telephone apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
238	Broadcast and wireless communications equipment	0.243	0.021	0.264	2.081	0.177	2.258
239	Other communications equipment manufacturing	0.249	0.026	0.275	1.907	0.203	2.110
240	Audio and video equipment manufacturing	0.243	0.019	0.262	2.537	0.202	2.739
241	Electron tube manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
242	Bare printed circuit board manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
243	Semiconductor and related device manufacturing	0.484	0.042	0.526	1.494	0.128	1.623
244	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
245	Electronic connector manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
246	Printed circuit assembly (electronic assembly) manufacturing	0.182	0.017	0.200	1.974	0.187	2.160
247	Other electronic component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
248	Electromedical and electrotherapeutic apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
249	Search, detection, and navigation instruments manufacturing	0.416	0.028	0.444	1.638	0.110	1.748
250	Automatic environmental control manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
251	Industrial process variable instruments manufacturing	0.547	0.028	0.576	1.387	0.072	1.459
252	Totalizing fluid meters and counting devices manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
253	Electricity and signal testing instruments manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
254	Analytical laboratory instrument manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
255	Irradiation apparatus manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
256	Watch, clock, and other measuring and controlling device manufacturing	0.304	0.026	0.330	1.752	0.150	1.902
257	Software, audio, and video media reproducing	0.000	0.000	0.000	1.000	0.000	1.000
258	Magnetic and optical recording media manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
259	Electric lamp bulb and part manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
260	Lighting fixture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
261	Small electrical appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
262	Household cooking appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
263	Household refrigerator and home freezer	0.000	0.000	0.000	1.000	0.000	1.000

	manufacturing						
264	Household laundry equipment manufacturing	0.368	0.019	0.387	1.361	0.069	1.430
265	Other major household appliance manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
266	Power, distribution, and specialty transformer manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
267	Motor and generator manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
268	Switchgear and switchboard apparatus manufacturing	0.313	0.016	0.329	1.448	0.074	1.522
269	Relay and industrial control manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
270	Storage battery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
271	Primary battery manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
272	Communication and energy wire and cable manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
273	Wiring device manufacturing	0.279	0.016	0.295	1.578	0.089	1.667
274	Carbon and graphite product manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
275	All other miscellaneous electrical equipment and component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
276	Automobile manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
277	Light truck and utility vehicle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
278	Heavy duty truck manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
279	Motor vehicle body manufacturing	0.299	0.024	0.323	1.506	0.122	1.628
280	Truck trailer manufacturing	0.359	0.024	0.383	1.527	0.102	1.629
281	Motor home manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
282	Travel trailer and camper manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
283	Motor vehicle parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
284	Aircraft manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
285	Aircraft engine and engine parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
286	Other aircraft parts and auxiliary equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
287	Guided missile and space vehicle manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
288	Propulsion units and parts for space vehicles and guided missiles	0.000	0.000	0.000	1.000	0.000	1.000
289	Railroad rolling stock manufacturing	0.229	0.021	0.250	1.603	0.150	1.753
290	Ship building and repairing	0.000	0.000	0.000	1.000	0.000	1.000
291	Boat building	0.000	0.000	0.000	1.000	0.000	1.000
292	Motorcycle, bicycle, and parts manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
293	Military armored vehicle, tank, and tank component manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
294	All other transportation equipment manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
295	Wood kitchen cabinet and countertop manufacturing	0.533	0.026	0.559	1.581	0.077	1.658
296	Upholstered household furniture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
297	Nonupholstered wood household furniture manufacturing	0.438	0.026	0.464	1.467	0.087	1.554
298	Metal and other household furniture (except wood) manufacturing1	0.266	0.016	0.283	1.679	0.103	1.783
299	Institutional furniture manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
300	Wood television, radio, and sewing machine cabinet manufacturing1	0.445	0.015	0.460	1.413	0.048	1.460

301	Office furniture and custom architectural woodwork and millwork manufacturing1	0.380	0.018	0.398	1.500	0.073	1.572
302	Showcase, partition, shelving, and locker manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
303	Mattress manufacturing	0.280	0.019	0.300	1.637	0.113	1.750
304	Blind and shade manufacturing	0.266	0.024	0.289	1.923	0.173	2.096
305	Surgical and medical instrument manufacturing	0.357	0.020	0.376	1.741	0.097	1.838
306	Surgical appliance and supplies manufacturing	0.451	0.021	0.472	1.450	0.067	1.517
307	Dental equipment and supplies manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
308	Ophthalmic goods manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
309	Dental laboratories	0.814	0.020	0.833	1.297	0.031	1.328
310	Jewelry and silverware manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
311	Sporting and athletic goods manufacturing	0.441	0.023	0.463	1.455	0.075	1.530
312	Doll, toy, and game manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
313	Office supplies (except paper) manufacturing	0.458	0.017	0.475	1.403	0.052	1.455
314	Sign manufacturing	0.658	0.020	0.678	1.337	0.040	1.377
315	Gasket, packing, and sealing device manufacturing	0.588	0.019	0.607	1.338	0.043	1.380
316	Musical instrument manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
317	All other miscellaneous manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
318	Broom, brush, and mop manufacturing	0.000	0.000	0.000	1.000	0.000	1.000
319	Wholesale trade	0.558	0.020	0.577	1.476	0.052	1.528
320	Retail - Motor vehicle and parts	0.771	0.017	0.787	1.348	0.029	1.377
321	Retail - Furniture and home furnishings	0.584	0.018	0.602	1.478	0.046	1.523
322	Retail - Electronics and appliances	0.788	0.019	0.807	1.352	0.032	1.384
323	Retail - Building material and garden supply	0.587	0.017	0.604	1.463	0.042	1.505
324	Retail - Food and beverage	0.612	0.018	0.630	1.462	0.043	1.505
325	Retail - Health and personal care	0.646	0.014	0.660	1.384	0.031	1.415
326	Retail - Gasoline stations	0.456	0.014	0.469	1.515	0.046	1.561
327	Retail - Clothing and clothing accessories	0.491	0.015	0.506	1.524	0.047	1.571
328	Retail - Sporting goods, hobby, book and music	0.570	0.015	0.586	1.519	0.041	1.560
329	Retail - General merchandise	0.629	0.018	0.647	1.442	0.040	1.482
330	Retail - Miscellaneous	0.712	0.014	0.726	1.370	0.027	1.396
331	Retail - Nonstore	0.344	0.012	0.356	1.628	0.058	1.685
332	Air transportation	0.305	0.020	0.324	1.748	0.113	1.862
333	Rail transportation	0.417	0.012	0.430	1.653	0.049	1.703
334	Water transportation	0.353	0.042	0.395	1.771	0.212	1.983
335	Truck transportation	0.557	0.016	0.573	1.597	0.046	1.643
336	Transit and ground passenger transportation	0.656	0.020	0.676	1.305	0.041	1.346
337	Pipeline transportation	0.000	0.000	0.000	1.000	0.000	1.000
338	Scenic and sightseeing transportation and support activities for transportation	0.885	0.014	0.899	1.259	0.019	1.278
339	Couriers and messengers	0.593	0.012	0.606	1.331	0.027	1.358
340	Warehousing and storage	0.768	0.016	0.784	1.300	0.027	1.328
341	Newspaper publishers	0.554	0.028	0.582	1.330	0.068	1.398
342	Periodical publishers	0.465	0.021	0.485	1.649	0.074	1.722

343	Book publishers	0.394	0.020	0.414	2.013	0.101	2.113
344	Directory, mailing list, and other publishers	0.319	0.014	0.333	1.847	0.082	1.930
345	Software publishers	0.459	0.022	0.481	1.944	0.092	2.036
346	Motion picture and video industries	0.355	0.030	0.384	2.354	0.199	2.553
347	Sound recording industries	0.236	0.014	0.251	11.004	0.671	11.675
348	Radio and television broadcasting	0.681	0.027	0.708	1.406	0.055	1.461
349	Cable and other subscription programming	0.000	0.000	0.000	1.000	0.000	1.000
350	Internet publishing and broadcasting	0.169	0.016	0.184	3.942	0.371	4.313
351	Telecommunications	0.341	0.011	0.352	2.261	0.076	2.337
352	Data processing, hosting, and related services	0.508	0.022	0.530	1.649	0.073	1.721
353	Other information services	0.000	0.000	0.000	1.000	0.000	1.000
354	Monetary authorities and depository credit intermediation	0.426	0.015	0.441	1.560	0.055	1.615
355	Nondepository credit intermediation and related activities	0.590	0.025	0.614	1.486	0.062	1.548
356	Securities, commodity contracts, investments, and related activities	0.648	0.038	0.686	1.691	0.098	1.789
357	Insurance carriers	0.434	0.066	0.500	1.630	0.248	1.878
358	Insurance agencies, brokerages, and related activities	0.656	0.038	0.694	1.505	0.087	1.592
359	Funds, trusts, and other financial vehicles	0.321	0.045	0.365	7.238	1.005	8.243
360	Real estate	0.269	0.006	0.275	1.607	0.036	1.643
361	Imputed rental value for owner-occupied dwellings	0.117	0.009	0.125	#DIV/0!	#DIV/0!	#DIV/0!
362	Automotive equipment rental and leasing	0.441	0.029	0.470	1.846	0.119	1.965
363	General and consumer goods rental except video tapes and discs	0.826	0.028	0.854	1.362	0.047	1.408
364	Video tape and disc rental	0.520	0.035	0.555	1.604	0.107	1.710
365	Commercial and industrial machinery and equipment rental and leasing	0.467	0.034	0.501	1.940	0.142	2.082
366	Lessors of nonfinancial intangible assets	0.186	0.009	0.195	3.263	0.154	3.418
367	Legal services	0.701	0.015	0.716	1.442	0.030	1.472
368	Accounting, tax preparation, bookkeeping, and payroll services	0.749	0.016	0.765	1.408	0.030	1.438
369	Architectural, engineering, and related services	0.819	0.015	0.834	1.438	0.026	1.464
370	Specialized design services	0.564	0.014	0.578	1.601	0.041	1.642
371	Custom computer programming services	0.842	0.012	0.854	1.400	0.020	1.420
372	Computer systems design services	1.195	0.018	1.213	1.288	0.019	1.307
373	Other computer related services, including facilities management	0.793	0.015	0.808	1.339	0.025	1.364
374	Management, scientific, and technical consulting services	0.717	0.018	0.735	1.498	0.038	1.536
375	Environmental and other technical consulting services	0.740	0.017	0.757	1.467	0.034	1.500
376	Scientific research and development services	0.702	0.018	0.720	1.573	0.041	1.614
377	Advertising and related services	0.557	0.021	0.579	1.658	0.064	1.721
378	Photographic services	0.496	0.015	0.511	1.686	0.053	1.739
379	Veterinary services	0.554	0.015	0.568	1.446	0.038	1.484
380	All other miscellaneous professional, scientific, and technical services	0.270	0.018	0.289	2.694	0.184	2.877

381	Management of companies and enterprises	0.651	0.018	0.669	1.529	0.041	1.570
382	Employment services	0.926	0.018	0.944	1.321	0.025	1.347
383	Travel arrangement and reservation services	0.474	0.015	0.489	1.645	0.051	1.696
384	Office administrative services	0.743	0.014	0.757	1.386	0.026	1.412
385	Facilities support services	0.686	0.020	0.706	1.607	0.046	1.654
386	Business support services	0.672	0.014	0.686	1.492	0.031	1.524
387	Investigation and security services	0.792	0.014	0.806	1.360	0.023	1.384
388	Services to buildings and dwellings	0.603	0.010	0.613	1.386	0.023	1.409
389	Other support services	0.468	0.012	0.480	1.547	0.040	1.587
390	Waste management and remediation services	0.448	0.024	0.472	1.732	0.094	1.825
391	Elementary and secondary schools	0.777	0.013	0.790	1.355	0.022	1.377
392	Junior colleges, colleges, universities, and professional schools	0.684	0.015	0.699	1.395	0.031	1.425
393	Other educational services	0.630	0.018	0.648	1.520	0.044	1.564
394	Offices of physicians, dentists, and other health practitioners	0.800	0.013	0.813	1.336	0.022	1.358
395	Home health care services	0.766	0.013	0.779	1.331	0.022	1.353
396	Medical and diagnostic labs and outpatient and other ambulatory care services	0.531	0.012	0.543	1.493	0.034	1.527
397	Hospitals	0.671	0.016	0.687	1.431	0.034	1.466
398	Nursing and residential care facilities	0.928	0.015	0.943	1.291	0.021	1.312
399	Child day care services	0.544	0.021	0.565	1.460	0.057	1.517
400	Individual and family services	0.773	0.023	0.797	1.360	0.041	1.400
401	Community food, housing, and other relief services, including rehabilitation services	0.883	0.019	0.903	1.400	0.031	1.430
402	Performing arts companies	0.732	0.037	0.768	1.477	0.074	1.551
403	Spectator sports	0.524	0.047	0.571	1.612	0.146	1.759
404	Promoters of performing arts and sports and agents for public figures	0.477	0.029	0.506	2.092	0.126	2.218
405	Independent artists, writers, and performers	0.784	0.017	0.801	1.348	0.029	1.377
406	Museums, historical sites, zoos, and parks	0.760	0.018	0.779	1.385	0.034	1.419
407	Fitness and recreational sports centers	0.701	0.027	0.728	1.461	0.056	1.517
408	Bowling centers	0.481	0.021	0.502	1.872	0.081	1.954
409	Amusement parks, arcades, and gambling industries	0.347	0.017	0.364	2.233	0.109	2.342
410	Other amusement and recreation industries	0.408	0.023	0.431	2.013	0.113	2.126
411	Hotels and motels, including casino hotels	0.515	0.017	0.532	1.591	0.051	1.642
412	Other accommodations	0.578	0.019	0.597	1.624	0.053	1.677
413	Food services and drinking places	0.486	0.020	0.505	1.534	0.062	1.597
414	Automotive repair and maintenance, except car washes	0.561	0.016	0.577	1.418	0.041	1.460
415	Car washes	0.501	0.015	0.516	1.511	0.045	1.556
416	Electronic and precision equipment repair and maintenance	0.496	0.012	0.508	1.435	0.035	1.470
417	Commercial and industrial machinery and equipment repair and maintenance	0.432	0.012	0.445	1.427	0.040	1.467
418	Personal and household goods repair and maintenance	0.472	0.014	0.486	1.461	0.042	1.503
419	Personal care services	0.576	0.016	0.592	1.508	0.042	1.550
420	Death care services	0.700	0.028	0.728	1.400	0.055	1.455

421	Dry-cleaning and laundry services	0.657	0.014	0.671	1.329	0.028	1.358
422	Other personal services	0.349	0.012	0.361	2.276	0.080	2.356
423	Religious organizations	0.395	0.049	0.444	1.792	0.223	2.014
424	Grantmaking, giving, and social advocacy organizations	0.888	0.030	0.918	1.608	0.054	1.662
425	Civic, social, professional, and similar organizations	0.905	0.029	0.934	1.499	0.048	1.546
426	Private households	1.052	0.012	1.064	1.205	0.014	1.219
427	Postal service	0.978	0.016	0.994	1.298	0.021	1.319
428	Federal electric utilities	0.000	0.000	0.000	1.000	0.000	1.000
429	Other Federal Government enterprises	1.000	0.012	1.012	1.238	0.015	1.253
430	State and local government passenger transit	0.778	0.015	0.794	1.406	0.027	1.433
431	State and local government electric utilities	0.207	0.006	0.213	1.330	0.037	1.367
432	Other state and local government enterprises	0.466	0.018	0.484	1.791	0.069	1.860

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINAL

APPENDIX S
STATEMENT OF FINDINGS

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

STATEMENT OF FINDINGS

I. PROJECT DESCRIPTION

1. This statement concerns a proposal by the Rock Island District, U.S. Army Corps of Engineers to construct a levee and floodwall system in Cedar Rapids, Linn County, Iowa. This project would reduce the existing and future flood risk and damages to public and private infrastructure and facilities in the City of Cedar Rapids from the Cedar River. This would be accomplished by implementing the National Economic Development Plan (Alternative 4C). This alternative reduces flood risk on the east side of the Cedar River in downtown Cedar Rapids which includes a majority of the commercial and industrial structures in the downtown area with a levee and floodwall system.

2. An Environmental Assessment (EA) addressing the impacts of the proposed project has been prepared by the District, Economic and Environmental Analysis Branch, in compliance with the National Environmental Policy Act. This EA was prepared and is included/integrated within the report entitled *Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project, and Feasibility Study Report with Integrated Environmental Assessment*, dated August 2010, hereafter referred to as Study. This Study was circulated for public review from August 30, 2010 to September 30, 2010. A Programmatic Memorandum of Agreement has been executed for the protection of historic properties and compliance with the National Historic Preservation Act and is attached to this Statement of Findings.

II. PUBLIC INTEREST REVIEW

Joint Public Notice CEMVR-OD-P-2010-0096 was issued for this project in compliance with the Clean Water Act on September 8, 2010 and expired on September 22, 2010.

The draft Study was distributed to the public for a 30-day review period on or about August 30, 2010.

A Public Meeting was held in Cedar Rapids on September 21, 2010 answering questions and soliciting written public comments.

III. PUBLIC REVIEW COMMENTS

The following is a list, summarizing the comments received during the review period for the Public Notice, the Study, and/or the Public Meeting. Generally, they appear in the order in which they were received, and each is followed by the District response. A copy of each letter is attached to this package.

1. An electronic message was received from Mr. Frank King dated 8-31-2010

COMMENTS/CONCERNS

1. If the Corps builds a levee and flood protection system on the east side of the Cedar River, won't that force the water to the west side thereby increasing the incidence of damage to existing structures?

2. If Cedar Lake is so polluted that it is not worth protecting, will home owners risk those pollutants being carried into their homes during flood events? Did that happen in 2008? Since his home was damaged during the 2008 event, does it need to be demolished because of the hazardous waste from Cedar Lake?

RESPONSES

1. A levee can increase the water level of a stream by reducing the cross-sectional area available for water to flow downstream. It is rare that a levee reduces the capacity of the channel but can restrict the ability of the overbank area to convey water. For the slow moving and relatively flat rivers in Iowa this type of constriction increases the water surface level upstream of the location where the area is reduced. The State of Iowa has a rule concerning how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the 0.01 exceedance probability flood (a large flood that has 1 chance in 100 chances of occurring in any given year) cannot be increased more than 1 foot by any proposed levee. At specific locations this guidance is often computed ahead of time and published on FEMA flood Insurance maps. The area that can be encroached is designated as the flood fringe. The area that cannot be encroached is called the floodway. The floodway always includes the river and sometimes land on either side of the river. At Cedar Rapids the levee alternatives evaluated by the Corps of Engineers are all located in the flood fringe and do not enter into the floodway.

The actual increase in the water surface elevation depends upon the specific flood or the discharge. The increase in water surface elevation also depends upon how far up river the property is located. The farther upstream the property is located the less the increase. Eventually as one looks upstream the with-project water level returns to the without-project water level. Within the City of Cedar Rapids, average increases for various economic damage reaches with Alternative 4 (east levee only) appear in the Main Report, table 38, and in Appendix A, pages A-32 through A-34 and Plate A-1. Floods with 1 percent, 0.5 percent, and a 0.2 percent chance of occurring have respectively 1 in 100, 1 in 200 and a 1 in 500 chance of occurring in any given year. The flood of 2008 had a discharge of 140,000 cfs, which exceeds the 0.2 percent chance event.

The overtopping crest of the levee is about 140,000 cfs. Average increases in water surface elevation due to the levee or floodwall for Alternatives 1 and 1A and Alternative 4C over various economic damage reaches appear in table A-31. (Projects are also discussed in Appendix A under "With Project Impacts", pages A-33 to A-36.)

2. The determination as to whether or not protecting Cedar Lake is a viable alternative was based on several factors. The presence of pollutants was one of those factors. However, there was no further analysis to determine the extent of contaminants, associated risks, or cleanup costs. As part of the Study

the District is tasked with determining the presence of contaminants based on Phase I (research of available records) and, where possible, Phase II (sampling and analysis). For Cedar Lake, the District conducted a Phase I only. This Phase I revealed the historical presence of contaminants. As stated above, it was outside the Study scope to determine the specific risks of the concerned contaminants. Your concerns regarding contact with Cedar Lake water resulting from the 2008 event or potential future events should be addressed by the Iowa Department of Natural Resources or the Environmental Protection Agency Region 7 office.

2. Response to the Draft Study from John F. Doershuk, State Archaeologist dated 8-31-2010

COMMENT/CONCERN

Provided the District with several recommendations for verbiage changes to section 5.1.9. Cultural Resources.

RESPONSE

The recommended changes have been made in the main report.

3. Electronic message from the Iowalive dated 10-3-2010

COMMENTS/CONCERNS

1. At what flood crest level will the floodwall be overtopped. Can you choose the exact downtown location along the floodwall at your discretion.

2. How much higher will the water rise on the west side of the river as a result of the floodwall preventing water from flooding the east side?

3. Will the 100 and 500 year flood plains on the west side of the river be moved much closer to the river as a result of the floodwall? About how much closer?

4. Will the floodwall require recalculation of the 100 and 500 year flood plains on both sides of the river?

RESPONSES

1. The flood wall for Alternative 4C would first overtop at the downstream end near the Cargill plant (extend 19th Street into the river) at elevation 728.5 feet. If this elevation is transferred to the gage it would be elevation 733 feet (stage 31.5 feet).

2. A levee can increase the water level of a stream by reducing the cross-sectional area available for water to flow downstream. It is rare that a levee reduces the capacity of the channel but can restrict the ability of the overbank area to convey water. For the slow moving and relatively flat rivers in Iowa this type of constriction increases the water surface level upstream of the location where the area is reduced. The State of Iowa has a rule concerning how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the 0.01 exceedance probability flood (a large flood that has 1 chance in 100 chances of occurring in any given year) cannot be increased more than 1 foot by any proposed levee. At specific locations this guidance is often computed ahead of time and published on FEMA flood Insurance maps. The area that can be encroached is designated as the flood fringe. The area that cannot be encroached is called the floodway. The floodway always includes the river and sometimes land on either side of the river. At Cedar Rapids the levee alternatives evaluated by the Corps of Engineers are all located in the flood fringe and do not enter into the floodway.

The actual increase in the water surface elevation depends upon the specific flood or the discharge. The increase in water surface elevation also depends upon how far up river the property is located. The farther upstream the property is located the less the increase. Eventually as one looks upstream the with-project water level returns to the without-project water level. Within the City of Cedar Rapids, average increases for various economic damage reaches with Alternative 4 (east levee only) appear in the Main Report, table 38, and in Appendix A, pages A-32 through A-34 and Plate A-1. Floods with 1 percent, 0.5 percent, and a 0.2 percent chance of occurring have respectively 1 in 100, 1 in 200 and a 1 in 500 chance of occurring in any given year. The flood of 2008 had a discharge of 140,000 cfs, which exceeds the 0.2 percent chance event.

The overtopping crest of the levee is about 140,000 cfs. Average increases in water surface elevation due to the levee or floodwall for Alternatives 1 and 1A and Alternative 4C over various economic damage reaches appear in table A-31. (Projects are also discussed in Appendix A under "With Project Impacts", pages A-33 to A-36.)

3. The 100-year and 500-year flooded areas would increase in size, thus they would move away from the river. The east levee increases the 100-year around 0.1 to 0.2 feet so there would be a small increase in flooded area due to the project. Additionally, as part of this Study effort the flood flow frequency estimates and hydraulic model through Cedar Rapids were updated to include recent flood records and the current river geometry. This analysis resulted in improved estimates of the base (100-year) flood profile for existing conditions that the City may use to request a map revision from FEMA regardless of whether a project is constructed.

4. Yes. Changes in the Flood Insurance Rate Maps (FIRM) may result from this Study. If a levee(s) were constructed that provided protection against the base (100-year) flood, the FIRM would need to be updated to reflect this line of protection as well as any changes in the base flood profile that result from the project. Additionally, as part of this Study effort the flood flow frequency estimates and hydraulic model through Cedar Rapids were updated to include recent flood records and the current river geometry. This analysis resulted in improved estimates of the base (100-year) flood profile for existing conditions that the City may use to request a map revision from FEMA regardless of whether a project is constructed.

4. Electronic message from Sarah Furnish dated September 3, 2010

COMMENTS/CONCERN

1. Cedar Rapids citizens do not support the preferred plan.
2. Can't the already existing berm be raised and reinforced.

RESPONSES

1. None required.

2. The Corps of Engineers Feasibility Study Report evaluated many alternatives for flood damage reduction alignments on both the east and west sides of the Cedar River. Alternatives evaluated included alignments that followed the river's bankline as well as set back alignments further back from the river bankline. Many segments of the bankline alignments in the Study do follow existing levee and existing floodwall alignments that the City maintains. It should be noted that existing systems would need to be completely removed and rebuilt in order to meet Federal standards. Set back alignments contained within the Study, for the most part match the City's desired alignment as passed by City Council.

Specific to the Time Check neighborhood, alternatives containing river's edge alignments cannot impact land purchased with funds from the FEMA Hazard Mitigation Grant Program (HMGP). FEMA rules do not allow construction of a flood damage reduction project or protection of lands purchased with HMGP funds. Alignments evaluated through this area, therefore, had to be set back accordingly and could not be placed near the river's bankline.

None of the flood damage reduction alignments along the west side of the river met required economic criteria in order to establish a Federal interest. Economic justification was found for alternative alignments on the east side, out of which a Recommended Plan was identified. The local sponsor, City of Cedar Rapids, ultimately has the decision whether or not to proceed with the Recommended Plan (Alternative 4C).

5. Electronic message from Susan Corrigan dated September 6, 2010 (similar comments were submitted by Ms. Corrigan during the September 21, 2010 Public Meeting):

COMMENTS/CONCERNS

1. It is inequitable to have our government provide flood protection in this manner (east side levee/floodwall only) as it unfairly financially burdens west side businesses and residents.

2. Flood protection on the east side will only heighten the probability for additional flooding on the west side.

3. Scientific evidence shows that flooding is a real issue to contend with in Cedar Rapids due to a culmination of watershed issues, climate changes, and other environmental factors.

RESPONSES

1. The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

2. A levee can increase the water level of a stream by reducing the cross-sectional area available for water to flow downstream. It is rare that a levee reduces the capacity of the channel but can restrict the ability of the overbank area to convey water. For the slow moving and relatively flat rivers in Iowa this type of constriction increases the water surface level upstream of the location where the area is reduced. The State of Iowa has a rule concerning how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the 0.01 exceedance probability flood (a large flood

that has 1 chance in 100 chances of occurring in any given year) cannot be increased more than 1 foot by any proposed levee. At specific locations this guidance is often computed ahead of time and published on FEMA flood Insurance maps. The area that can be encroached is designated as the flood fringe. The area that cannot be encroached is called the floodway. The floodway always includes the river and sometimes land on either side of the river. At Cedar Rapids the levee alternatives evaluated by the Corps of Engineers are all located in the flood fringe and do not enter into the floodway.

The actual increase in the water surface elevation depends upon the specific flood or the discharge. The increase in water surface elevation also depends upon how far up river the property is located. The farther upstream the property is located the less the increase. Eventually as one looks upstream the with-project water level returns to the without-project water level. Within the City of Cedar Rapids, average increases for various economic damage reaches with Alternative 4 (east levee only) appear in the Main Report, table 38, and in Appendix A, pages A-32 through A-34 and Plate A-1. Floods with 1 percent, 0.5 percent, and a 0.2 percent chance of occurring have respectively 1 in 100, 1 in 200 and a 1 in 500 chance of occurring in any given year. The flood of 2008 had a discharge of 140,000 cfs, which exceeds the 0.2 percent chance event.

The overtopping crest of the levee is about 140,000 cfs. Average increases in water surface elevation due to the levee or floodwall for Alternatives 1 and 1A and Alternative 4C over various economic damage reaches appear in table A-31. (Projects are also discussed in Appendix A under "With Project Impacts", pages A-33 to A-36.)

3. Comment noted. The purpose of the study is to determine if the Corps can make a recommendation for Federal interest (i.e. the damages prevented by the project need to exceed the project costs).

6. Electronic message from the State Historical Society of Iowa, dated September 10, 2010

COMMENTS/CONCERNS

They list six bulleted conditions that, if any are met, will be the ONLY circumstance that will elicit a response. Otherwise, at the end of the 30-day review period, we may either proceed based on the finding or determination, or consult with the Advisory Council on Historic Preservation in lieu of the SHPO.

RESPONSE

None required.

7. Electronic message from Amy Homan dated September 15, 2010

COMMENTS/CONCERNS

1. Would the area near Quaker Oats (Cedar Lake) and Penford Products (8th Ave SW side) be protected. Protecting the existing industry on both sides of the river, including the Cedar Lake area would be of highest priority. These industrial businesses cannot be cost effectively moved and the City cannot afford to lose any additional business.

2. Relocating the residential sections, while it may be emotionally upsetting to some, appears to be the most cost effective measure to provide the river ample opportunity to spread out and slow flooding, should this happen again.

RESPONSES: 1. The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river; including the Penford Products facility. None of the west bank alternatives had a high enough BCR. The only alternative that meets the Corps selection criteria is Alternative 4C, and it protects only the east bank. Alternative 4C has a BCR of 1.15 and meets the BCR criteria. Penford would not be part of flood damage reduction, nor would Cedar Lake. Quaker Oats would be part of the flood damage reduction of Alternative 4C.
2. None required.

8. Electronic message from John Houck dated September 15, 2010

COMMENTS/CONCERNS

1. I am in favor of the "No Action Alternative." What is the benefit to protecting the east side against a flood comparable to the 2008 flood. Cedar Rapids may experience another flood producing a river level 2 feet higher than the 2008 flood. What then? Also, there is a lot of benefit to a "greenspace." I'm in favor of people building in areas where they will not be impacted by flooding.

2. The feasibility report which you've provided for review is overwhelming, difficult to read off a diskette, problematic to reprint so a hard copy may be obtained, overly technical, and probably an exorbitant expense for taxpayers. This presentation in the Cliff Notes format would have been acceptable.

RESPONSES

1. None required.

2. The Rock Island District acknowledges that the Main Report and Appendices were long and, at times very difficult to understand, given the technical nature of the subject. This is regrettable but necessary as we wanted to be transparent with the public and natural resource agencies by providing appropriate amount of information/data for a complete review. Upon request, Mr. Houck was provided with a hard copy of the Main Report for ease of reading versus reading/printing off a computer/diskette.

9. Electronic message from State Historical Society of Iowa, Dan K. Higginbottom dated September 15, 2010

COMMENT/CONCERN

They suggest seven minor changes in the main report regarding cultural/historical sections.

RESPONSE

Relevant suggested changes to the main report have been made.

10. Electronic message from Ashley L. Super dated September 19, 2010

COMMENTS/CONCERNS

1. What additional expert information would the Corps need to change its mind? How can/does politics enter into the equation? I recommend that the Corps let the ASA(CW) office do what it feels it must do, but <u>stand your ground on your own professional judgments</u>.

2. Many residents feel demonized by the City and have not had adequate representation in any of the processes revolving around recovery plans. Complaints from residents are that their concerns were totally ignored by the City and I am greatly concerned that the Corps did not hold its own independent meeting with residents.

3. The city is telling the residents that the Corps has approved the City's plan to tear down their homes for flood mitigation measures.

4. Where is the Watershed Plan mentioned on page 115 of the main report and how is it being implemented?

5. Many residents do not feel the voluntary property acquisition program mentioned on page 116 are voluntary by any definition of the word. It is my hope that the Federal government calls for a US special prosecutor to put a hold on the whole mess (how Federal and state recovery funds were actually spent) and to perform that investigation in front of a grand jury.

RESPONSES

1. The U.S. Army Corps of Engineers is the lead Federal flood control agency and as such it has considerable experience in the planning and design of flood control projects. Through an extensive series of reviews beginning in the early stages of the plan's development and continuing through to the completion of the final report the Corps experience is incorporated into the project. Information that is developed external to the Corps would need to meet the Corps strict technical standards. As has been stated at every public meeting the general public has been advised to write its Congressional delegation.

2. The Corps has conducted a number of Informational Meetings to explain the Corps planning process, update the public on project status and allow an opportunity for community feedback. The city participated in these meetings in its roll of the project's non-Federal sponsor.

3. The City has acquired properties damaged by the flood with funds provided by FEMA HMGP and HUD CDBG grants. A condition of the FEMA grant program is that the City coordinates with the Corps to determine if there are any current or proposed flood control programs in the buyout area. This coordination represents the extent of the Corps participation in the voluntary buyout program.

4. The Iowa Cedar River Basin Study is just now getting underway. See http://www2.mvr.usace.army.mil/projects/index.cfm.

5. The voluntary acquisition program, a City initiative using a combination of City, State and Federal funding, is outside the scope of this report.

11. Electronic message from David and Joyce Smithers dated September 19, 2010

COMMENT/CONCERN

I hope that the Army Corps refuses to be part of the war on the flood victims of Cedar Rapids. Rather, I would like the Corps to be part of a public works program that rebuilds the workers neighborhoods of Cedar Rapids, Iowa.

RESPONSE

Rebuilding neighborhoods is not within the authorities granted to the U.S. Army Corps of Engineers. The Corps is authorized to investigate, plan and determine the cost effectiveness of certain Federal flood risk management projects.

12. Electronic message from Greg Vail dated September 12, 2010

COMMENTS/CONCERNS

1. The City has forced people out of their homes. FEMA did not offer an "involuntary buyout." Under a "voluntary buyout": denying building permits qualifies as coercion, denying voluntary assistance is coercion, denying information for proper decisions is coercion, denying "Jumpstart" funding for rebuilding is coercion. The City set up "zones" and then discriminatorily treated homeowners in these "zones" differently than all other flood victims. The people in these "zones" are being treated with psychological warfare still today, and literally threatened to be "forced to move in the future." This is even though "eminent domain" cannot be declared in a "federal disaster area."

2. It would appear that FEMA is being defrauded by the City of Cedar Rapids. Homes are being declared "eminent threat", when they are not, so that the city can get FEMA to pay for the demolition cost of the home. Homes are being claimed as "asbestos and lead" contaminated, when they are not, and falsely reported so that money for abatement can be received and "eminent threat" can be declared falsely. "Eminent threat is an ordinance created by city staff, after the flood, so they could make this possible."

3. The City is attempting to build a floodwall that will put the existing, already rebuilt neighborhood, at greater risk for flooding. The City's "Preferred Plan" to build a floodwall on the NW side of Cedar Rapids shows a floodwall that stops short of the area where flooding starts in Cedar Rapids. Of the area north of this wall floods as the water moves south this floodwall becomes a divide that will literally channel the water to flood the surrounding neighborhood. The United States Army Corps of Engineers does not support the City's "Preferred Plan."

RESPONSES

1. These comments address issues that are not within the authorities granted to the U.S. Army Corps of Engineers. The Corps is authorized to investigate, plan and determine the cost effectiveness of certain Federal flood risk management projects. The comment is noted and should be directed to FEMA and the City.

2. These comments address issues that are not within the authorities granted to the U.S. Army Corps of Engineers. The Corps is authorized to investigate, plan and determine the cost effectiveness of certain Federal flood risk management projects. The comment is noted and should be directed to FEMA and the City.

3. Study alternatives address flood damage reduction on both sides of the Cedar River and are included in the report appendices. The City supports the U.S. Army Corps of Engineers' Recommended Plan 4C, as part of a comprehensive flood risk management plan for the Cedar River in Cedar Rapids. Due to a BCR of less than 1, the City's preferred levee/floodwall alignment (Alternative 1 or 1A) was not economically justified.

13. Electronic letter from the City of Cedar Rapids, Jeffery Pomeranz, City Manager, dated September 21, 2010

COMMENTS/CONCERNS

1. The report does not discuss enough of the consequences of the levee on the west side over 22 ft (1 percent flood) event.

2. Executive summary was not direct enough.

3. A one side strategy has significant economic consequences that are not fully noted in the report.

4. How does the report take into account the soils of the SE side and water boils.

5. The design phase needs to add discussion for the Sinclair site and any possible brown field items in that area.

6. Section 3.1.1 They are using 1991 FIRM Maps and says the 2010 is not approved. The City currently has 2010 approved FIRM Maps.

7. Section 3.1.4, under the Damage Reach Detail they have reach 1 in a different order than the rest. This is minor but the other reaches are easier to read.

8. The size of pumps mentioned in the report seems to be for a 1 or 2 year storm event, which would not be large enough.

9. Page 223 indicates that the levee footprint and construction area could impact as much as 24 acres of wetland in the backwater area. If Alternative 1C were implemented mitigation would be required to replace lost wetland functions. Has any area been identified for replacement.

10. Vacant.

11. Page 225 indicates that the Cedar River Trail would be realigned, which will provide a safer recreational trail route. How do people access the downtown from the realigned rivers edge Cedar River Trail.

12. Has the Linn County Trails Association been consulted?

13. On page 233 under 5.1.9, the first sentence of the third paragraph repeats "architectural" when it should say "archeological". Is the APE defined elsewhere in the report?

14. On page 263 the first complete sentence in the first paragraph uses the word "rick" instead of "risk".

15. Page 267 under coordination, was Linn County Trails included?

16. Are there openings and access to the Tree of Five Seasons located in the park space on the corner of 1st Avenue East and 1st Street NE?

17. It should be noted that the Parks and Recreation Department currently receives $165 per acre at Tuma Park which would be revenue lost if the area becomes a borrow site.

18. Can the trail alignment from Cedar Lake to 8th Avenue be integrated with the existing alignment to include an access through the floodwall/levee at its existing location at 7th Avenue SE.

19. How much space is planned between the trail and the flood wall?

20. Where does the funding come from for environmental remediation of properties in the proposed greenway and who is responsible for it.

RESPONSES

1. The 100-year and 500-year flooded areas would increase in size, thus they would move away from the river. The east levee increases the 100-year around 0.1 to 0.2 feet so there would be a small increase in flooded area due to the project. Additionally, as part of this Study effort the flood flow frequency estimates and hydraulic model through Cedar Rapids were updated to include recent flood records and the current river geometry. This analysis resulted in improved estimates of the base (100-year) flood profile for existing conditions that the City may use to request a map revision from FEMA regardless of whether a project is constructed.

2. The Executive Summary has been revised to focus on the key issues.

3. The Other Social Effects of protecting both sides of the river were considered as part of the study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank.

Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

4. At the SE side of the project along the proposed levee alignment for Alternative 4C, a total of nine borings (Borings B-25, B-26, B-27, B-28, B-29, B-30, B-38, B-40 and B-41) were not drilled.

Most of the borings in the SE portion of the project have not been drilled due to ROE reasons. Based on the subsurface information as revealed from the borings which have been drilled so far, shear strength parameters for the geotechnical analysis have been estimated. The values of these parameters are on the conservative side and are presented in the geotechnical appendix in the report (Appendix G). Additional borings will be obtained once the project reaches the project engineering and design phase. All borings will be analyzed and designs further developed in order to comply with required USACE standards to include through and under seepage.

5. The Sinclair site and other brownfield/HTRW sites are discussed on the HTRW Appendix (Appendix F). The HTRW appendix requires the HTRW sites to be addressed prior to Design/Construction phase.

6. 3.1.1. Floodplain. Prior to the 2008 event, the FEMA 1991 flood insurance rate map (FIRM) was used by the City to define the local floodplain (figure 4). The new FEMA Digital FIRM [(DFIRM)(dated April 5, 2010)] is shown in figure 5. Due to FEMA map production time constraints, the new FEMA map products do not include the USACE Study updated hydrology and hydraulic analysis. The Study collected new data to hydraulically model and develop the USACE 2010 Floodplain Delineation Maps which was used to define the existing conditions (figure 6). These maps are summarized and contrasted by damage reaches in tables 2 and 3. Generally, for the 100-year (1 percent chance event), 500 year (0.2 percent chance event), and greater than 500 year, the number of parcels and acreages increase from FEMA 1991 to USACE 2010. The increase in parcels and acreages can be directly attributed to the increase in the aerial extent of the floodplain delineations as more updated hydrologic and hydraulic information has became available.

7. Section 3.1.4 text has been revised so Reach 1 is described in the same order as the subsequent reaches.

8. Part of the analysis requires computing the interior flood elevation that has 1 chance in 100 of occurring. This is a blend of gravity and blocked gravity and does not equal the 100-yr storm.

However based upon the size of most of the outlet diameters at the river the culverts can pass the 100-year rainfall under gravity conditions (low river level) with minimal damage. This condition exists over 98 percent of the time (see Appendix A pages A-20 and A 27). This does not mean that streets will not flood. But it is a local responsibility to convey discharge from rainfall to the levee since the Federal government does not pay for upgrading storm sewers.

9. Potential wetland mitigation sites were not identified for any of the alternatives not part of the Recommended Plan. Wetland mitigation cost estimates for this project were assumed to come from a mitigation bank.

10. Vacant

11. The Recommended Plan, Alternative 4C, did not find Federal interest for a recreation component. The recreation alternative reviewed was to locate a trail on riverside of any new floodwalls and levees. Any trail system developed on the river side of a flood risk management system could access the downtown area through the closure structures at each street/sidewalk opening.

12. No direct coordination has taken place with the Linn County Trails Association.

13. On page 233 under 5.1.9, the first sentence of the third paragraph has been corrected to say "archeological". The Area of Potential Effect (APE) had been incorporated into two additional figures in the final report and they are Figures 79 and 80.

14. The spelling error has been corrected.

15. The proposed trail alignment shown in blue on C-101-4C-T was laid out as such to minimize costs by avoiding the addition of another closure structure.

16. No. Access, as currently laid out, would have to come through the closure structure at either 1st Avenue or the closure structure at the Five-in-One Dam. Additional review of access to this site and the dam/hydroelectric facility would need to be explored during the project engineering and design phase.

17. It has been noted.

18. Yes, this was alignment with a gate opening at the end of 7th Avenue SE is identified on plate C-103-4C-T in the Recreation Appendix Plates (Appendix M) and was analyzed as such in the Study.

19. Plate C-113-4C-T in the Recreation Appendix defined a preliminary distance of 10 feet between the face of the floodwall and edge of trail. This was a very preliminary layout in order to determine if there was Federal interest to cost share the recreation alternative. Economic analysis determined a benefit-cost-ratio less than 1 for the recreation alternative to construct a trail along the Cedar River, so no recreation alternative is recommended.

20. The Recommended Plan is located entirely on the east side of the Cedar River. No Federal interest was found in this Study for any work pertaining to the west side containing the proposed greenway.

14. Letter from Martin T. Smith dated September 21, 2010 and September 30, 2010

COMMENTS/CONCERNS

1. Mr. Smith lists numerous objections (and reasons for the objections) to the failure of the project to provide protection, in the form of a levee/floodwall system to the west side of the river.

2. He asks the Corps to change its recommendation in two ways: He would like to eliminate the roller gates at the 8th and 12th Avenue Bridges. He suggests eliminating the gates and taking the roads over the top of levees at these two locations and lists reasons supporting his suggestion.

3. Suggests moving the 4C levee alignment in the area of 14th Avenue NE and lists hydrologic reasons.

4. Asks the Corps to reconsider the alignment of 4C near Sinclair industrial site and lists several reasons why.

5. As the City and County have made citing decisions for repair or replacement of some of the damaged structures listed under "Damage Reach Details," Section 3.2.2 should have those decisions shown in the final report.

6. Suggests four errors of street names be changed in the final report.

7. In view of the likelihood that the trend in climate is creating increased probability of large floods in Iowa, I request that the level of flood protection for the Cedar Rapids project be based on the peak flow rate experienced in 2008 representing the 0.2% per year probability event.

8. In my previous comments, I advocated that the levee at 14th Avenue SE be moved farther from the river. In a conversation at the 21st September meeting, I came to believe that the 16th Avenue Bridge is a barrier that creates a noticeable fall in river level during large floods. If the northeast approach to the 16th Avenue Bridge were changed to a bridge higher than the levee, the floodway capacity would be increased in this area. Raising the East approach would not create additional river crossing capacity during floods, unless the West approach were also raised.

9. I have already advocated raising the East approaches and eliminating gates at 8th and 12th Avenues to allow access to the highest river crossings as long as possible during major floods. If 14th Avenue were also taken over the levee top, it would create a consistency for road crossings in the New Bohemia area. I ask you to consider this change.

RESPONSES

1. The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

2. Opportunities to completely eliminate closure structures by going up and over a line of protection are certainly desirable for any project if the benefit to cost exists. With no flood damage reduction proposed on the west side for the tentatively selected Federally Supportable Plan, the benefits to justify the additional costs associated with raising the east approach ramps at the 8th Avenue and 12th Avenue Bridges are very small and do not justify the substantial additional cost.

3. Further refinement of the Alternative 4C alignment will take place throughout the entire corridor during the project engineering and design phase. This refinement will look for opportunities to minimize

impacts to things such as real estate, infrastructure, and cultural resources while balancing engineering aspects such as water surface profiles as mentioned in the comment.

4. Setting the alignment back further from the Cedar River through this area (Sinclair industrial site) will be further explored during the project engineering and design phase.

5. Noted. The report captured information as it was known at the time it was collected. Numerous decisions continue to be made each month throughout the Study area that constantly changes existing conditions.

6. Street names within the stated sections of the report were reviewed and corrected.

7. Flow frequencies and resulting surface profiles are strictly based on historical data to date, commonly referred to as the period of record. Existing standards we are required to follow do not allow for projections of future climate change. The standards we follow are recognized and followed by all Federal agencies.

8. Major costs associated with modifying any existing bridges or their approaches would not be economically justified due to the minimal benefits that can be accounted for within our regulations.

9. Major costs associated with modifying any existing bridges or their approaches would not be economically justified due to the minimal benefits that can be accounted for within our regulations.

15. Letter from Robert Williams from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

Objects to proposal to build a levee/floodwall system on the east side only. "Why would anyone build only on the east and push water back on the west – doing more damage. Do not build – don't sacrifice SW side for downtown."

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

16. Letter from Todd Cobb from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS: "I don't want anything built that will send the flood water to my home on the SW side."

RESPONSE: A levee can increase the water level of a stream by reducing the cross-sectional area available for water to flow downstream. It is rare that a levee reduces the capacity of the channel but can restrict the ability of the overbank area to convey water. For the slow moving and relatively flat rivers in Iowa this type of constriction increases the water surface level upstream of the location where the area is reduced. The State of Iowa has a rule concerning how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the 0.01 exceedance probability flood (a large flood that has 1 chance in 100 chances of occurring in any given year) cannot be increased more than 1 foot by any proposed levee. At specific locations this guidance is often computed ahead of time and published on FEMA flood Insurance maps. The area that can be encroached is designated as the flood fringe. The area that cannot be encroached is called the floodway. The floodway always includes the river and sometimes land on either side of the river. At Cedar Rapids the levee alternatives evaluated by the Corps of Engineers are all located in the flood fringe and do not enter into the floodway.

The actual increase in the water surface elevation depends upon the specific flood or the discharge. The increase in water surface elevation also depends upon how far up river the property is located. The farther upstream the property is located the less the increase. Eventually as one looks upstream the with-project water level returns to the without-project water level. Within the City of Cedar Rapids average increases for various economic damage reaches with Alternative 4 (east levee only) appear in the main report page 188 table 38; and Appendix A, pages A-32 through A-34 and Plate A-1. Floods with 1 percent, 0.5 percent, and a 0.2 percent chance of occurring have respectively 1 in 100, 1 in 200 and a 1 in 500 chance of occurring in any given year. The flood of 2008 had a discharge of 140,000 cfs, which exceeds the 0.2 percent chance event.

The overtopping crest of the levee is about 140,000 cfs. Average increases in water surface elevation due to the levee or floodwall for Alternatives 1 and 1A and Alternative 4C over various economic damage reaches appear in table A-16. (Projects are also discussed in Appendix A under "With Project Impacts" pages A-33 to A-36.)

17. Letter from the Peoria Tribe of Indians of Oklahoma, John P. Froman, Chief, dated September 15, 2010

COMMENTS/CONCERNS: The Peoria Tribe has no objection to the proposed construction.
RESPONSE: None required.

18. Letter from Ajai Dittmar response to the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS: 1. "Has the "berm" been considered in any of these plans? Would it not be wise to fix the "berm" so that it fit the "standards"? It's made up of dirt. I have video."

2. "This has not been voluntary in any way! The people were forced to sell so you guys could put a "floodwall" in on the west side. Our City has lied to us. Please help us! Many people agree that protecting both sides of the river (is) feasible."

3. "Where is the historical appreciation?"

RESPONSES

1. The Corps of Engineers Feasibility Study report evaluated many alternatives for flood damage reduction alignments on both the east and west sides of the Cedar River. Alternatives evaluated included alignments that followed the river's bankline as well as set back alignments further back from the river bankline. Many segments of the bankline alignments in the Study do follow existing levee and existing floodwall alignments that the City maintains. It should be noted that existing systems would need to be completely removed and rebuilt in order to meet Federal standards. Set back alignments contained within the Study, for the most part match the City's desired alignment as passed by City Council.

Specific to the Time Check neighborhood, alternatives containing river's edge alignments cannot impact land purchased with funds from the FEMA Hazard Mitigation Grant Program (HMGP). FEMA rules do not allow construction of a flood damage reduction project or protection of lands purchased with HMGP funds. Alignments evaluated through this area, therefore, had to be set back accordingly and could not be placed near the river's bankline.

None of the flood damage reduction alignments along the west side of the river met required economic criteria in order to establish a Federal interest. Economic justification was found for a few of the alternative alignments on the east side, out of which a Recommended Plan was identified. The local sponsor, City of Cedar Rapids, ultimately has the decision whether or not to proceed with the Recommended Plan.

2. The City has acquired properties damaged by the flood with funds provided by FEMA HMGP and HUD CDBG grants. A condition of the FEMA grant program is that the city coordinates with the CORPS to determine if there are any current or proposed flood control programs in the buyout area. This coordination represents the extent of the CORPS participation in the voluntary buyout program.

The Other Social Effects of protecting both sides of the river were considered as part of the study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

3. Since there is no Corps Federal interest in flood damage reduction on the west bank of the Cedar River there will be no authorized Federal Corps interest in the historic preservation, as part of a Corps of Engineers project.

19. Letter from Courtney Ball from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

"I know the Army Corps' report is limited by the rules you must follow, but I hope congress will support alternatives that protect the west side of the city. We must have better protection than the Corps' recommended plan. It is unjust."

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

20. Letter from Beverly Kinney from Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

"My favorite is Alternative alignment 4C, also typical sections levee and floodwalls and pumping plants like the City of New Orleans once given a chance in Cedar Rapids. It will reduce flooding in the future? Similar idea with Lock and Dam No. 11 has pumping plant in Dubuque?"

RESPONSE

None required.

21. Letter from Clint Twedt-Ball from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. The Corps' cost benefit analysis fails to place any value on people and disruption to neighborhoods when they flood. This disruption comes with an economic cost just as substantial as bricks and mortar.

2. The cost benefit is disingenuous for FEMA and the SBA to give people money to rebuild and then place a levee on the other side of the river that will increase flooding. People should have been told

of this before they re-invested and were trapped in mortgages and SBA loans on homes they can't sell due to a lack of flood protection.

RESPONSES

1. The cost-benefit analysis was conducted according to USACE Engineering Regulation 1105-2-100. Effects on human life and well being are addressed under the Other Social Effects account and in the socioeconomic impacts portion of the Environmental Impacts/Effects section of the report.

2. This comment should be directed to the City of Cedar Rapids.

22. Letter from Rick Davis from Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

"Since the event of 2008 the city has chosen to build Federal court house and close 3rd St building and closing the street. Event Center and by or to building. Also a lot of other buildings. This also places water and pushes water to the west side creating a dam. Walls will raise west side water. These buildings should be taken into decisions."

RESPONSE

A levee can increase the water level of a stream by reducing the cross-sectional area available for water to flow downstream. It is rare that a levee reduces the capacity of the channel but can restrict the ability of the overbank area to convey water. For the slow moving and relatively flat rivers in Iowa this type of constriction increases the water surface level upstream of the location where the area is reduced. The State of Iowa has a rule concerning how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the 0.01 exceedance probability flood (a large flood that has 1 chance in 100 chances of occurring in any given year) cannot be increased more than 1 foot by any proposed levee. At specific locations this guidance is often computed ahead of time and published on FEMA flood Insurance maps. The area that can be encroached is designated as the flood fringe. The area that cannot be encroached is called the floodway. The floodway always includes the river and sometimes land on either side of the river. At Cedar Rapids the levee alternatives evaluated by the Corps of Engineers are all located in the flood fringe and do not enter into the floodway.

The actual increase in the water surface elevation depends upon the specific flood or the discharge. The increase in water surface elevation also depends upon how far up river the property is located. The farther upstream the property is located the less the increase. Eventually as one looks upstream the with-project water level returns to the without-project water level. Within the City of Cedar Rapids, average increases for various economic damage reaches with Alternative 4 (east levee only) appear in the Main Report, table 38, and in Appendix A, pages A-32 through A-34 and Plate A-1. Floods with 1 percent, 0.5 percent, and a 0.2 percent chance of occurring have respectively 1 in 100, 1 in 200 and a 1 in 500 chance of occurring in any given year. The flood of 2008 had a discharge of 140,000 cfs, which exceeds the 0.2 percent chance event.

The overtopping crest of the levee is about 140,000 cfs. Average increases in water surface elevation due to the levee or floodwall for Alternatives 1 and 1A and Alternative 4C over various economic damage reaches appear in table A-31. (Projects are also discussed in Appendix A under "With Project Impacts", pages A-33 to A-36.)

23. Letter from Gail Naughton from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. "By not protecting the west side, economic development will be severely impacted and the area will not recover, let alone grow and progress. Acres of land will essentially be written off in the center of the city. No large investments of infrastructure by private developers will be made with the east side protected and the west side subject to increased flooding. Thus the west side will never reach the BCR needed to achieve funding recommendation. Ultimately it is a recipe for deterioration of the tax base and the quality of life. The value of older homes should not be depreciated. The fact is rebuilding costs are not decreased because they are old and they are more well constructed than new homes. This criterion is flawed and should be changed."

2. The most important loss on the west side is the older historic fabric of the city which cannot be quantified. It will continue to deteriorate and the loss to the city will be immeasurable. The Czech Village area is a tourist destination that attracts millions of dollars in economic impact to the city. It will be endangered by an unprotected river.

3. The BCR calculation favors protection of business and industry but not homes and neighborhood businesses. This is an inequity in the process that should be addressed.

RESPONSES

1. The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

2. Since there is no Corps Federal interest in flood damage reduction on the west bank of the Cedar River there will be no authorized Corps Federal interest in the historic preservation, as part of a Corps of Engineers project.

3. The benefits of the project are the reduction in residential, commercial, industrial and public flood damages resulting from the project.

24. Letter from Karen Brook from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. "I am concerned about the lack of accounting for social justice issues in the economic assessment process. The west side provides neighborhoods of affordable housing that are very important to the workforce of the city."

2. "I am also concerned about what the permanent floodwalls on the east side of the city will do (to) the economic viability of the downtown, since they cut off recreational & cultural uses along the river that could guarantee revenue & growth in the downtown."

3. "I think the overall CBR process needs to look at more than just the economic value of properties & look more holistically at the quality of life in the city. It also needs to link into larger efforts to improve watershed management."

RESPONSES

1. Social justice is addressed under the Other Social Effects account; it is not a quantified benefit under the economic evaluation procedures.

2. As shown in Figure 73, Alternative 4C includes 15 individual closure structures to maintain access to downtown at critical traffic corridors, including streets, railroad tracks, and the trail system. General location and type of closures used are called out in the Feasibility Study plates. For cost estimating and construction scheduling purposes, the number and types of closure structures include seven steel roller gates, four steel swing gates and four removable floodwalls. The closure gates serve locations identified in the City's River Corridor Redevelopment Plan. More details are available in Appendices H. Structural and I. Cost Engineering.

In contrast with the No Action Alternative, the Study suggests structural projects like Alternative 4C would enable the City to revitalize and redevelop, contributing to community and regional and business growth; recover and reinvest in the flood-impacted area, reconnecting friends and families, and social sustainability; develop plans that would generate increased tax revenue and income to local and state governments, especially if potential increases in property values with business and industrial development.

3. Effects on human life and well being are addressed under the Other Social Effects account and in the socioeconomic impacts portion of the Environmental Impacts/Effects section of the report. Watershed management is being studied as part of the USACE Iowa-Cedar Rivers Watershed Study.

25. Letter from Chuck Swore from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. "Our city lost hundreds of affordable homes. Any plan that does not offer protection to these rebuilt affordable homes is of zero value to our city.

2. "I understand the need for the 1 to 1 ratio of cost to protection but certainly hope that Congress will insert common sense into the ratio and approve our request to protect both sides of the river."

RESPONSES

1. The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

2. None required.

26. Letter from Edward Castelein from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

"I hate to see that the 4C option recommended by the Corp(s) will result in more damage to the west side during a flood of the 2008 magnitude. The downtown area on the east side is dying and the Chamber of Commerce and real estate people control this town and could care less about the residents of the west side."

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

27. Letter from Craig Hanson from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. Pumping capacity is a concern for rain events. Just this week was a 1 yr event in the downtown.
2. Solid walls through downtown may cause decreased values for properties and decrease enjoyment of the river.
3. Value basis was not explained well, future needs to explain more.
4. Pumping capacity needs to meet the 100 yr event.
5. An option to protect Penford needs to be considered.

RESPONSES

1. Corps of Engineers guidance specifies that pump capacity must be justified incrementally based upon an economic analysis. This analysis takes into consideration the duration of time that the river is high enough to require pumping, the value of the damage reduced, and the cost of the pump station. At Cedar Rapids, during most of the project life the water from interior storms will drain by gravity into the Cedar River.

2. As shown in Figure 73, Alternative 4C includes 15 individual closure structures to maintain access to downtown at critical traffic corridors, including streets, railroad tracks, and the trail system. General location and type of closures are called out in the Study plates. The number and types of closure structures include seven steel roller gates, four steel swing gates and four removable floodwalls. The closure gates serve locations identified in the City's River Corridor Redevelopment Plan.

3. The benefits of the project are the reduction in residential, commercial, industrial and public flood damages resulting from the project. The benefit evaluation assumed that with a few exceptions, all structures were rebuilt and business returned to former use with or without protection. This provided maximum benefit credit to the flood affected areas.

4. Part of the analysis requires computing the interior flood elevation that has 1 chance in 100 of occurring because of rainfall. This is a blend of gravity and blocked gravity and does not equal the 100-yr storm.

However, based upon the size of most of the outlet diameters at the river the culverts can pass the 100-year rainfall under gravity conditions (low river level) with minimal damage. This condition exists over 98 percent of the time (see Appendix A pages A-20 and A 27). This does not mean that streets will not flood. But it is a local responsibility to convey discharge from rainfall to the levee since the Federal government does not pay for upgrading storm sewers.

5. A levee that included Penford was considered in the Study as Alternative 13. It was screened from further consideration early in the planning process. See pages 171, 176, 177 and 179 of the main report. The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be one or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river; including the Penford Products facility. None of the West bank alternatives had a high enough BCR. The only alternative that meets the Corps selection criteria is Alternative 4C, and it protects only the east bank. Alternative 4C has a BCR of 1.15 and meets the BCR criteria.

28. Letter from anonymous from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

Will there be citizen representation at the meeting in Washington D.C?

RESPONSE

The City will be represented by elected officials, and City staff. Representatives of state and local government will also be invited to attend. Representatives of the general public will not be participating.

29. Electronic message from Diamond V Mills, John C. Bloomhall, President, dated September 23, 2010

COMMENTS/CONCERNS

The District will be recommending Alternative 4C as the FSP. This alternative provides no flood risk protection to the West side of Cedar Rapids. The implementation of 4C will provide protection to the East side of Cedar Rapids during flood events while causing further damage to homes, businesses and other structures located on the West side of Cedar Rapids. Another flood event similar to 2008 would increase water surface elevations by 2.35 ft. resulting in significantly greater damage to both Diamond V's facilities. Having constructed an additional manufacturing facility in 2009, I can accurately estimate the replacement cost of our existing facility located at 436 G Avenue N.W. in the $50 - $60 million range.

Additional facilities on the West side of the Cedar River would suffer also. Penford Products, the Czech-Slovak Museum, Cedar Rapids Police Dept., Linn County Sheriff office; Wells Fargo Louis B. Sullivan bank building, schools and other public infrastructure are just a few examples of significant assets that would be damaged again, in addition to the many homes and commercial properties located on the West side of the river.

Based upon the information provided, it would cost approximately $250 million to protect both sides of Cedar Rapids with a meaningful flood risk mitigation plan. I believe this would be a prudent course of action to protect Iowa's second largest city and significant manufacturing center. I completely understand the US Army Corps of Engineers is bound by law in the methodology, BCR requirements, etc. Yet I struggle to grasp how any government entity can recommend construction of a protection system that will knowingly cause increased damage to public and private infrastructure and increased risk to public safety on the West side of Cedar Rapids.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

30. Letter from John Wasta from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. It is totally ridiculous to protect only one side of the river.

2. I feel we need more access through the (flood)walls. We need to be able to have venues on the river side for when flooding is not a problem and we can enjoy the river.

3. I think more earthen can be used in Timecheck/west downtown and Czech areas.

4. This whole flood recovery and Corps process shows how out of touch with reality our government processes and agencies are. Someone recently said that our government just plain does not know how to recover, either from a disaster of physical or economic nature.

RESPONSES

1. The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

2. Alternatives were studied that had a significant amount of openings and vistas along the line of protection by way of removable floodwalls but none of these alternatives reached a benefit to cost ratio above 1. Removable floodwalls are significantly more expensive to construct, maintain and operate than permanent concrete floodwalls. In order to find an alternative with a benefit to cost ratio above 1, a very basic design that utilized plain concrete floodwalls to reduce construction costs was arrived at in order to find an alternative that established a Corps Federal interest.

3. Both the Time Check and Czech Village neighborhoods were in Damage Reaches (2B and 2D) defined in Section 3.1.4 of the Study, and included in Alternative alignments 1 and 2. The Study evaluated and compared alternative alignments during iteration step 3, as summarized in Table 34. The draft benefit-cost ratio (BCR) for Alternative alignment 1 was less than 0.5, and for Alternative alignment 2 was less than 0.35.

Iteration step 4 further adjusted and refined Alternative alignments 1, 4 and 10, as described in Section 4.2.4, and added Alternative alignment 1A, which also included both the Time Check and Czech Villages, and much of both banks of the Cedar River in Cedar Rapids. Considering the relative costs and benefits of each alternative in iteration step 4, their economic performance is reported in Table 35, where

alternatives 1-C, 1A-C, 4-C and 10-E have the highest relative BCRs within each alternative alignment (1, 1A, 4 and 10).

As described in Section 4.3 the final iteration step evaluated alternatives using 1) the relative levee elevation, 2) the level of completeness, and 3) National Economic Development (NED) benefits. Section 4.3.2 comparisons found Alternatives 1-C and 1A-C with BCR of 0.75 and 0.77 respectively, are not economically justified since the BCR is less than 1.0. Among other appendices, Appendices H, E, I and B (Structural, Real Estate, Cost Engineering and Economics, respectively) each provide supporting information about the preliminary engineering designs, property rights acquisitions, estimated costs, and estimates of relative costs and benefits.

4. None required.

31. Letter from Sandra Skelton from the Public Meeting dated September 21, 2010

COMMENTS/CONCERNS

1. I am appalled that all the focus is on dollars and no study has been done on the effect this has on human life and well being. The people on the west side have been through enough! Now we are told there is not enough value in our re-stored homes to deserve a levy or floodwall on the west side of the Cedar River.

2. The flood itself did not take any human lives, but the purposeful denial of protection for the west side increases the potential for added stress, mental breakdowns, suicide attempts, family breakups, and more damage and loss to our newly renovated homes and neighborhoods. We are tired of the constant work, worry and depression. Give the west side equal treatment as the businesses that work for. We will work on finding funds.

RESPONSES

1. Effects on human life and well being are addressed under the Other Social Effects account and in the socioeconomic impacts portion of the Environmental Impacts/Effects section of the report.

2. The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11. However this information has no effect on the Federal standard method which the Corps of Engineers is required to use for economic analysis.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

32. Electronic message from Patty Carter (John C. Berge in signature block) dated September 27, 2010

COMMENTS/CONCERNS

1. It seems to me that as the proposed flood control projected for the east side of the river, you are projecting a much more serious flood on the west side, because your present program is forcing all the

water to the west side, to spread out for control purpose. Therefore if you have a flood as serious as the 2008, it is just spreading out further to the west.

2. Now there is a dike along the river on the west side. I believe they could extend the dike to the north until they could connect it to the high ground in Ellis Park, and raise the present dike by widening it, and installing concrete blocks (solid concrete), or install a track for a movable wall that could be installed and removed as needed. This would be calling for the dike next to the river all the way on the west side except for the north end if they didn't want to buy out the houses that are there.

3. Along the Penford property the dike that has been installed there is a steel wall. I believe this could be raised up by welding sheets of steel on the top and then putting fill along the wall. I believe the present wall that is there belongs to Penford.

RESPONSES

1. A levee can increase the water level of a stream by reducing the cross-sectional area available for water to flow downstream. It is rare that a levee reduces the capacity of the channel but can restrict the ability of the overbank area to convey water. For the slow moving and relatively flat rivers in Iowa this type of constriction increases the water surface level upstream of the location where the area is reduced. The State of Iowa has a rule concerning how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the 0.01 exceedance probability flood (a large flood that has 1 chance in 100 chances of occurring in any given year) cannot be increased more than 1 foot by any proposed levee. At specific locations this guidance is often computed ahead of time and published on FEMA flood Insurance maps. The area that can be encroached is designated as the flood fringe. The area that cannot be encroached is called the floodway. The floodway always includes the river and sometimes land on either side of the river. At Cedar Rapids the levee alternatives evaluated by the Corps of Engineers are all located in the flood fringe and do not enter into the floodway.

The actual increase in the water surface elevation depends upon the specific flood or the discharge. The increase in water surface elevation also depends upon how far up river the property is located. The farther upstream the property is located the less the increase. Eventually as one looks upstream the with-project water level returns to the without-project water level. Within the City of Cedar Rapids, average increases for various economic damage reaches with Alternative 4 (east levee only) appear in the Main Report, table 38, and in Appendix A, pages A-32 through A-34 and Plate A-1. Floods with 1 percent, 0.5 percent, and a 0.2 percent chance of occurring have respectively 1 in 100, 1 in 200 and a 1 in 500 chance of occurring in any given year. The flood of 2008 had a discharge of 140,000 cfs, which exceeds the 0.2 percent chance event.

The overtopping crest of the levee is about 140,000 cfs. Average increases in water surface elevation due to the levee or floodwall for Alternatives 1 and 1A and Alternative 4C over various economic damage reaches appear in table A-31. (Projects are also discussed in Appendix A under "With Project Impacts", pages A-33 to A-36.)

2. The feasibility Study looked at alternatives (1 and 1A) that did provide a continuous line of protection aligned along the Cedar River west side bankline that tied into Ellis Park such as described in the comment. In order to meet Federal standards, existing levees would have to be entirely removed and rebuilt. Thus the Study estimated all new features throughout every alignment. After all alternatives with alignments protecting the west side were analyzed, none had benefit-to-cost ratios above a 1 required to establish a Federal interest.

3. Our experience tells us that adding height to any existing floodwall is never as simple as it might seem. The increased height would create increased hydraulic loads on the floodwall that it was not originally design to handle. Typical measures include substantial foundation and wall support

modifications if not total reconstruction of the floodwall in order to achieve a higher height. Also, seepage of water under the floodwall would need to be evaluated. No alternatives were found in this Study that found a Federal interest to provide flood damage reduction to any area of the west side including Penford.

33. Electronic message from Iowalive9 dated September 28, 2010

COMMENTS/CONCERNS:

1. What analysis was performed and used as a basis for the 32.4 ft. flood protection level, chosen for Cedar Rapids, as reported on page 193, section 4.3.2.2, in the Report?

a. Where can the analysis be accessed?

b. Who is responsible for selecting the 32.4 ft level—based on what advice, given by whom?

c. Will the 2nd Ave. Bridge continue to withstand 32.4 ft. flood levels?

i. How about the other bridges?

ii. What happens to the flood levels upstream if one of the bridges topples, such as happened to the railroad bridge in '08?

d. Why was such an important flood crest protection number buried so deeply in the Report—and excluded from the Executive Summary?

2. The Report claims a 91.24 percent probability that the top of a 32.4 ft flood crest levee/floodwall will not be exceeded. That means there is an 8.76 percent chance of a 32.4 ft. flood crest exceeding the top of the proposed levees/floodwalls—each year. On what analysis was the 91.24 percent number determined and where can the analysis be accessed?

3. How much higher will the water rise on the west side of the river, at a 32.4 ft flood crest, as a result of the levee/floodwall preventing water from flooding the east side? We expect it could be as much as 5 feet—at the floodwall overtopping level.

4. How much will the 100 and 500 year flood plains be changed, on both sides of the river, as a result of the proposed levee/floodwall built to protect the east side of the river?

a. How much worse will flooding be in Palo as a result of levees/floodwalls proposed and built in Cedar Rapids?

5. What is the estimated TOTAL annual cost for maintenance etc. for the proposed levee/floodwall, pumps etc.?

6. The Corps is commended for clearly pointing out in the Report how poorly Cedar Rapids was prepared to alert or protect itself from the 2008 flood. The gas company did a much better job of anticipating the 31.2 ft. flood crest--and successfully protecting residents and businesses from broken or damaged gas lines.

7. Levee experts claim there are but two types of levees—those that have failed and those that will fail.

a. What steps will be taken to prove such experts wrong—for the life of the Cedar Rapids levees?

b. What is the life expectancy for the proposed levees?

c. On what analysis is the life expectancy based?

i. Where can the analysis be accessed?

RESPONSES

1.a. The analysis can be found in the report appendix (Appendix A).

1.b. The project alternative selected is based upon a flood damage reduction analysis which maximizes net economic benefits (NED plan) to justify a Federal interest.

1.c.i. and 1.c.ii. Flood and damage risks associated with specific bridges are beyond the scope of a feasibility Study like this by the Corps. While these non-Federal structures are largely beyond the

authority of the Corps, these and other associated risks are the kinds of details that would be worked out during the next Preliminary Engineering and Design Phase, if the Project is authorized by Congress.

1.d. The following statements have been added to the Executive Summary in the description of Recommended Plan 4C. "The design height of the system would correspond to an elevation of 733.7 feet, 1988 NAVD, at the USGS gage just upstream of the 8th Avenue Bridge. The Alternative 4C system would be constructed at a height approximately equivalent to a stage of 32.4 feet, approximately 1.3 feet higher than the June 2008 flood crest, providing a substantial degree of risk reduction."

2. This value is the percent of floods making up the family of discharges with 0.002 exceedance probability of occurring in any given year that is contained by the target levee crest elevation. It should be pointed out that floods can exceed the 0.002 exceedance probability event. This number is used in comparing alternatives not providing the performance of the levee in one number. Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) software was used for alternative analysis and comparison. The website http://www.hec.usace.army.mil/ contains the program software and user manual.

3. See Response 2. to Iowalive electronic message September 3, 2010.

4. See Response 3. to Iowalive electronic message September 3, 2010. For the recommended plan the water surface at Palo would increase 0.1 foot for the 2008 flood event and less for other flood events.

5. The total annual cost for operation and maintenance of the Recommended Plan, Alternative 4C, was determined to be $7,200 each year throughout the life of the project plus a 30-year replacement cost of pumps of $720,000. These are present day values. These estimates were arrived at based on an average of historic costs received from managers of four existing urban flood risk management systems within Iowa. See pages 218 and 219 in the Public Review Draft for further specifics.

6. None required.

7.a. Risks are associated with every system including levees and floodwalls. The height of each constructed system is always subject to a flood that may some day over top it. Risks of overtopping are determined based on the hydrologic statistics for the period of record (roughly the past 100 years for the Cedar River).

Levee and floodwall systems are designed to handle any floods at or below their design height. Systems must be properly operated and maintained throughout their life in order to maintain their original integrity. Comprehensive annual inspections are performed each year by the Corps of Engineers with local sponsors to ensure proper operation and maintenance is occurring on Federal systems. Local sponsors are responsible for performing their own inspection of the system at least once in between each annual inspection.

7.b. Life expectancy directly corresponds to the system being maintained and operated at an acceptable level. If a system is properly maintained and operated, it can have an indefinite life expectancy. If a system is not properly maintained and operated, it can be found to be in an unacceptable condition within the first couple of years after its construction.

7.c. All alternatives evaluated within this feasibility Study were analyzed based on a 50-year life cycle in order to determine feasibility of each alternative.

7.c.i. The 50-year life cycle analysis is contained within the feasibility Study Economic Analysis Appendix (Appendix B).

34. Letter from Florence E. Jacobs dated September 24, 2010

COMMENTS/CONCERNS

For many years the people on the west side of Cedar Rapids, Iowa have been asking for more protection from flooding of the Cedar River, but to no avail.

Tuesday evening, of this week, I attended a U.S. Army Corps of Engineers meeting to learn of your Flood Risk Management Benefit Cost ratio (BCR) study for the City of Cedar Rapids to learn that a new dike is to be built on the **east side** of the Cedar River, but the west side will be unprotected. This is very unfair. If we receive another flood the water will be one foot plus higher than in 2008. **We also need to be protected.** Your survey was conducted right after the flood in 2008 and doesn't take into consideration the businesses and homes that have been rebuilt or will be rebuilt in the near future. To name a few: Cooper's Mill Motel and Restaurant, Diamond V Mills, the Yeast Factory, Johnson's Gas, Pierson's Florist, Casey's, P & P, St. James Church, McKinnon's Barber Shop, Penford to name a few, plus all of the homes and many other businesses not mentioned here.

You need to re-consider funding for both sides of the river. Millions of dollars leave our country to countries also in need. Shouldn't we take care of our own first.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11. However this information has no effect on the Federal standard method which the Corps of Engineers is required to use for economic analysis.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

35. Letter from Julie Shaw postmarked September 27, 2010

COMMENTS/CONCERNS

What we find most concerning is the narrow scope of vision that is occurring by basing the decision on skewed data. Obviously the BCR will be less on the side of the river that had a greater proportion of residences-to-businesses. I assume these numbers are based on past and present business and property values without regard for future projects or potential growth. Further, the plans to disregard the west side

of the river will most certainly impact the rebuilding of the west side, thereby creating a "good-side/bad-side" of the river, where none occurred before.

It is absolutely demoralizing to find that we will continue to have pre-flood protection. You are sending a clear and degrading message to all of Cedar Rapids. Homeowners and business owners alike will most certainly take the status of the levy into account before inhabiting this area. Businesses only succeed if the customer base is present and strong.

RESPONSE

The benefits of the project are the reduction in residential, commercial, industrial and public flood damages resulting from the project. The benefit evaluation assumed that with a few exceptions, all structures were rebuilt and business returned to former use with or without protection. This provided maximum benefit credit to the flood affected areas. The future without and with-project conditions were forecasted under this study.

36. Electronic message from Gary Stansbery dated September 29, 2010

COMMENTS/CONCERNS

I'm contacting you in regard to the placement of the flood wall along the Cedar River in Cedar Rapids, IA. In your Engineers' plan it recommends a levy on the east bank of the river only due to the cost racial (ratio) to cost its protecting. I know that your Army Corps of Engineers' is just doing their duty according to the book. But there should be some consideration to the human factor also for building a flood wall on the west side of the river. It has come out if there is just a flood wall on east side only that any future floods will be compounded on the west side. The west side was hard hit in the 2008 flood. A lot of homes and businesses lost and a lot of families misplaced. The west side in losing what they had, has made a whole generation lose their life's savings. In my case which is not out of the norm is that I retired just before the flood looking forward to rest from working all those years and saving for this opportunity to retire. To find myself in debt again to rebuild, or relocate, and using part of my savings to recoup my losses I feel I'm one of those people that has lost my whole generation of savings. I think it is unacceptable you as the Army Corps of Engineers tell me you are going to protect only the east side and make the west side flood worst. There should be some consideration to human sacrifice in the planning of a flood wall.

Some businesses are ready to come back on the west side but are reluctant to do so because there will be no flood protection on the west side. This would be a great lost opportunity to bring back, and add new businesses, to the west side.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11. However this information has no effect on the Federal standard method which the Corps of Engineers is required to use for economic analysis.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank.

Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

37. Electronic letter from Iowa Department of Natural Resources, Rich Wirtz, Flood Plain Management Program, dated September 29, 2010

COMMENTS/CONCERNS

1. Regarding criteria a and b: It is our understanding the chosen alternative (Alternative 4C) will propose to use a design protection level corresponding to the Q500 flood profile (a.k.a. the "500-year" flood, based on the 0.002 exceedance probability discharge). The application must clearly show the Q500 profile within the project area and show that 3 feet of freeboard above the Q500 profile is provided.

2. Regarding criteria c: It is our understanding Alternative 4C will propose to locate all construction outside (landward) of the currently delineated floodway. The application must confirm this understanding.

3. Regarding criteria d: The application must include sufficient detail to confirm that interior drainage and ponding issues are thoroughly analyzed and that adequate, reasonable systems are proposed to handle these issues for events up to and including the design (0.002 exceedance probability) event.

4. Regarding criteria e: The application must show that accepted engineering and construction procedures and practices will be followed for all components of the flood protection work, including the efficacy of machine components requiring operation and maintenance such as closure structures and pumping stations.

5. Please note, as the hydrologic and hydraulic analysis of the Federally Supportable Plan are based on the development of flood flows and channel geometry not contained in the effective Flood Insurance Study, a Letter of Map Revision will be required upon completion of the project.

6. The project will require the approval of the Department. At such time as the design of the Federally Supportable Plan is complete, feel free to contact the Flood Plain Management Program, Water Resources Section (Mr. Wirtz) with any questions you may have regarding Corps submittal to the Department for a Flood Plain Development Permit.

RESPONSE

The Iowa DNR Letter (Flood Plain Management Program, Water Resources Section) comments are noted. Assuming the project is authorized, these comments will be addressed in the project permit submittal after final project plans and specifications are prepared for construction contract solicitation.

38. Electronic letter from Iowa Chapter of Sierra Club, Cedar Wapsie Group, Pam Mackey Taylor and Wallace Taylor dated September 29, 2010

COMMENTS/CONCERNS

1. The Recommended Plan (east side only) presents an environmental justice issue. Although the assessment purports to comply with Executive Order 12898, the information in the assessment has been

manipulated and mischaracterized. For example, on page 255, the statement is made that no environmental justice concerns were raised during the public participation process. However our members were present at public meetings where such concerns were raised. These comments may not have used magic words "environmental justice" but the message was loud and clear that the lower income residents and businesses on the west side of the river were being discriminated against.

2. There are historic areas that will not be protected, including the Time Check neighborhood, Czech Village, and the Wells Fargo Bank Building.

3. The Study does not have an integrated plan for upstream watershed management. This project needs to be part of a comprehensive plan, which it is not. Upstream watershed management is more than retention basins. It includes wetland restoration. Your agency should remember the Galloway Report, prepared by your agency after the 1993 floods in the Midwest. This report made clear that the best way to prevent floods and to protect people and property is to promote the natural flood control provided by wetlands, vegetation and other natural attributes of a healthy watershed.

4. In the city there should be a large variety of measures to retain water on the property with a slow release, including permeable paving, rain gardens, prairie plantings, as well as the retention basins that have been used.

5. The project needs to be accompanied with changes in the local ordinances to stop building homes, garages, and businesses in the 100- and 500-year flood plain, including no further filling in of the flood plain.

6. Any time fill is moved into a floodplain, the flood waters get diverted to other properties up and down the river. Properties that once were outside of the floodplain can suddenly be within the floodplain as fill is moved into the watershed.

7. The laws and regulations provide the Corps an opportunity to look at factors other than cost. The Executive Order (EO12898) clearly indicates that the Corps is to consider environmental justice issues and good watershed management. That clearly was not done in this case.

RESPONSES

1. The final report has been revised to reflect that concerns were expressed during the public participation process concerning perceived inequities of putting a floodwall on one side of the river and not the other. Both sides of the river have lower income residences and businesses (see Table 27, Page 112 in the Report). While both sides of the river were considered for protection in the Study, only the east side of the river could be economically justified. The Other Social Effects of protecting both sides of the river were considered as part of the study as described in Sections 3.1.16, 3.2.7, 4.4.5, and 5.1.11. However this information has no effect on the Federal standard method which the Corps of Engineers is required to use for economic analysis.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

2. Implementation of Alternative 4C would not provide flood risk reduction for Time Check, Czech Village, or the Wells Fargo Bank Building.

3. The study and implementation of upstream detention measures, wetlands, and other conservation measures is outside the scope and jurisdiction of the feasibility Study for Cedar Rapids. The local cost share partner on this project, the City of Cedar Rapids, only has jurisdiction within its corporate limits.

The Corps of Engineers does not have jurisdiction in this Study to impact upland areas beyond the Study area.
A comprehensive watershed study for the Cedar and Iowa Rivers recently got underway that is geared towards evaluating sustainable management strategies within these watersheds. This study is comprised of an interagency team that will consider comprehensive watershed planning and measures that includes measures in upland areas. The fact sheet for this study is titled "Upper Mississippi River Comprehensive Plan – Iowa-Cedar Rivers Watershed" and can be found at the Rock Island District website that list all of our project fact sheets at the following address. http://www2.mvr.usace.army.mil/projects/index.cfm

4. Primary actions taken by the City include seven measures listed in 4.3.1., notably including item "(6) building code review/revisions."

5. Floodplain management and flood risk reduction are shared responsibilities among the Federal, state, local government, and the public. There are existing restrictions on building structures and placing fill material in the designated 100 year floodplain. For more information on the current floodplain management ordinances in Cedar Rapids please contact Dave Scanlon at 319-286-5879, d.scanlon@cedar-rapids.org. or Sandy Pumphrey at 319-286-5854, s.pumphrey@cedar-rapids.org. Ultimately, the City is responsible for implementing local floodplain ordinances and in fact would be required to develop a new floodplain management plan in combination with a Corps project.

6. None required.

7. See Response 1 above.

39. Electronic message from Iowalive dated September 30, 2010

COMMENTS/CONCERNS

1. When and where can the Corps's response to public questions be accessed?
2. What is the accuracy of the 91.24 percent probability that the top of a 32.4 foot flood crest levee/floodwall will not be exceeded?
3. What is the basis for such implied accuracy (91.24 percent)? Is the Corps saying that there is no chance the probability of not topping will be worse than 91 percent? If not, what is the + and – tolerance on the 91.24 percent number?
4. Why didn't the report include detailed procedures and methods for Cedar Rapids to use when the levee/floodwalls are topped, as the report clearly showed an 8.76 percent probability of happening.
5. How will water be moved from the "protected" areas that are flooded-including pumps and flood gate actuation systems?
6. Does the Corps have substantial evidence a city, such as Cedar Rapids, can effectively close storm sewers and prevent back flow from a 32.4 foot flood crest?
7. Is the Corps satisfied that journalists and others reading the Report will fully understand there remains a concerned risk of flooding in the Cedar Rapids "protected" areas. When they write or talk about proposed "flood protection"?

RESPONSES

1. The Rock Island Districts responses to the comments/concerns received during the 30-day public review process will be posted on the District web page for viewing. These responses should be posted sometime late October 2010.

2. This value is the percent of floods making up the family of discharges with 0.002 exceedance probability of occurring in any given year that is contained by the target levee crest elevation. It should be pointed out that floods can exceed the 0.002 exceedance probability event. This number is used in comparing alternatives not providing the performance of the levee in one number.

3. Is the Corps saying there is no chance the probability of not topping will be worse than 91 percent? No. This value is the percent of floods making up the family of discharges with a 0.02 percent chance of occurring in any given year that is contained by the target levee crest elevation. It should be pointed out that floods can exceed the 0.002 exceedance probability event.

A levee containing 90 percent of 0.002 exceedance probability events is speaking of a family of events. For this analysis a normal distribution was used. The mean of this distribution is 121,735 cfs; the family has a 95 percent confidence limit of 100,210 cfs and a 5 percent confidence limit of 154,308 cfs.

4. Flood fighting methods will be contained within an appendix of the operations and maintenance manual if and when a project is constructed. Also the City would be required to update their floodplain management plan which contains emergency evacuation actions.

5. Permanent floodgates placed on storm outlets would be opened to allow gravity drainage of any flooded areas once the surface level on the river drops below any interior ponding elevations. All floodgates would be operable with a portable motor and/or manual hand crank operators.

6. Permanent floodgates would be placed on all storm drains outlets along the entire distance of any new levee/floodwall flood risk management system. Review of existing outlets would be done during engineering and design to determine if there are any opportunities to combine outlets in order to reduce the overall number of closures required. Minimal time (several hours) and minimal manpower would be required to operate all the floodgates. The effort needed to properly operate the proposed system is consistent with that needed to operate other levee and floodwall systems in Iowa, and is considered to have a very high probability of being effective.

7. The Corps of Engineers strives to be transparent and clear as possible when it come to defining the risks associated with existing conditions and all proposed alternatives. These risks are defined within the feasibility Study report.

40. Letter from Kathy Milroy dated September 30, 2010, comment sheet from the September 21, 2010 public meeting:

COMMENTS/CONCERNS

I am concerned about the west side not being protected. As a home owner I feel we should have the protection from any flooding. We are paying taxes.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative

that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

Flood risk reduction is a shared responsibility among the Federal, state, and local governments and public. Federal structural measures would be in addition to the considerable complimentary nonstructural measures being implemented by the City as part of the flood recovery process. Primary actions taken by the City include measures listed in 4.3.1., notably including (1) development of a preferred long-term flood strategy through structural and nonstructural measures; (4) voluntary property acquisitions in conjunction with FEMA, HUD, and LOST (over 1,200 structures have been identified for these programs); and (6) building code review/revisions.

41. Letter from Gloria Ruzicka dated September 30, 2010, comment sheet from the September 21, 2010 public meeting:

COMMENTS/CONCERNS

Please do flood protection both sides of the river.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

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42. Letter from Randy Chapman dated September 30, 2010, comment sheet from the September 21, 2010 public meeting:

COMMENTS/CONCERNS

We need flood protection on the west side too. We pay taxes and live here too. If no flood protection on west side, shouldn't be on east side either. So don't channel the water to the west.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

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43. Letter from Mary Flaherty dated September 30, 2010, comment sheet from September 21, 2010 public meeting:

COMMENTS/CONCERNS

Please protect the west side of the river. I am a homeowner on the west side. I along with many of my neighbors invested several thousands of dollars to fix our homes. This is our neighborhood. Many of us have lived here for many years. Of course the value of the west side would be less than the east side. All of the downtown and several factories are on the east side. Just because the economic value is less does not mean it is not important or have value to us. A levee is needed on the west side.

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

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44. Electronic message from Jeanne White dated September 30, 2010, comment sheet from September 21, 2010 public meeting:

COMMENTS/CONCERNS

This flood was epic and very devastating. The Corps tells us that we would "only receive 1-2 feet more of water." In our case, less than one foot of water would cover our electrical outlets, which would greatly increase the cost of rebuilding. The whole electrical system would have to be replaced and we are near the edge of the 500 year flood zone! Having a floodwall only on the east side will cause the WEST side of Cedar Rapids – a big chunk anyways – to literally disappear. Our property values will decrease even more than they have, and who would want to buy a home on the west side? Please approve a plan that would protect the east side AND the west. We all have worked hard to rebuild our homes – if we flood again the cost to rebuild will be greater. We are worth protecting. "We are here."

RESPONSE

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

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45. Letter from Richard L. Campbell postmarked September 28, 2010

COMMENTS/CONCERNS

I don't understand how the Corps figures the value of properties at risk. If it's worth $90,000 it's worth $90,000 whether it's 1 year old or 100 year old. The City of Cedar Rapid will lose major tax base from the lost value of homes and businesses that have been torn down/closed because of this flood, these will not come back without a levee. Mr. Campbell believes that the City of Cedar Rapids, Iowa needs Congress to allow the U.S. Army Corps of Engineers to build a levee on the west side of the City. Mr. Campbell also describes flood history from 1903 and other information on home values and depreciation.

RESPONSE

The Corps employs a "depreciation replacement value" in evaluating properties which may be protected by a potential project alignment. This value considers a structures construction quality,

materials, condition and effective age (not absolute age). So, an older home which has been well maintained and updated, will have this condition reflected in the effective age.

The Other Social Effects of protecting both sides of the river were considered as part of the Study as described in Sections 3.1.16, 3.2.7, 4.4.5 and 5.1.11.

The regulations under which the Corps operates requires that the project's benefits exceed the project's costs, or stated another way the benefit cost ratio must be 1 or greater. The Cedar River Feasibility Study did consider alternatives that would protect property on both sides of the river. All of the flood risk reduction options that would protect both sides of the river had a BCR of less than 1. The only alternative that meets the Corps selection criteria is Alternative 4C, BCR = 1.15 and it protects only the east bank. Basing the selection of a recommended alternative on the BCR removes politics, socio-economic factors and biases from the selection process.

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46. Electric message from Linda D. Seger dated September 30, 2010

COMMENTS/CONCERNS

On this last day of providing public comments to the Corps regarding Cedar Rapids, Iowa, I would like to thank you and all those involved for doing a fine job completing the task that was presented to you following the flood of 2008 June.

I do understand that you had perimeters that you had to maintain to keep this under the rules you were ordered to follow. I respect you for the quality of work and the promptness you completed it. You had no choice under the current conditions but to find the decision to be what you have declared. It is not the Corps that devalued the land on the west bank to a point to where it would not meet the cost ratio. I fully understand how you reached your recommendation. Thank you.

My concern as a home owner on that west bank of the Cedar River in Cedar Rapids, Iowa is to now work to see how my local and state governments can do a better job of protecting the city on the west side with what we can afford. I live eight blocks from the river and I have little fear of future flooding. My home now completely rebuilt from top to bottom has been here 101 years. My work will be to stay active in decisions made for and by the city to see that we get respectable flood protection without going overboard to have something that is completely over done to make developers and politicians happy and foolishly naive about what type of protection we really need near the Cedar River. I will never see another flood like 2008 in this city in my lifetime I am sure and I am 66 years old. If we do it will be by the excessive walls and levees that disrupt the flow of the river and cause run over spillways to be held and drowned all in the path of the dry side of their construction.

Thank you, again for working with the citizens of Cedar Rapids, Iowa, USA.

RESPONSE
Thank you for your input and understanding.

47. Electronic message from Clark Rieke, dated September 30, 2010

COMMENTS/CONCERNS

What is the most cost effective blend of flood protection alternatives? The flood protection feasibility issues for the most cost effective flood protection should be framed as a blend of alternatives. How much upstream detention together with how much channel flow enhancement can compliment what levee height?

I ask the Corps to consider upstream detention — the plan to temporarily detain storm water where it falls — because upstream detention provides benefits throughout the Cedar River watershed and the costs can be shared by all the communities who benefit. The benefits throughout the watershed include:

1. Localized protection from ever more frequent local flash floods;
2. Reduction in nitrite pollution from fertilizer in the runoff;
3. Stabilization of aquifers;
4. Potential for irrigation during periods of dryness.

My research on upstream detention suggests that there is some quantity of low cost upstream detention (some on lands that the governments already own or control) that can give us some percentage of reduction in the risk of flood crest height at a cost effective level.

I believe that the first third of the acre feet of distributed detention needed can cost significantly less per unit than the last third, so we need to ask how does that cost compare to the cost of the reduction in the levee height that this much detention will allow.

In a system that is blending the alternatives, another important factor is the cumulative effects of river flow enhancements through the cities and all along the watershed. I believe that a conversion of most of the many dams of all kinds that exist throughout the Cedar watershed to adjustable dams can create a system of values that can be used to mitigate the height of flood crests. When the risk of flooding increases because watershed is becoming saturated, it is an important factor to drain as much water as possible before the next significant rain. Lowering these dams during high risk times due to high saturation allows a mitigation system to let as much water drain away as possible a little sooner than if the existing dams would stand as they currently do. By having an adjustable dam lowered this will reduce the height of the crest over this point, then after a crest has passed over an adjustable dam that had been lowered to facilitate faster flow, this dam could be slowly raised to hold the water at a height as high as possible without causing more damage at this point in the river. This holding back of the flow by raising the dam will reduce the head or speed of the crest flowing from this point. If distributed storage areas are like the parking lots for storm-runoff, then adjustable dams are like the speed bumps. If these two tools are used in a coordinated way, they can be complementary in challenge of the management of the traffic jam of the flowing stormwater known as flood crests.

RESPONSE

The feasibility Study for Cedar Rapids considered over 25 general structural features and 10 non-structural features. (See Table 30 beginning on page 151 in the Public Review Draft.) Each of these features was screened across a matrix of parameters that included: potential for reduction in flood crest, flood management effectiveness, construction timeline, permitting timeline, and costs. The primary scope of this Study was to analyze if there are any feasible alternatives to reduce existing and future flood risk and damages to public and private infrastructure and facilities in the City of Cedar Rapids. One of the main criteria was features that could be implemented in a relatively short period time. The Recommended Plan, Alternative 4C, was identified as most cost effective alternative within this Study.

The study and implementation of hundreds if not thousands of upstream detention measures is outside the scope and jurisdiction of the feasibility Study for Cedar Rapids. The local cost share partner on this project, the City of Cedar Rapids, only has jurisdiction within its corporate limits. The Corps of Engineers does not have jurisdiction in this Study to impact upland areas beyond the Study area.

A comprehensive watershed study for the Cedar and Iowa Rivers was recently initiated that is geared towards evaluating sustainable management strategies within these watersheds. This study is comprised of an interagency team that will consider comprehensive watershed planning and measures that includes measures in upland areas. The fact sheet for this study is titled "Upper Mississippi River Comprehensive Plan – Iowa-Cedar Rivers Watershed" and can be found at the Rock Island District website that list all of our project fact sheets at the following address: http://www2.mvr.usace.army.mil/projects/index.cfm

IV. PROJECT IMPLEMENTATION SCHEDULE

The tentative schedule for construction of this project, after signing of the FONSI; acquisition of all required permits and certifications; and other procedural requirements; could begin as soon as 2013.

V. SUMMARY OF ENVIRONMENTAL IMPACT REVIEW

1. A report with integrated EA has been prepared for this project and circulated for review. This review has not identified any potentially significant adverse impacts either direct, indirect, or cumulative, resulting from implementation of the project as proposed. Thus, a FONSI was prepared and included in the Study.

2. Alternatives considered for this project are No Federal Action; Levee/floodwall systems on both sides of the river (Alternative 1); Levee/floodwall system on both sides of the river with east side portion shorter than Alternative 1 (Alternative 1A); Levee/floodwall system on the east side of the river (Alternative 4C, the Recommended Plan); and Levee/floodwall system on the east side of the river reducing flood risk to two separate industrial areas (Alternative 10).

VI. SUMMARY OF FINDINGS

I find that the implementation of the project, as proposed, and under conditions set forth, and as prescribed by regulations published in 33 CFR Parts 320 to 340, and 40 CFR Part 230, is not contrary to the public interest.

15 OCT 10

Date

Shawn P. McGinley
Colonel, US Army
Commander & District Engineer

McGuire, Lonn I MVR

From: frank.king@mchsi.com
Sent: Tuesday, August 31, 2010 2:54 PM
To: McGuire, Lonn I MVR
Subject: Feasibility study Cedar Rapids

Mr. McGuire;

I am no expert at these issues and looking at the report of in the neighborhood of 200 pages I find to be quite overwhelming so I will ask a simple question. If the Corp builds a levee and flood protection system on the east side of the Cedar River won't that force the water to the west side thereby increasing the incidence of damage to existing structures? My home is 8 blocks from the river in the 500 year flodd plain and we received only 6 inches on the first floor but suffered over 100k in overall loss. It seems to me that the Corp says they do nothing if it causes damage elsewhere but how can you protect one side without forcing that water to the more vulernable west side?
I Thank You for your answers.

Sincerley:
Frank King
319-265-2479
319-270-6857

McGuire, Lonn I MVR

From: frank.king@mchsi.com
Sent: Tuesday, August 31, 2010 2:59 PM
To: McGuire, Lonn I MVR
Subject: Cedar Rapids

Mr.McGuire;
I forgot to ask one other question and that is if Cedar Lake is so polluted that it is not worth protecting then will homeowners risk those pollutants being carried into their homes during flood events? And did that happen in 2008? In my home the varnish was eatin right off the woodwork so if that was caused by hazardous waste does my home need to be demolished? I rebuilt it but now I am worried that it might be a dangerous house for people to live in. Please resond at your earliest convenience as I am quite concerned.
Thanks again
Frank King

2.

Doershuk, John F

From: Doershuk, John F
Sent: Tuesday, August 31, 2010 1:26 PM
To: 'lonn.i.mcguire@usace.army.mil'; Higginbottom, Daniel [DCA]; 'Deiss, Ronald W MVR'
Subject: Comments: Cedar Rapids draft for Public Flood Risk Study Report/EA Aug '10

RE:

August 2010
Cedar River
Cedar Rapids, Iowa
Flood Risk Management Project
Feasibility Study Report with Integrated Environmental Assessment
Public Review Draft

See p. 233 "5.1.9. Cultural Resources."

3rd paragraph--

The District and the City ~~is~~ are planning to conduct Phase I and II ~~architectural and architectural~~ surveys in order to identify archeological and architectural sites within the area of potential effect (APE) and to assess effects upon those identified as NRHP eligible or listed properties. Both of these phased surveys will be completed using costs as part of the planning phase of the Project. If mitigation is required for any NRHP archeological and architectural sites, these costs will be covered up to 1 percent of total construction costs. An exception to an increase above 1 percent of total construction costs requires approval of the Corps Headquarters.

Recommended changes in red.
JFD

John F. Doershuk, Ph.D.
State Archaeologist
University of Iowa

3.

McGuire, Lonn I MVR

From: Zukowski, Michael P MVR
Sent: Friday, September 03, 2010 1:49 PM
To: McGuire, Lonn I MVR
Subject: FW: FLOOD CREST PROTECTION LEVEL FOR CEDAR RAPIDS?
Attachments: FLOOD CONTROL--ALTERNATE 4C PG 227.jpg

As we discussed this PM

-----Original Message-----
From: iowalive [mailto:iowalive@q.com]
Sent: Friday, September 03, 2010 1:12 PM
To: Fournier, Ronald F MVR; Zukowski, Michael P MVR
Cc: Dolan, Marsha G MVR
Subject: RE: FLOOD CREST PROTECTION LEVEL FOR CEDAR RAPIDS?

Greetings, Ron Fournier & Michael Zukowski--

Thank you for your fast and helpful response! We did find Alternate 4C on page 227--as attached. We incorrectly read the table of contents as page 277. :-(

Thank you for clarifying the process underway to obtain floodwall approval and funding. We hear Pelosi is getting into the act as well—to the extent she will authorize taxpayer funding to protect the west side of the river.

From your description of the floodwall height, it appears a flood crest of 27 feet would overtop the floodwall.

Ron, at your suggestion, we herein ask Michael Zukowski, the following questions:

1. At what flood crest level will the floodwall be overtopped? You can choose the exact downtown location along the floodwall at your discretion.

2. How much higher will the water rise on the west side of the river as a result of the floodwall preventing water from flooding the east side? We expect it could be as much as 5 feet—at the floodwall overtopping level.

3. Will the 100 and 500 year flood plains on the west side of the river be moved much closer to the river as a result of the floodwall?

a. If yes, about how much closer?

4. Will the floodwall require recalculation of the 100 and 500 year flood plains on both sides of the river?

Sincerely,

Iowalive

4.

McGuire, Lonn I MVR

From: Dolan, Marsha G MVR
Sent: Tuesday, September 07, 2010 6:22 AM
To: McGuire, Lonn I MVR
Subject: FW: Cedar Rapids forced buyouts.

Marsha Dolan
Public Involvement Specialist
US Army Corps of Engineers
PO Box 2004
Rock Island IL 61204-2004
309.794.5648

-----Original Message-----
From: Sarah Furnish [mailto:gofurnish@yahoo.com]
Sent: Friday, September 03, 2010 9:41 AM
To: Dolan, Marsha G MVR
Subject: Cedar Rapids forced buyouts.

Hello,
I just wanted to let you know that Cedar Rapids citizens do not support the preferred plan. The city has tried to systematically remove a neighborhood for redevelopment. They do not want to pay a dime towards flood protection on the west side of town they want FEMA and the Corps to pay for it. Isn't it time the city of Cedar Rapids start taking some responsibly for it self instead of taking money from American tax payers? Can't the already existing berm be raised and reinforced where it is already? The city's green-way and new levy rips through neighborhoods were flood victims have already returned. The city has done it's best to make it impossible for most to return. City officials were recently quoted in the Cedar Rapids Gazette as saying, "They can come back if they want but they will all be eventually asked to leave. This has been everything but a voluntary buyout, ask around!
Thank you,
Sarah Furnish

5.

Zukowski, Michael P MVR

To: Susan Corrigan
Subject: RE: Flood protection corp of engineers

-----Original Message-----
From: Susan Corrigan [mailto:susancorrigan@imonmail.com]
Sent: Monday, September 06, 2010 6:41 PM
To: Zukowski, Michael P MVR
Subject: Flood protection corp of engineers

Hello, pls advise if I should be sending this to someone else. Your name was the only one I could find to provide my input on the flood protection plan for Cedar Rapids.

I cannot support the Army Corp of Engineers assessment that public dollars be allocated to protect the east side of the Cedar River but not the west side of the river in Cedar Rapids. Flood protection is funded by the government (and I recognize that some of this may be shared at different levels: local, state, and federal); whereas, the decision to not protect, places the entire financial burden for protection on the individual, business or organization. Millions of private dollars have been spent by west side entities to recover from the 2008 flood in anticipation that while it would take time, better flood protection would be put in place. Many taking out tremendous amounts of debt to help themselves.

A personal example is my church, Saint Patrick's, located on the west side of the river. This is a beautiful, historic church built in 1891. Parishioners have funded the return of the church and are completing a million dollar fundraiser to bring back the community center. This is more than two years after the flood and we're still raising money to bring it back. Relocating the church and community center is not reasonable. It is a historic building and too many dollars are invested. Flood insurance is expensive---full coverage for building and contents is no longer optional given the risk. The recovery and additional flood insurance costs are borne by private citizens.

This is one example in thousands.

The three basic issues that I have:

1) it is incredibly inequitable to have our government provide flood protection in this manner as it unfairly financially burdens west side residents and businesses. Flood protection should be provided in a similar fashion that other government funded services are provided (streets, police, fire). These are not determined on the "value" of the resident or business.

2) flood protection on the east side will only heighten the probability for additional flooding on the west side in the next event and

3) scientific evidence shows that flooding is a real issue to contend with in Cedar Rapids due to culmination of watershed issues, climate changes (more precipitatation), and other environmental factors. Iowa has been experiencing more flooding - most recently this year was the extensive damage at Lake Delhi; Ames, and Des Moines. But science hasn't been able to predict when and where the "concentration" or "deluge" of precipitation will occur and what location will bear the downstream impact.

STATE HISTORICAL SOCIETY of IOWA

A Division of the Iowa Department of Cultural Affairs

Your request for comment by the State Historic Preservation Officer has been received.

Date Received: **9/10/2010** End of 30 Day Period: **10/10/2010**
Agency: **COE** SHPO R&C #: **090657190**

CEMVR-OD-P-2010 - CITY OF CEDAR RAPIDS - CEDAR RIVER, CEDAR RAPIDS, IA, FLOOD RISK MANAGEMENT FEASIBILITY STUDY REPORT - PUBLIC NOTICE - AGENCY DETERMINATION

In accord with federal regulations, our office will respond **ONLY** when:

- The SHPO has received incomplete information or inadequate documentation under 36CFR800 11(a), (d), and (e) **OR**
- The SHPO objects to your definition of the Area of Potential Effect (APE) for the undertaking **OR**
- The SHPO objects to your finding of whether a property is or is not eligible for listing on the National Register of Historic Places **OR**
- The SHPO objects to your finding of the project's effect on a historic property **OR**
- The project is proposed to have a "No Adverse Effect," with or without conditions, and where the SHPO disagrees with the finding **OR**
- The project is determined to have an "Adverse Effect" on a historic property and the federal agency is consulting with SHPO on how to resolve such "Adverse Effects"

Otherwise, at the end of the 30-day period, you may either proceed to the next step in the process based on the finding or determination, or consult with the Advisory Council on Historic Preservation in lieu of the SHPO. In order to determine the next step in the process, please review the appropriate section of the federal regulations [36CFR800.4(d)(1) or the Programmatic Agreement under which your project is being reviewed.

Be advised that the successful conclusion of consultation with the SHPO does not fulfill the agency's responsibility to consult with other parties who may have an interest in properties that may be affected by this project. Nor does it override the sovereign status of federally recognized American Indian Tribes in the Section 106 consultation process.

We have made these comments and recommendations according to our responsibility defined by Federal law pertaining to the Section 106 process. The responsible federal agency does not have to follow our comments and recommendations to comply with the Section 106 process. It also remains the responsible federal agency's decision on how you will proceed from this point for this project.

Should you have any questions please contact me at the number or email below, **referencing the R&C # above.**

SHPO Review & Compliance Coordinator
(515) 281-8743

7.

McGuire, Lonn I MVR

From: Amy Homan [ahoman@iowanorthern.com]
Sent: Wednesday, September 15, 2010 8:49 AM
To: McGuire, Lonn I MVR
Subject: Cedar River Flood risk Mgmt project

After brief review of the proposed plans two things come to mind:

1 - If I am reading the report correctly, the area near Quaker Oats (Cedar Lake) and Penford Products (8th Ave SW side) would not be fully protected?

Protecting the existing industry on both sides of the river, including the Cedar Lake area would be of highest priority. These industrial businesses cannot be cost effectively moved and the city cannot afford to lose any additional business.

2 - Relocating the residential sections, while it may be emotionally upsetting to some, appears to be the most cost effective measure to provide the river ample opportunity to spread out and slow flooding, should this happen again.

Sincerely.

Amy Homan

2705 30th Street SW

Cedar Rapids, IA 52404

8.

McGuire, Lonn I MVR

From: John Houck [jhouck@linnareacu.org]
Sent: Wednesday, September 15, 2010 9:39 AM
To: McGuire, Lonn I MVR
Subject: Environmental Impact Effects

First, I'm in favor of the "No Action Alternative." What is the benefit to protecting the east side against a flood comparable to the 2008 flood. Cedar Rapids may experience another flood producing a river level 2 feet higher than the 2008 flood. What then? Also, there is a lot of benefit to a "greenspace." I'm in favor of people building in areas where they will not be impacted by flooding.

Secondly, the feasibility report which you've provided for review is overwhelming, difficult to read off a diskette, problematic to reprint so a hard copy may be obtained, overly technical, and probably an exorbitant expense for tax payers. This presentation in the Cliffs Notes format would have been acceptable.

John Houck

Property owner 41-49 16th Ave. SW, Cedar Rapids

(319) 350-0937

Electronic Privacy Notice. This e-mail, and any attachments, is only intended for the person(s) to whom it is addressed and may contain confidential information. If you are not the intended recipient, please be advised that you are legally prohibited from retaining, using, copying, distributing, or otherwise disclosing this information in any manner. If you have received this e-mail in error, please notify the sender and delete it immediately. Thank you for your cooperation.

STATE HISTORICAL SOCIETY of IOWA

A Division of the Iowa Department of Cultural Affairs

September 15, 2010

In reference to R & C#: 090657190

Mr. Ron Deiss, Archaeologist
Corps of Engineers – Rock Island District
Clock Tower Building P.O. Box 2004
Rock Island, IL 61204-2004

RE: COE – LINN COUNTY – CITY OF CEDAR RAPIDS – FLOOD RISK MANAGEMENT FEASBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT – (FONSI)

Dear Mr. Deiss,

We have received the Corps' August 30, 2010 letter and the attached draft *Cedar River Cedar Rapids, Iowa Flood Risk Management Project. Feasibility Study Report with Integrated Environmental Assessment.* We offer the following comments and recommendations regarding pages 249 – 252 for your consideration.

Page 249
Paragraph 2, line 3: change "…and the Iowa SHPO…" to "…and the Iowa State Historic Preservation Office (hereinafter referred to as "SHPO")…"

Page 250

Paragraph 4, line 4: change "….with SHSI;" to "... with SHPO;".

Paragraph 5, lines 2 and 6: change "SHSI" to "SHPO".

Page 251

Paragraph 2. Complete the paragraph with the following: "Future archaeological investigations shall be guided by the geomorphological assessment and landform suitability model developed by Bear Creek Archeology and proposed in the report *Background Cultural Research and Geomorphological Investigation of Measures for the Cedar River Flood Risk Management Feasibility Study Linn County, Cedar Rapids, Iowa [BCA 1620].*

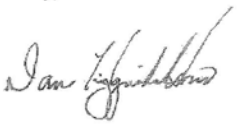
Paragraph 3. The PA also allows for a phased approach to the identification and evaluation of historic properties [36 CFR 800.4(b)(2)] and coordination with NEPA [36 CFR 800.8]. These are important points and should be made in the EA document.

Paragraph 4, lines 4 and 5: change "and other consulting parties to *evaluate* the significance of the historic property and *assess* potential effects."

Page 252
Paragraph 2, line 1: change "Upon execution of the PA, and promulgation by extensive correspondence with numerous consulting parties…" to "Upon execution of the PA, and implementation of its terms…".

Thank you for providing our office with the opportunity to review and comment. Please feel free to contact me at (515) 281-8744 or by email at Daniel.higginbottom@iowa.gov if you have any questions or require further assistance.

Sincerely,



Daniel K. Higginbottom, Archaeologist
Iowa State Historic Preservation Office

10.

Sunday, September 19, 2010

To: Mr. Lonn McGuire
U.S. Army Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Via: E-mail to Mr. McGuire at: lonn.i.mcguire@usace.army.mil
Cc: marsha.g.dolan@usace.army.mil and Christopher.P.Haring@usace.army.mil

Re: CEDAR RIVER/CEDAR RAPIDS, IOWA FLOOD RISK MANAGEMENT PROJECT FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT PUBLIC REVIEW DRAFT August 2010

From: Ashley L. Super, CPPB Retired
5160 16th Ave SW, Apt # 10
Cedar Rapids, IA 52405
Phone: 319-396-4217 / Mobile: 515-249-3603
Email: ASuperShe@aol.com

Dear Mr. McGuire,

In accordance with the invitation at
http://www.mvr.usace.army.mil/PublicAffairsOffice/CedarRapids/CedarRapids.htm
I am submitting the following comments and questions concerning the Feasibility Study Report Draft. I also plan to attend the Public Meeting at 6 p.m., September 21 in the Grand Ballroom of the Crowne Center Plaza Five Seasons Hotel. Thank you for this opportunity to participate in this process.

1) Political Meddling with Corps' Unbiased Findings. On Page 2 of the Study Report's Executive Summary, it is stated, "Alternatives 1A and 1A-C are NOT economically justified. Only two alternatives, Alternatives 4C and 10E, remain for comparison and consideration as the recommended plan." Also, as confirmed in the Corps public report to the Mayor, June 23, 2010, Page 17, "Alternative 1 is the closest to the City's Preferred Plan."
http://www.mvr.usace.army.mil/PublicAffairsOffice/CedarRapids/CRInfoBrief-23June2010.pdf.
Further, in the Executive Summary of the study Report on Page 3, it states, "The District has requested approval from the Assistant Secretary of the Army for Civil Works to recommend Alternative 4C as the Federally Supportable Plan (FSP)." Also on page 151 in Table 30 of Iteration One, Feature S25 (Construct Floodwall at Ellis) the Corps states the Flood Mgmt Effectiveness would be zero and was removed from Further Consideration" and on Page 157 it states "Subsequent discussions with the City narrowed the measures to levee/floodwall alignments for the downtown Cedar River Corridor."

However, it is reported that US Senator Charles Grassley disagrees with your expert recommendation. "Grassley promised that the Iowa congressional delegation will do battle with the Army Corps of Engineers to make sure it gives fair consideration to The City's Plan." --- The Gazette, Aug 31, 2010, 3rd Paragraph at:
http://easterniowagovernment.com/2010/08/30/until-senate-ends-earmarks-grassley-will-seek-iowas-share/

Questions: a) What additional expert information would the Corps need to change its mind?
b) How can / does politics enter into the equation?

I realize that the Assistant Secretary of the Army for Civil Works [ASA(CW)] may grant an exception when there are overriding reasons for selecting another plan based on other Federal,

State, local and international concerns, however, I fail to see how the Corps should be forced to change their recommendations prior to justifications are made for such an unusual exception. I recommend that you let the ASA(CW) office do what it feels it must do, but stand your ground on your own professional judgments.

2) Lack of Citizen Involvement. On Page 110 of the study report, it states, "The majority of those impacted by the 2008 flood in Cedar Rapids were the low-income and the elderly... have the least access to resources, and lack the political and social connectedness..." I must point out how this is so true especially when it comes to being able to protect their property from government abuse, specifically, from prominent connected elitists within city government and their friends within state and federal government, as well as their interests with private contractors and developers. Many residents feel demonized by the city and have not had adequate representation in any of the processes revolving around recovery plans. From the stories I have heard from the residents, I believe this to be true.

   On Page 113 in Section 3.2.1 it states "the City has engaged community residents in the creation of the RCRP." Phase One of the plan focuses on flood management strategies to maximize protection from future flood losses, choosing a preliminary flood management alignment which would allow the community to move forward with redevelopment planning, and the receipt of feedback from residents on issues such as flood management, housing, sustainable neighborhoods, business reinvestment, etc. Three open houses were held as part of the Phase One process with a total attendance of over 2,600 people at those meetings."

   Moreover on Page 142 it goes on to say, "More than 1,400 citizens came together spending thousands of hours of planning time at eight public meetings to contribute to creating their vision for neighborhood reinvestment in the City's nine flood affected neighborhoods. [ ] A new 220 acre greenway along both banks of the Cedar River is a major component of Cedar Rapids' preferred flood management strategy. The greenway concept grew out of community input during the first phase of flood recovery planning in 2008"

   I've heard many complaints from residents that there concerns were totally ignored by the city and I am greatly concerned that the Corps did not hold its own independent meetings with residents; choosing to rely and trust only the City's word of the input.

3) Stories of Fraud, Harassment, Extortion and Misrepresentation

   In Section 3.2.1.3 it states, "The City defined construction zone was established to provide a corridor for the Study to potentially adjust to the City's planning efforts (yellow areas in figure 52)."

   It may interest the Corps to know that a) the city is proceeding with construction preparations, leveling the neighborhoods, as if the City's plan was already approved and fully funded, which it is not the case; b) The city is telling residents that the Corps has approved of the City's plan to tear down their homes for flood mitigation measures; c) the City is using the "eminent threat" excuse without justification to tear down repairable homes without owner permission or adequate compensation; d) properties that are indeed under City control which are clear eminent threats are allowed to stand and to fester to devalue the neighborhood further and drive remaining residents to abandon their homes, endangering families in the process.

4) On Page 115 it states, "A watershed plan needs to be incorporated". Question: Where is this plan and how is it being implemented?

5) On Page 116 it states, "The City's recovery efforts include a voluntary property acquisition program funded by two Federal sources and a potential local source (city/state)." Again, in talking with the residents in the presumed "Construction Zone", many residents Do Not fell the

buyouts are Voluntary by any definition of the word. The residents feel harassed and victimized by the city's efforts to drive them to sell their property at pennies per dollar or to simple abandon their property all together. Many have nowhere else to go or the resources to relocate. If one was to investigate how federal and state recovery funds were actually being spent, much of it may be found to have gone to "alternate purposes" as stated by the Mayor in April, and to harassing residents, demolishing their homes without proper compensation. From the stories I have heard, it is my hope that the Federal Government calls for a US special prosecutor to put a hold on the whole mess and to perform that investigation in front of a grand jury.

Sincerely,

Ashley Super
Concerned citizen

11.

McGuire, Lonn I MVR

From: David & Joyce Smithers [smithers@netins.net]
Sent: Sunday, September 19, 2010 7:07 PM
To: McGuire, Lonn I MVR; ASuperShe@aol.com
Cc: Jones, Dawn; Lori Nelson; Marlon Pierre-Antoine; MonaShaw@aol.com; Paul Deaton; Paul Street; Dolan, Marsha G MVR; Haring, Christopher P MVR
Subject: Re: Comments on CEDAR RAPIDS FLOOD RISK FEASIBITY STUDY REPORT

Ashley,
Please publish this on your facebook notes. I hope that the Army Corps refuses to be part of the war on the flood victims of Cedar Rapids. Rather, I would like the Corps be part of a public works program that rebuilds the workers' neighborhoods of Cedar Rapids, IA.

The people are losing hope that justice exists under our capitalist form of government. Disaster capitalism seems to become more and more what people experience all of the time. It doesn't have to be this way.
David Smithers
Box 357
Wellman, Iowa 52356-0357

----- Original Message -----
From: ASuperShe@aol.com
To: lonn.i.mcguire@usace.army.mil
Cc: Christopher.P.Haring@usace.army.mil ; marsha.g.dolan@usace.army.mil
Sent: Sunday, September 19, 2010 6:42 PM
Subject: Comments on CEDAR RAPIDS FLOOD RISK FEASIBITY STUDY REPORT

To: Mr. Lonn McGuire

U.S. Army Corps of Engineers

Clock Tower Building, P.O. Box 2004

Rock Island, Illinois 61204-2004

Via: E-mail

Re: CEDAR RIVER/CEDAR RAPIDS, IOWA FLOOD RISK MANAGEMENT PROJECT FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT PUBLIC REVIEW DRAFT August 2010

Dear Mr. McGuire,

In accordance with instructions at http://www.mvr.usace.army.mil/PublicAffairsOffice/CedarRapids/CedarRapids.htm, I am submitting the attached comments (PDF) concerning the Feasibility Study Report Draft. I also plan to attend the Public Meeting at 6 p.m., September 21 in the Grand Ballroom of the Crowne

12.

McGuire, Lonn I MVR

From: Haring, Christopher P MVR
Sent: Monday, September 20, 2010 5:47 AM
To: McGuire, Lonn I MVR; Jackson, Sharryn A MVR; Dolan, Marsha G MVR
Subject: FW:

FYI....you may have seen this in other emails, if so please discard

-----Original Message-----
From: Greg Vail [mailto:vailnsons@yahoo.com]
Sent: Sunday, September 19, 2010 9:40 PM
To: Haring, Christopher P MVR
Subject: Fw:

----- Forwarded Message ----
From: Greg Vail <vailnsons@yahoo.com>
To: tbranstad@governorbranstad2010.com
Sent: Sun, September 12, 2010 11:01:50 AM
Subject:

dear mr Haring i am sending you a copy of this because i believe the city of Cedar Rapids idea for a flood wall will create more danger for the neighborhoods.I hope you can help us get more proof on the point I make in issue number three. We live in the greenway and do not approve of the cities' preffered plan and understand the A.C.E. does not approve of their plan either. i hope we can work together. Issue number one and two may be of some interest to you also.

My name is Gregory Vail and I live at 1426 1st st n.w. in Cedar Rapids, IA 52405 (319)9813747. While meeting with Terry Brandstad, Carmine Boal, an Jimmy Centers at Cooper's Mill in Cedar Rapids these are the issues that i brought up that i felt were of the greatest concern to this community.

1) The city has forced people out of their homes. FEMA did not offer an "involuntary buyout". Under a "voluntary buyout" :

- Denying building permits qualifies as coercion
- Denying volunteer assistance is coercion
- Denying information for proper decisions is coercion
- Denying "Jumpstart" funding for rebuilding is coercion

The city set up "zones" and then discriminatorily treated the homeowners in these "zones" differently than all other flood victims. The people in these "zones" are being treated with psychological warfare still today, and literally threatened to be "forced to move in the future". This is even though "eminent domain" cannot be declared in a "federal disaster area".

2) It would appear that FEMA is being defrauded by the city of Cedar Rapids. Homes are being declared an "eminent threat", when they are not, so that the city can get FEMA to pay for the demolition cost of the home. Homes are being claimed as "asbestos and lead" contaminated, when they are not, and falsely reported so that money for abatement can be received and "eminent threat" can be declared falsely. "Eminent threat is an ordinance created by city staff, after the flood, so they could make this possible."

3) The city is attempting to build a flood wall that will put the existing, already rebuilt neighborhood, at greater risk for flooding. The cities "Preferred Plan" to build a flood wall on the NW side of Cedar Rapids shows a flood wall that stops short of the area

where flooding starts in Cedar Rapids. if the area north of this wall floods as the water moves south this flood wall becomes a divide that will literally channel the water to flood the surrounding neighborhood. The United States Army Corps of Engineers does not support the city's "Preferred Plan."

Thankyou very much for your time and concern

Grgory Vail

13.

CEDAR RAPIDS
City of Five Seasons

September 29, 2010

Mike Zukowski
U.S. Army Corps of Engineers Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

Re: City of Cedar Rapids Comments on the draft Feasibility Study Report

Included in this letter are the City of Cedar Rapids comments on the draft *U.S. Army Corps of Engineers' Cedar River Cedar Rapids, Iowa Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment* (Feasibility Study Report) for inclusion in the required NEPA documentation.

1. The report does not discuss enough of the consequences of the levee on the west side over 22 ft (1% flood) event.
2. The Executive Summary was not direct enough.
3. A one side strategy has significant economic consequences that are not fully noted in the report.
4. How does the report take into account the soils of the SE side and water boils?
5. The Design Phase needs to add discussion for the Sinclair site and any possible brown field items in that area.
6. Section 3.1.1 uses 1991 FIRM Maps and says the 2010 is not approved. The City currently has 2010 approved FIRM Maps.
7. Section 3.1.4, under the Damage Reach Detail, has reach 1 in a different order than the rest. This is minor but the other reaches are easier to read.
8. The size of pumps mentioned in the report seems to be for a 1 or 2 year storm, which would not be large enough.
9. Page 223 indicates that the levee footprint and construction area could impact as much as 24 acres of wetland in the backwater area. If Alternative 1C were implemented mitigation would be required to replace lost wetland functions. Has any area been identified for replacement?

Office of the Cedar Rapids City Manager
City Hall • 3851 River Ridge Drive NE • Cedar Rapids, Iowa 52402 • (319) 286-5080 • FAX (319) 286-5144

CEDAR RAPIDS
City of Five Seasons

11. Page 225 indicates that the Cedar River Trail would be realigned, which will provide a safer recreational trail route. How do people access the downtown from the realigned rivers edge Cedar River Trail?
12. Has the Linn County Trails Association been consulted?
13. On page 233 under 5.1.9, the first sentence of the third paragraph repeats "architectural" when it should say "archeological". Is the APE defined elsewhere in the report?
14. On page 263 the first complete sentence in the first paragraph uses the word "rick" instead of "risk".
15. Can the trail realignment on C-101-4C-T be explained?
16. Are there openings and access to the Tree of Five Seasons located in the park space on the corner of 1st Avenue East and 1st Street NE?
17. It should be noted that the Parks and Recreation Department currently receives $165 per acre at Tuma Park which would be revenue lost if the area becomes a borrow site.
18. Can the trail realignment from Cedar Lake to 8th Avenue be integrated with the existing alignment to include an access through the flood wall/levee at its existing location at 7th Avenue SE?
19. How much space is planned between the trail and the floodwall?
20. Where does the funding come from for environmental remediation of properties in the proposed greenway and who is responsible for it?

Thank you for the continued ability to provide comments on this very important project. The City looks forward to continued coordination as this project becomes a reality. Please direct any questions regarding this letter to Adam Lindenlaub at 319-286-5064 or at a.lindenlaub@cedar-rapids.org.

Jeffery A. Pomeranz
City Manager

Office of the Cedar Rapids City Manager
City Hall • 3851 River Ridge Drive NE • Cedar Rapids, Iowa 52402 • (319) 286-5080 • FAX (319) 286-5144

14.

P.O. Box 2326
Cedar Rapids, Iowa 52406-2326
319-573-6809

21 September 2010

USACE Cedar River Study
Mr. Lonn McGuire
Environmental and Economics Branch
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204

Comments on Draft Feasibility Study Report for Flood Risk Management Project, Cedar River, City of Cedar Rapids, Iowa:

I first wish to enter my objection to the failure of the FSP to provide any protection to the west side of the river. This would damage the community in several ways. It would make it difficult or impossible to maintain most of the affordable housing near the city center. The cost to raise or flood proof the existing structures is beyond the means of many pre-flood residents. The expense of such flood proofing will increase substantially the cost of housing in the flood-affected areas, removing such properties from the affordable category. An area more than one kilometer wide will be paralyzed for redevelopment, resulting in increased sprawl. At the time the flood occurred, the City had begun initiatives to attempt to reduce sprawl, so failure to protect this area will work against goals the City had set before the flood. In addition, sprawl increases commuting distances and times, resulting in increased air pollution and costs for City operations. Protection of only one side of the river may cause resentments and social and political disunity that may take generations to overcome.

There are a few things I would ask the Corps to change in its recommendation. Two of them are the roller gates at the 8th and 12th Avenue bridges. I suggest eliminating the gates and taking the roads over the top of levees at these two locations. At the crest of the flood, both the 8th and 12th Avenue bridges were mostly above the water. With modification of the approaches, these two bridges could provide additional river crossings after all the bridges with gates would have to be closed. Admittedly, with no flood protection on the west side, the 12th Avenue bridge would be a "bridge to nowhere", but the City has expressed its determination to have the west side protected. The 8th Avenue bridge connects the Police Station and a small area that was an island during the flood to a river crossing that would allow access to and from the Police Station and connection to the protected area on the east side until a flood height reached about 28 to 29 feet at the "8th Ave" flood gage. Eighth Avenue SE and Diagonal Drive SW make up a route for emergency vehicles between Mercy Hospital and West side locations, including access to Interstate 380, so keeping this route open as long as possible during public emergencies seems to me a worthwhile goal.

At 8th Avenue, much of the road slope on the dry side of the levee would be adjacent to the Federal Courthouse, which has its first level about 10 feet above the street level at 8th Ave and 2nd Street SE, and a parking lot on the other side of 8th Ave. Any future structure on the south side of 8th Avenue would more easily accommodate the road climbing to the levee top during original construction than if the road slope is created after the building is constructed.

At 12th Avenue, the road slope on the dry side would be between 2nd and 3rd Streets SE. It appears the only the building currently occupied in the 200 block of 12th Avenue is the building on the north side of 12th Avenue facing 3rd Street. It would be better to have any change to street elevation in this

block take place before renovation of buildings than after renovation. Between the existing bridge abutment and the levee, 12th Avenue bridge should be extended to maintain floodway capacity an avoid creating, in effect, a "wing dam".

In the Draft study, the alternative 4C show the levee at 14th Avenue SE completely west of 2nd Street (Sta 245+80.00 to Sta 247+20.00). Alternative 4C profile sheet 2, ref# C-106-4C, shows a greater than one foot fall in water level over a short distance (about 130 feet) for the 0.2% probability event. Assuming this is correct, I advocate moving the levee in this area as far NE as possible, including, if necessary, closing 2nd Street in the 1300 block. This would appear to require no unplanned property acquisition.

Draft Alternative 4C also shows the levee skirting to the south of the Farmstead Foods (Wilson-Sinclair) property and the Rescar site. This forces the levee to be especially close to the river in this area and causes the plan to have as much as 900 to 1000 feet of additional floodwall construction than if the levee were continued across all of the Farmstead property and (at least part of) the Rescar property. As this area has a narrow river channel and a steep hill on the south side of the river west of the former Rock Island Railway bridge remnant, placing flood protection so close to the river on the north side seems undesirable. I understand the Corps has avoided these properties because of possible delays due to environmental cleanup of the sites. I urge the Corps to leave this alignment subject to change, if the City can perform cleanup of these sites sufficiently soon to allow the levee and floodwall construction within the planned time frame. In addition, alignment of the levee farther from the river in this area is closer to the City's preferred plan.

As the City and County have made siting decisions for repair or replacement of some of the damaged structures listed under "Damage Reach Details," Section 3.2.2 (pp116 ff) should have those decisions shown in the final report.

Finally, there a few items of minor errors in street names.
On page 63, 16th Ave Bridge is called the 16th Street Bridge.
On pages 162, 165, 166, 167, and 181 in the Descriptions of Alignment for some alternatives, 8th Avenue is called 8th Street and 12th Avenue is called 12th Street.
On page 171, 8th Avenue SW is called 8th Avenue SE.

I offer my best wishes for the success of the project.

Respectfully submitted,

Martin T. Smith

Martin T. Smith

McGuire, Lonn I MVR

14.

From: martin smith [mtsinflatland@gmail.com]
Sent: Thursday, September 30, 2010 12:08 PM
To: McGuire, Lonn I MVR
Subject: comments on Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project, Feasibility Study Report, from Martin T Smith

I wish to add a few comments to those I submitted at the meeting In Cedar Rapids on 21 September.

In view of the likelihood that the trend in climate is creating increased probability of large floods in Iowa, I request that the level of flood protection for the Cedar Rapids project be based on the peak flow rate experienced in 2008 representing the 0.2% per year probability event.

In my previous comments, I advocated that the levee at 14th Avenue SE be moved farther from the river. In a conversation at the 21st September meeting, I came to believe that the 16th Avenue Bridge is a barrier that creates a noticeable fall in river level during large floods. If the northeast approach to the 16th Avenue Bridge were changed to a bridge higher than the levee, the floodway capacity would be increased in this area. Raising the East approach would not create additional river crossing capacity during floods, unless the West approach were also raised.

I have already advocated raising the East approaches and eliminating gates at 8th and 12th Avenues to allow access to the highest river crossings as long as possible during major floods. If 14th Avenue were also taken over the levee top, it would create a consistency for road crossings in the New Bohemia area. I ask you to consider this change.

Martin T. Smith, Cedar Rapids, Iowa

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

SAVE THE CITY NOT JUST DOWN TOWN — I HAVE LIVED IN THE SAME HOUSE FOR 54 YRS, WHY WOULD ANYONE BUILD ONLY ON THE ~~EAST~~ AND PUSH WATER BACK ON THE WEST — DOING MORE DAMAGE — DO NOT BUILD — DONT SACRAFICE SW SIDE FOR DOWN TOWN,

All comments should have the following information to be included in the record. PLEASE PRINT.

Name ROBERT WILLIAMS

Agency/Organization (if applicable) _____

Address 520 7TH AVE SW

City CEDAR RAPIDS. State IA, Zip 52404

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

16.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I do not want anything built that will send the flood water to my home on the SW side

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Todd Cobb

Agency/Organization (if applicable) _____

Address 74 22nd Ave SW

City CR State IA Zip 52404

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

17.

PEORIA TRIBE OF INDIANS OF OKLAHOMA
118 S. Eight Tribes Trail (918) 540-2535 FAX (918) 540-2538
P.O. Box 1527
MIAMI, OKLAHOMA 74355

CHIEF
John P. Froman

SECOND CHIEF
Jason Dollarhide

September 15, 2010

District Engineer
U.S. Army Corps of Engineers
Rock Island District
ATTN: OD-P(Wayne Hannel)
Clock Tower Building—P.O. Box 2004
Rock Island, Illinois 61204-2004

RECEIVED
SEP 17 2010
CEMVR-OD-P

RE: CEMVR-OD-P-2010-0996

Thank you for notice of the referenced project. Please note that the contact person has changed, Frank Hecksher is the new Section 106/NAGPRA representative. The Peoria Tribe of Indians of Oklahoma is currently unaware of any documentation directly linking Indian Religious Sites to the proposed construction. In the event any items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during construction, the Peoria Tribe request notification and further consultation.

The Peoria Tribe has no objection to the proposed construction. However, if human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction should stop immediately, and the appropriate persons, including state and tribal NAGPRA representatives contacted.

John P. Froman
Chief

TREASURER John Sharp | SECRETARY Hank Downum | FIRST COUNCILMAN Carolyn Ritchey | SECOND COUNCILMAN Jenny Rampey | THIRD COUNCILMAN Alan Goforth

NO To The "Preferred Plan"

18.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Has the "berm" been considered in any of these plans? Would it not be wise to fix the "berm" so that it fit the "Standards"? It's made up of dirt. I have video.

This Has NOT been voluntary in any way! The people were forced to sell so you guys could put a "floodwall" in on the West side!

Our city has lied to all of us. Please help us! Many people agree that protecting both sides of the river feasible.

Where is the historical appreciation?

Who is in Charge here. We have the finger pointing game going on here.

WHO will HELP the PEOPLE?

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Ajai Dittmar

Agency/Organization (if applicable) CAVE

Address 1426 1st. St NW.

City Cedar Rapids State Iowa Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I know that the Army Corps' report is limited by the rules you must follow, but I hope congress will support alternatives that protect the west side of the city. We must have better protection than the Corps' recommended plan. It is unjust.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Courtney Ball

Agency/Organization (if applicable) Matthew 25 Ministry Hub

Address 1236 8th St. NW

City Cedar Rapids State IA Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:

US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

My Favorite is Alternative Alignment 4.C
Also Typical sections - Levee and Flood Walls
and Pumping Plants.
like the city of New Orleans
once Given a chance in Cedar Rapids.
It will Reduce Flooding in the Future?
Similar idea with lock and Dam No. 11
has Pumping plant IN Dubuque?

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Beverly Kinney

Agency/Organization (if applicable) _____

Address 1433 C Ave. N.E

City Cedar Rapids State Iowa Zip 52402

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

21.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I believe that there are several problems with the Army Corps cost benefit analysis process.

1. It fails to place any value on people and disruption to neighborhoods when they flood. This disruption comes with an economic cost just as substantial as bricks and mortar.
2. It is disengenous for FEMA and the SBA to give people money to rebuild and then place a levee on the other side of the river that will increase flooding. People should have been told of this before they re-invested and were tranped in mortgages and SBA loans on homes they can't sell due to a lack of flood protection.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Clint Twedt-Ball

Agency/Organization (if applicable) Matthew 25

Address 400 3rd Ave. SW

City Cedar Rapids State IA Zip 52402

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Since the Event of 2008
The City has chosen to build Federal Courthouse and close 3rd. building and closing the street. Event Center ending on to building. Also alot of other Buildings.
This displaces water and Pushes water to the west side. Creating a Dam.
Walls will raise ~~not~~ west side water.
These buildings should be taken into divisions.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Rick Davis

Agency/Organization (if applicable) _____

Address 612 moose Drive

City CR State Iowa Zip 52405

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US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
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Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

23.
23.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

By not protecting the west side, economic development will be severely impacted and the area will not recover, let alone grow and progress. Acres of land will essentially be written off right in the center of the city. No large investments of infrastructure by private developers will be made with the east side protected and the west side subject to increased flooding. Thus the west side will never reach the BCR needed to achieve funding recommendation. Ultimately it is a ~~recipe~~ recipe for deterioration of the tax base and quality of life.

The value of older homes should not be depreciated. The fact is rebuilding costs are not decreased because they are old and they are more well-constructed than new homes. This criteria is flawed and should be changed.

The most important loss on the west side is the older historic fabric of the city which cannot be quantified. It will continue to deteriorate and the loss to the city will be immeasurable.

The Czech Village area is a tourist destination that attracts millions of dollars in economic impact to the city. It will be endangered by an unprotected river.

over

All comments should have the following information to be included in the record. PLEASE PRINT.

Name GAIL NAUGHTON

Agency/Organization (if applicable) NATIONAL CZECH & SLOVAK MUSEUM & LIBRARY

Address 87 16TH AVE. SW

City CEDAR RAPIDS State IA Zip 52404

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

23.

~~It appears that~~ The BCR calculation favors protection of business and industry but not homes and neighborhood businesses. This is an inequity in the process that should be addressed.

24.
24.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

- I am concerned about the lack of accounting for social justice issues in the economic assessment process. The West Side provides neighborhoods of affordable housing that are very important to the workforce of the city.

I am also concerned about what the permanent floodwalls on the east side of the city will do the economic viability of the downtown, since they cut off recreational & cultural uses along the river that could generate revenue & growth in the downtown.

I think the overall CBR process needs to look at more than just the economic value of properties & look more holistically at the quality of life in the city. It also needs to link into larger efforts to improve watershed management.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Karen Brook

Agency/Organization (if applicable) Trees Forever

Address 770 7th Ave.

City Marion State IA Zip 52302

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

25.
25.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Our City lost hundreds of Affordable homes. Any plan that does NOT offer protection to these rebuilt Affordable homes is of Zero value to our City.

I understand the need for the 1 to 1 RATIO of cost to protection but certainly hope that Congress will insert common sense into the RATIO And Approve our Request to protect both sides of the river.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Chuck Swore

Agency/Organization (if applicable) Cedar Rapids City Council

Address 2609-1st Ave N.W.

City Cedar Rapids State Iowa Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

26.
26.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I HATE TO SEE THAT THE 4C OPTION RECCOMENDED BY THE CORP WILL RESULT IN MORE DAMAGE TO THE WEST SIDE DURING A FLOOD OF THE 2008 MAGNITUDE, THE DOWNTOWN AREA ON the EAST SIDE IS DYING AND THE CHAMBER of COMMERCE AND Real Estate PEAPLE CONTROL THIS TOWN AND COULD CARE LESS ABOUT THE RESIDENTS OF THE WEST SIDE!

All comments should have the following information to be included in the record. PLEASE PRINT.

Name EDWARD CASTELEIN

Agency/Organization (if applicable) _____

Address 3327 ELLIS Rd N.W.

City CEDAR RAPIDS State IA. Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
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Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

27.
27.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

- Pumping ~~capic~~ capacity is a concern for rain events. Just this week was a 1yr event in the downtown.
- Solid walls through downtown ~~by~~ may cause decreased values for properties and decrease enjoyment of the river.
- Value basis was not explained well a future needs to explain more
- Pumping capacity needs to meet 100yr Rainevent.
- Room for mtg was good and accessable.
- "BCR" → slide should be Benefiet to Cost Ratio (BCR)
- COL stated he was color blind. How can he be a line officer? Combat Arms Officer?
- An option to protect Penford needs to be considered, High ground, high ~~#~~ item. ~~one~~
- Slide show example $ cost was needed to explain the economic valv of a benefiet.
-

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Craig Hanson

Agency/Organization (if applicable) _____

Address 7425 Normandy DR NE

City CR State Ia Zip 52402

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

28.
28.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Will there be citizen representation in Washington DC.?
You can move the Missouri River for Carter Lake Iowa in Omaha, Neb?

Cut through the Dump and stop toying with our Lives!

All comments should have the following information to be included in the record. PLEASE PRINT.

Name _____

Agency/Organization (if applicable) _____

Address _____

City _____ State _____ Zip _____

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Diamond V

P.O. Box 74570
Cedar Rapids, IA 52407-4570
Tel.: 800-373-7234 319-366-0745

29.

September 23, 2010

US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg., PO Box 2004
Rock Island, IL 61204-2004

Dear Mr. McGuire:

Thank you for the opportunity to provide comment regarding the Cedar River Cedar Rapids, Iowa Flood Risk Mitigation Project.

Diamond V is a sixty-seven year old company founded in Cedar Rapids. We have two major facilities located in the Time Check neighborhood in Cedar Rapids. Our corporate headquarters is located at 838 First Street N.W., and our major manufacturing facility is located at 436 G Avenue N.W. Both facilities were significantly damaged during the flood of 2008.

The District will be recommending Alternative 4C as the FSP. This alternative provides no flood risk protection to the West side of Cedar Rapids. The implementation of 4C will provide protection to the East side of Cedar Rapids during flood events while causing further damage to homes, businesses and other structures located on the West side of Cedar Rapids. Another flood event similar to 2008, would increase water surface elevations by 2.35 ft. resulting in significantly greater damage to both Diamond V's facilities. Having constructed an additional manufacturing facility in 2009, I can accurately estimate the replacement cost of our existing facility located at 436 G Avenue N.W. in the $50 - $60 million range.

Additional facilities on the West side of the Cedar River would suffer also. Penford Products, the Czech-Slovak Museum, Cedar Rapids Police Dept., Linn County Sheriff office; Wells Fargo Louis B. Sullivan bank building, schools and other public infrastructure are just a few examples of significant assets that would be damaged again, in addition to the many homes and commercial properties located on the West side of the river.

Based upon the information provided, it would cost approximately $250 million to protect both sides of Cedar Rapids with a meaningful flood risk mitigation plan. I believe this would be a prudent course of action to protect Iowa's second largest city and significant manufacturing

Corporate Offices:
838 1st Street NW
Cedar Rapids, IA
Fax# 319-366-6333

Manufacturing Facility:
436 G Avenue NW
Cedar Rapids, IA 52405
Fax# 319-298-1081
Fax# 319-398-1032

Technical Center
Kirkwood College Campus
6301 Kirkwood Blvd. SW
Cedar Rapids, IA 52404

E-mail: diamondv@diamondv.com

http://www.diamondv.com/

Diamond V

P.O. Box 74570
Cedar Rapids, IA 52407-4570
Tel.: 800-373-7234 319-366-0745

29.

center. I completely understand the US Army Corps of Engineers is bound by law in the methodology, BCR requirements, etc. Yet I struggle to grasp how any government entity can recommend construction of a protection system that will knowingly cause increased damage to public and private infrastructure and increased risk to public safety on the West side of Cedar Rapids.

I strongly support the City of Cedar Rapids recommended flood protection Alternative 1.

If you have any questions, you may contact me at the telephone number shown above or email at jbloomhall@diamondv.com.

Thank you.

Sincerely,

DIAMOND V MILLS

John C. Bloomhall

John C. Bloomhall
President, C.E.O.

JCB jb

Corporate Offices:
838 1st Street NW
Cedar Rapids, IA
Fax# 319-366-6333

Manufacturing Facility:
436 G Avenue NW
Cedar Rapids, IA 52405
Fax# 319-298-1081
Fax# 319-398-1032

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Cedar Rapids, IA 52404

E-mail: diamondv@diamondv.com

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Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

IT IS TOTALLY RIDICULOUS TO PROJECT ONLY ONE SIDE OF THE RIVER.
I ALSO FEEL WE NEED MORE ACCESS THROUGH THE WALLS.
I THINK WE CAN WORK WITH WALLS BUT NEED TO BE ABLE TO ~~[illegible]~~ HAVE VENUES ON THE RIVER SIDE FOR WHEN FLOODING IS NOT A PROBLEM AND WE CAN ENJOY THE RIVER
I THINK MORE THAN LEVEES CAN BE USED IN TIME CHECK/WEST SIDE TOWN AND CZECH AREAS.
THIS WHOLE FLOOD RECOVERY AND CORPS PROCESS SHOWS HOW OUT OF TOUCH WITH REALITY OUR GOVERNMENT PROCESSES AND AGENCIES ARE.
SOMEONE RECENTLY SAID THAT OUR GOVERNMENT JUST PLAIN DOES NOT KNOW HOW TO RECOVER, EITHER FROM A DISASTER OF PHYSICAL OR ECONOMIC NATURE.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name JOHN WASTA

Agency/Organization (if applicable) _____

Address 221 KENT CT NE

City CEDAR RAPIDS State IA Zip 52402

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I am appalled that all focus is on dollars and no study has been done on the effect this has on human life and well-being. The people on the West side of Cedar Rapids have been through enough! Now we are told there is not enough value in our re-stored homes to deserve a levy or flood wall on the West side of the Cedar River. The flood itself did not take any human lives — but the purposeful denial of protection for the West side increases the potential for added stress, mental breakdowns, suicide attempts, family break-ups — and more damage and loss to our newly renovated homes and neighborhoods. We are TIRED of the constant work, worry and depression. Give the West side EQUAL treatment as the businesses they work for. We will work on finding funds!

All comments should have the following information to be included in the record. PLEASE PRINT.

Name * Sandra M Skelton

Agency/Organization (if applicable) _____

Address 1125 - 10th St. N.W.

City Cedar Rapids State IA Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

32.

McGuire, Lonn I MVR

From: Patty Carter [twostardet@imonmail.com]
Sent: Monday, September 27, 2010 10:37 AM
To: McGuire, Lonn I MVR
Subject: Flood Management Project for the Cedar River, Cedar Rapids, Iowa

It seems to me that as the proposed flood control projected for the east side of the river, you are projecting a much more serious flood on the west side, because your present program is forcing all the water to the west side, to spread out for control purpose. Therefore if you have a flood as serious as the 2008, it is just spreading out further to the west.

Now there is a dike along the river on the west side. I believe they could extend the dike to the north until they could connect it to the high ground in Ellis Park, and raise the present dike by widening it, and installing concrete blocks (solid concrete), or install a track for a movable wall that could be installed and removed as needed. This would be calling for the dike next to the river all the way on the west side except for the north end if they didn't want to buy out the houses that are there.

Along the Penford property the dike that has been installed there is a steel wall. I believe this could be raised up by welding sheets of steel on the top and then putting fill along the wall. I believe the present wall that is there belongs to Penford.

John C Berge

Cedar Rapids, Iowa

33.

McGuire, Lonn I MVR

From: iowalive9 [iowalive9@q.com]
Sent: Tuesday, September 28, 2010 6:36 AM
To: McGuire, Lonn I MVR
Cc: Chester Culver; DICK FREDERICKS
Subject: QUESTIONS & COMMENTS REGARDING CEDAR RAPIDS FLOOD PROTECTON DRAFT

Greetings, Mr. Lonn McGuire, U.S. Army Corps of Engineers:

The following questions and comments are submitted on behalf of the Iowalive network, and its spokesman, Mr. Dick Fredericks, Palo, Iowa—in regard to Public Input to the Public Review Draft of the Feasibility Study Report for Cedar Rapids.

1. What analysis was performed and used as a basis for the 32.4 ft. flood protection level, chosen for Cedar Rapids, as reported on page 193, section 4.3.2.2, in the Report?

a. Where can the analysis be accessed?

b. Who is responsible for selecting the 32.4 ft level—based on what advice, given by whom?

c. Will the 2nd Ave. bridge continue to withstand 32.4 ft. flood levels?

i. How about the other bridges?

ii. What happens to the flood levels upstream if one of the bridges topples, such as happened to the railroad bridge in '08?

d. Why was such an important flood crest protection number buried so deeply in the Report—and excluded from the Executive Summary?

2. The Report claims a 91.24 percent probability that the top of a 32.4 ft flood crest levee/floodwall will not be exceeded

a. That means there is an 8.76% chance of a 32.4 ft. flood crest exceeding the top of the proposed levees/floodwalls—each year.

b. That compares to an approximate 6% pay back on Iowa slot machines, where the average gambler loses about $58 per vist to the casino.

c. This means the chance of a flood crest topping the levees/floodwalls is 2.76 percentage points (45%) worse than the chance of a slot machine gambler winning on an Iowa slot machine!!

d. On what anaysis was the 91.24 % number determined?

i. Where can the analysis be accessed?

3. How much higher will the water rise on the west side of the river, at a 32.4 ft flood crest, as a result of the levee/floodwall preventing water from flooding the east side? We expect it could be as much as 5 feet–at the floodwall overtopping level.

4. How much will the 100 and 500 year flood plains be changed, on both sides of the river, as a result of the proposed levee/floodwall built to protect the east side of the river?

a. How much worse will flooding be in Palo as a result of levees/floodwalls proposed and built in Cedar Rapids?

5. What is the estimated TOTAL annual cost for maintenance etc. for the proposed levee/floodwall, pumps etc.?

6. The Corps is commended for clearly pointing out in the Report how poorly Cedar Rapids was prepared to alert or protect itself from the 2008 flood. The gas company did a much better job of anticipating the 31.2 ft. flood crest--and successfully protecting residents and businesses from broken or damaged gas lines.

7. Levee experts claim there are but two types of levees–those that have failed and those that will fail.

a. What steps will be taken to prove such experts wrong–for the life of the Cedar Rapids levees?

b. What is the life expectancy for the Proposed levees?

c. On what analysis is the life expectancy based?

i. Where can the analysis be accessed?

Sincerely,

Iowalive A growing network of volunteer citizens and professionals for improving Iowa..

34.

September 24, 2010

US Army Engineer District Rock Island
Attn: CEMBR-TD-E McGuire
Clock Tower Building, PO Box 204
Rock Island, Illinois 61204-2004

Dear Sir:

For many years the people on the west side of the Cedar River in Cedar Rapids, Iowa have been asking for more protection from flooding of the Cedar River, but to no avail.

Tuesday evening, of this week, I attended a U.S. Army Corp of Engineer meeting to learn of your Flood Risk Management Benefit Cost Ratio (BCR) study for the City of Cedar Rapids to learn that a new dike is to be built on the **east side** of the Cedar River, but the west side will be unprotected. This is very unfair. If we receive another flood the water will be one foot plus higher than in 2008. **We also need to be protected**. Your survey was conducted right after the flood in 2008 and doesn't take into consideration the businesses and homes that have been rebuilt or will be rebuilt in the near future. To name a few: Cooper's Mill Motel and Restaurant, Diamond V Mills, the Yeast Factory, Johnson's Gas, Pierson's Florist, Casey's, P & P, St. James Church, McKinnon's Barber Shop, Penford to name a few, plus all of the homes and many other businesses' not mentioned here.

You need to re-consider funding for both sides of the river. Millions of dollars leave our country to countries also in need. Shouldn't we take care of own first?

Thank you for your consideration.

Sincerely,
Florence E. Jacobs
Florence E. Jacobs
206 Norma Street SW, formerly 1123 Ellis Blvd. NW
Cedar Rapids, Iowa 52404

CEDAR RIVER, CEDAR RAPIDS, IOA
FLOOD RISK MANAGEMENT PROGECT

PUBLIC MEETING COMMENT SHEET
21 SEPTEMBER 2010

Re: The Draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Dear Sirs:

I will try and keep my comments brief and hope their brevity does not diminish the seriousness or sincerity of the following:

What we find most concerning is the narrow scope of vision that is occurring by basing a decision on skewed data. Obviously the BRC ratio will be less on the side of the river that had a greater proportion of residences –to- businesses. I assume this these numbers are based on past and present business and property values without regard for future projects or potential growth. Further, the plans to disregard the west side of the river will most certainly impact the rebuilding of the west side, thereby creating a "good-side/bad-side" of the river, where none occurred before. Penny-wise, pound-foolish, as always. There needs to be a customer base for the businesses on the near-east side and those customers are now, and will continue to include those citizens who live on the near-west side.

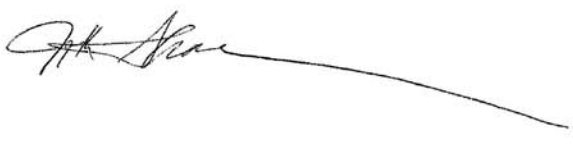
A passing glance at any flood map makes it clear that the west-side suffered the vast majority of residential and property in square-foot losses, while the east side suffered greater business loss. Obviously, the value in dollar amount of a single business is generally greater than that of a single home, and in cases such as cornerstone businesses such as Mercy Medical Center, it would take an entire neighborhood to match their financial value. However, without consumers, Mercy would not function, nor would the smaller business that you are biased in protecting.

As we watch devastated neighborhoods razed and new ones slowly emerge, our hopes emerge as well. We moved to this area recently, specifically to the inner-west side because we were confident in its restoration and wished to be part of the re-birth of the most beautiful area in Cedar Rapids. We buy local, we work locally and we are in the process of starting a small business. It is absolutely demoralizing to find that we will continue to have pre-flood protection.

You are sending a clear and degrading message to all of Cedar Rapids. Homeowners and business owners alike will most certainly take the status of the levy into account before inhabiting this area. The citizens are well-versed and educated but still anxious about re-entering this area. The local news announced the sound-bites, "The east side levy will cause the west side to flood worse in the event of another flood." How many citizens are willing to run that risk if they can avoid it? It has been difficult enough attracting new residents and businesses... ask any realtor.

We love our city; the whole city. We are the heart of the town, and unless the plans are to make Cedar Rapids a city of suburbs, I hope the Corp rejects the notion that the only value in a City is it's immediate dollar value without considering where those provide those dollars. Businesses only succeed if the customer base is present and strong. We who remain in this area are steadfast and passionate about its revival. I hope his this fact can be part, if not your guiding, consideration. It is the only right thing to do.

Respectfully,
Julie K. Shaw ARNP, MSN, GNP, ANP
1600 Ellis Blvd. NW
Cedar Rapids, Ia. 52405



McGuire, Lonn I MVR 36.

From: gary52405@aol.com
Sent: Wednesday, September 29, 2010 1:29 PM
To: McGuire, Lonn I MVR
Subject: Cedar Rapids Flood Wall

Mr. Lonn McGuire,

I'm contacting you in regard to the placement of the flood wall along the Cedar River in Cedar Rapids IA. .In your Engineers' plan it recommends a levy on the east bank of the river only due to the cost racial to cost its protecting. I know that your Army Corps of Engineers' is just doing their duty according to the book. But there should be some consideration to the human factor also for building a flood wall on the west side of the river. It has come out if there is just a flood wall on east side only that any future floods will be compounded on the west side. The west side was hard hit in the 2008 flood. A lot of homes and businesses lost and a lot of families misplaced. The west side in losing what they had, has made a whole generation lose their life's savings. In my case which is not out of the norm is that I retired just before the flood looking forward to rest from working all those years and saving for this opportunity to retire. To find myself in debt again to rebuild, or relocate, and using part of my savings to recoup my losses I feel I'm one of those people that has lost my whole generation of savings. I think it is unacceptable you as the Army Corps of Engineers tell me you are going to protect only the east side and make the west side flood worst. There should be some consideration to human sacrifice in the planning of a flood wall.

Some businesses are ready to come back on the west side but are reluctant to do so because there will be no flood protection on the west side. This would be a great lost opportunity to bring back, and add new businesses, to the west side.

Gary Stansbery

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
PATRICIA L. BODDY, INTERIM DIRECTOR

September 29, 2010

Mr. Lonn McGuire
Environmental and Economics Branch
U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

RE: Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project, Feasibility Study Report with Integrated Environmental Assessment, Public Review Draft (Cedar River)
Sections 21, 27 and 28, T83N, R07W; Linn County, within the incorporated limits of the City of Cedar Rapids, Iowa

Dear Mr. McGuire:

Thank you for this opportunity to review and comment on the above referenced feasibility report prepared by the U.S. Army Corps of Engineers, Rock Island District. Our understanding of the Federally Supportable Plan is as follows:

- The plan includes flood risk management features consisting of 2.17 miles of concrete flood walls; 0.75 miles of earthen levees; 0.23 miles of closure structures; the installation of five storm water pumping stations; the installation of one sanitary pumping station; and miscellaneous appurtenances.
- The plan protects the east side of the Cedar River in downtown Cedar Rapids which includes the majority of the commercial and industrial structures in the downtown area.
- The plans flood risk management features are designed to protect against the .002 exceedence probability event.

Approval by the Department is required for the construction, operation and maintenance of levees or dikes in urban areas along any river or stream draining more than two square miles. As the drainage area at the USGS gauge 400 feet upstream of the 8th Avenue Bridge in Cedar Rapids is approximately 6510 square miles, approval from the Department will be required for this project.

To gain approval for the project, an application must be submitted to the Department. The application must include engineering plans and specifications that show the Department's criteria are met.

Iowa Administrative Code 567-72.4(2) identifies the criteria for the review and approval of flood control levees and dikes under the Departments jurisdiction. These criteria include:

a) Design Level. The minimum design protection level for flood control levees or dikes shall correspond to the flood profile for the Q100.

b) Freeboard. The levee or dike height shall provide for at least 3 feet of freeboard above the design flood profile.

502 EAST 9th STREET / DES MOINES, IOWA 50319-0034
PHONE 515-281-5918 FAX 515-281-8895 www.iowadnr.gov

37.

c) Alignment. The alignment of a flood control levee or dike shall be consistent with the rules governing the location of encroachment limits set out in 567-75.4(455B).

d) Interior drainage. Flood control levees or dikes shall provide for adequate interior drainage and ponding.

e) Design and specifications. The structural design and construction of flood control levees or dikes must be undertaken in accordance with accepted engineering and construction procedures and practices.

Preliminary comments based on the Public Review Draft:

Regarding criteria a and b: It is our understanding the chosen alternative (Alternative 4C) will propose to use a design protection level corresponding to the Q500 flood profile (a.k.a. the "500-year" flood, based on the 0.002 exceedance probability discharge). The application must clearly show the Q500 profile within the project area and show that 3 feet of freeboard above the Q500 profile is provided.

Regarding criterion c: It is our understanding Alternative 4C will propose to locate all construction outside (landward) of the currently delineated floodway. The application must confirm this understanding.

Regarding criterion d: The application must include sufficient detail to confirm that interior drainage and ponding issues are thoroughly analyzed and that adequate, reasonable systems are proposed to handle these issues for events up to and including the design (0.002 exceedance probability) event.

Regarding criterion e: The application must show that accepted engineering and construction procedures and practices will be followed for all components of the flood protection work, including the efficacy of machine components requiring operation and maintenance such as closure structures and pump stations.

Please note, as the hydrologic and hydraulic analyses of the Federally Supportable Plan are based on the development of flood flows and channel geometry not contained in the effective Flood Insurance Study, a Letter of Map Revision will be required upon completion of the project.

In closing, the project will require the approval of the Department. At such time as the design of the Federally Supportable Plan is complete, feel free to contact me at 515-281-6906 with any questions you may have regarding your submittal to the Department for a Flood Plain Development Permit.

Sincerely,

Rich Wirtz, P.E.
Environmental Engineer
Flood Plain Management Program
Water Resources Section



Cedar Wapsie Group

118 3rd Ave SE, Suite 326
Cedar Rapids, IA 52401
September 29, 2010

Mr. Lonn McGuire
Environmental and Economics Branch
U.S. Army Corps of Engineers
Clock Tower Bldg., Box 2004
Rock Island, IL 61204

Re: Cedar Rapids Flood Risk Management Environmental Assessment

Dear Mr. McGuire:

Please accept the following comments regarding the Cedar Rapids Flood Risk Management Environmental Assessment on behalf of the Cedar-Wapsie Group of the Iowa Chapter of Sierra Club. Many of our members live or work in Cedar Rapids.

We are concerned that the preferred alternative provides for a levee on the east side of the river, protecting the downtown business district, but there is no levee on the west side that would protect a lower income residential community and small businesses. This proposal presents an environmental justice issue. Although the assessment purports to comply with Executive Order 12898, the information in the assessment has been manipulated and mischaracterized. For example, on page 255 of the assessment, the statement is made that no environmental justice concerns were raised during the public participation process. However our members were present at public meetings where such concerns were raised. These comments may not have used the magic words "environmental justice," but the message was loud and clear that the lower income residents and businesses on the west side of the river were being discriminated against. There are historic areas that will not be protected, including the Time Check neighborhood, Czech Village, and the Wells Fargo Bank Building.

Nor is there an integrated plan for upstream watershed management. This project needs to be part of a comprehensive

plan, which it is not. Upstream watershed management is more than retention basins. It includes wetland restoration. You agency should remember the Galloway Report, prepared by your agency after the 1993 floods in the Midwest. This report made clear that the best way to prevent floods and to protect people and property is to promote the natural flood control provided by wetlands, vegetation and other natural attributes of a healthy watershed.

In the city there should be a large variety of measures to retain water on the property with a slow release, including permeable paving, rain gardens, prairie plantings, as well as the retention basins that have been used.

The project needs to be accompanied with changes in the local ordinances to stop building homes, garages, and business buildings in the 100-year flood plain, including no further filling in of the flood plain.

Likewise the 500-year flood plain should be off-limits for filling and building of homes, garages, and business buildings.

Any time fill is moved into a floodplain, the flood waters get diverted to other properties up and down the river. Properties that once were outside of the floodplain can suddenly be within the floodplain as fill is moved into a watershed.

In conclusion, the laws and regulations provide the Corps an opportunity to look at factors other than cost. The Executive Order clearly indicates that the Corps is to consider environmental justice issues and good watershed management. That clearly was not done in this case.

Sincerely,

Pam Mackey Taylor, Conservation Chair
Sierra Club, Cedar Wapsie Group

Wallace L. Taylor, Legal Chair
Sierra Club, Iowa Chapter

McGuire, Lonn I MVR 39.

From:	iowalive9 [iowalive9@q.com]
Sent:	Thursday, September 30, 2010 8:24 AM
To:	McGuire, Lonn I MVR
Cc:	Chester Culver; DICK FREDERICKS; maren.stoflet@noaa.gov; Zukowski, Michael P MVR; Fournier, Ronald F MVR
Subject:	MORE QUESTIONS & COMMENTS REGARDING CEDAR RAPIDS FLOOD 'PROTECTON' DRAFT
Attachments:	image001.gif; image002.gif; image003.gif

Greetings, Mr. Lonn McGuire, U.S. Army Corps of Engineers:

Iowalive net workers thank you for your cooperation and response–which they sincerely believe will be of very high integrity!! Iowalive net workers have very high regards for the Corps of Engineers, and the National Weather Services–as demonstrated by their substantial efforts to generate the comments and ask the questions herein!!

The following are more comments and questions submitted on behalf of the Iowalive network, and its spokesman, Mr. Dick Fredericks, Palo, Iowa–in regard to Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project, Public Input to the Public Review Draft of the Feasibility Study Report for Cedar Rapids-- –found on website: http://www.mvr.usace.army.mil/PublicAffairsOffice/CedarRapids/CedarRapidsDraftFeasibilityReport.pdf.

Previous comments and questions are pasted farther below–and remain valid.

The following questions are submitted with the understanding they will be answered–and that there is no compelling need established, or documented, for Iowans to pay to have some businesses and residents occupy the disastrous flood plain in Cedar Rapids–as they foolishly want to do.

1. When and where can the Corps' response to public questions etc. be accessed?
2. What is the accuracy range of the 91.24 % probability that the top of a 32.4 ft. flood crest levee/floodwall will not be exceeded?

* Showing the 91.24 % number to two decimal places strongly implies an outstanding degree of accuracy.
* What is the basis for such implied accuracy?
* Is the Corps saying there is no chance the probability of not topping will be worse than 91%.
* If not, what is the + and - tolerance on the 91.24 % number?
* What is the calculated, or best estimated, average year of graduation from high school, for use in the following two charts–for those responsible for deriving the 91.24 % number? Anyone claiming to have better numbers, than those shown in the charts, is asked to

provide them. It is interesting that Iowa education officials like to claim Iowa to be the best "education state" in the nation. 39

65 YEAR CHART SHOWS CONTINUOUS IOWA SCHOOL FAILURE

cid:image001.gif@01CB4CE6.57CE7B90

MIND DEVELOPMENT CHART BELOW SHOWS CONSEQUENCES OF THE ABOVE CHART

cid:image002.gif@01CB4CE6.57CE7B90

3. Why didn't the Report include detailed procedures and methods for Cedar Rapids to use when the levees/floodwalls are topped, as the report clearly showed an 8.76 % probability of happening?

* How will the water be removed from the 'protected' areas that are flooded—including pumps and flood gate actuation systems?

1. Does the Corps have substantial evidence a city, such as Cedar Rapids, can effectively close storm sewers and prevent back flow from a 32.4 ft. flood crest? The hours worked by at least one city engineer are far beyond reason, as he strives to control flooding and other matters.

1. The Report clearly stated the city and County had no flood warning system in place in 2008, and still don't!

* Did the Report consider the mentality of Cedar Rapids officials wanting to spend $385 million, far more than the protected property is worth, to 'protect' property on the west side of the river?
* The title of the Report--Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project—strongly implies the flood risk is fully managed.

1. Does the Corps consider that to be appropriate since there remains an 8.76% probability the proposed levees/floodwalls will be topped?

2. Is the Corps satisfied that journalists and others reading the Report will fully understand there remains a concerned risk of flooding in the Cedar Rapids 'protected' areas, when they write or talk about proposed "flood protection"?

4. Here is the table of flood crest projections derived by Iowalive net workers. Does the Corps have a similar, or comparable, table—or better numbers—for the City Council and others to consider? The table clearly shows there is a 100% probability the 32.4 ft. flood crest levees/floodwalls will be topped—by how much, and when. Please be advised Iowalive net workers have recently made Cedar and Mississippi river flood crest forecasts that are equal or better than the National Weather Services forecasts. The actual numbers will be sent to you upon request—for your respected consideration and evaluation.

40.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I am concerned about the West side not being protected. As a home owner, I feel we should have the protection from any flooding. We are paying taxes!

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Kathy Milroy

Agency/Organization (if applicable) _____

Address 801 H Ave NW

City Cedar Rapids State Iowa Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

41.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Please do flood protection both sides of the river

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Gloria Ruzicka

Agency/Organization (if applicable)

Address 707 - 9th Street SW

City Cedar Rapids State IA Zip 52404

Completed Comment Sheet sent via US mail must be received by September 30, 2010:

US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

42.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

We need flood protection on the west side to ve pay taxes and live here too If no flood protection on west side Should not be on east either So don't channel the water to the west

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Randy C Hoffman

Agency/Organization (if applicable) _____

Address 709 9th ST SW

City Cedar Rapids State IA Zip 52404

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

Please protect the west side of the River.

I am a homeowner on the west side. I along with many of my neighbors invested several thousands of dollars to fix our homes. This is our neighborhood. Many of us have lived here for many years. Of course the value on the west side would be less than the east side. All of the downtown & several factories are on the east side. Just because the economic value is less does not mean it is not important or have value to us.

A levee is needed on the west side.

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Mary Flaherty

Agency/Organization (if applicable) _____

Address 806 H Ave NW

City Cedar Rapids State IA Zip 52405

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

Cedar River, Cedar Rapids, Iowa
Flood Risk Management Project

Public Meeting Comment Sheet
21 September 2010

Please provide any comments you have regarding the draft Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment.

I feel like I'm in a DR. Seuss Book "Horton Hears a Who." My community on the N.W side is just a little speck, trying to be heard. "We are here! We are here! We are here!" (Hopefully your mother read this book to you when you were small, otherwise you wont understand what I am saying. If you haven't read it, maybe you should. Anyway - This flood was Epic & very devastating. The Corps tells us that we would "only receive 1-2 feet more of water." In our case, ~~only~~ less than one foot of water would cover our electrical outlets, which would greatly increase the cost of rebuilding. The whole electrical system would have to be replaced - & we are near the edge of the 500 year flood zone! Having ~~only~~ a flood wall only on the East side will cause the WEST side of Cedar Rapids - a big chunk anyways - to literally disappear. Our property values will decrease even more than they have, & who would want to buy a home on the West side? Please approve a plan that would protect the East AND WEST. We all have worked hard to rebuild our homes - if we flood again - the cost to rebuild will be greater - We are worth protecting. "We are here!"

All comments should have the following information to be included in the record. PLEASE PRINT.

Name Jeanna White

Agency/Organization (if applicable) _____

Address 1323 9th St NW

City Cedar Rapids State IOWA Zip 505

Completed Comment Sheet sent via US mail must be received by September 30, 2010:
US Army Engineer District, Rock Island
ATTN: CEMVR-PD-E (McGuire)
Clock Tower Bldg, PO Box 2004
Rock Island, IL 61204-2004

THANK YOU FOR ATTENDING THIS MEETING AND PROVIDING YOUR COMMENTS.

45.

From 1903 to 1993 there was six floods from 93 to 2008 there has been 4 floods the first 90 years it flooded on average every 15year in the last 15 years there has been 4 floods that on average every 4 years the first 90 years there was two floods over 19 the last 15 year there has been 2 over 19 feet the first 90 year there was 1 flood of twenty feet the last 15 there was one over 31 feet Cedar Rapids is at a greater risk than the corps figured.

I don't understand how the corps figures the value of properties at risk, if it's worth 90,000 it worth 90,000 whether it's 1 year old or 100 years the corps will deprecate property as they get older. The assess value is usually less than its sales value that why the buyout price is 107% of the asses value. I believe 1300 homes were effected 161 will be protected by a levee on the east side of the river 1139 home will not be protected and at greater risk than before if the east side gets a levee. If you take 1139 times $85,000=96,815,000 from cost of levee on the west side 113, 000,000 would be 16,185,000 short of the cost of the levee if one would then use the cost of the business on the west side Penford corporation, Diamond V Mills plus all the small business would cover 16 000 000 short to meet your congress 1 to 1 ratio this is nothing fancy just every day 5th grade math

The city of Cedar Rapids will lose major tax base from the lost value of homes and business that have been tore down closed because of this flood these will not come back without a levee. My home was worth $120,000 now it worth $58,000 even though I completely restored it from bare studs on the first floor ceiling down everything is new.

It is because of reasons that I believe that the Cedar Rapids, Iowa need congress to allow the Army Corps of Engineering to build a levee on the west side of our fair city

Richard L Campbell

1701 8th St nw.

Cedar Rapids ,Iowa 52405

McGuire, Lonn I MVR 46.

From: Linda [Lsiglin44@hotmail.com]
Sent: Thursday, September 30, 2010 2:45 PM
To: McGuire, Lonn I MVR; Haring, Christopher P MVR
Subject: Cedar River, Cedar Rapids Flood risk Management Project

Public Meeting Comment Sheet for the open house held 21 September 2010

US Army Engineer District, Rock Island
Attn: CEMVR-PD_E (McGuire)
Clock Tower building, PO Box 2004
Rock Island, IL 61204-2004

CEMVR-PD-E McGuire:

On this last day of providing public comments to the Corps regarding Cedar Rapids, Iowa, I would like to thank you and all those involved for doing a fine job completing the task that was presented to you following the flood of 2008 June.

I do understand that you had perimeters that you had to maintain to keep this under the rules you were ordered to follow. I respect you for the quality of work and the promptness you completed it. You had no choice under the current conditions but to find the decision to be what you have declared. It is not the Corps that devalued the land on the west bank to a point to where it would not meet the cost ratio. I fully understand how you reached your recommendation. Thank you.

My concern as a home owner on that west bank of the Cedar River in Cedar Rapids, Iowa is to now work to see how my local and state governments can do a better job of protecting the city on the west side with what we can afford. I live eight blocks from the river and I have little fear of future flooding. My home now completely rebuilt from top to bottom has been here 101 years. My work will be to stay active in decisions made for and by the city to see that we get respectable flood protection without going overboard to have something that is completely over done to make developers and politicians happy and foolishly naive about what type of protection we really need near the Cedar River. I will never see another flood like 2008 in this city in my lifetime I am sure and I am 66 years old. If we do it will be by the excessive walls and levees that disrupt the flow of the river and cause run over spillways to be held and drowned all in the path of the dry side of their construction.

Thank you, again for working with the citizens of Cedar Rapids, Iowa, USA.

Linda D. Seger, home owner and flood activist
1629 8th Street NW
Cedar Rapids, IA 52405-1606 319-981-7537

McGuire, Lonn I MVR 47.

From: Clark Rieke [clarkrieke@mchsi.com]
Sent: Thursday, September 30, 2010 4:28 PM
To: McGuire, Lonn I MVR
Subject: most cost effective flood protection

What is the most cost effective blend of flood protection alternatives?

The flood protection feasibility issues for the most cost effective flood protection should be framed as a blend of alternatives. How much upstream detention together with how much channel flow enhancement can compliment what levee height?

I ask the Corps to consider upstream detention – the plan to temporarily detain storm water where it falls – because upstream detention provides benefits throughout the Cedar River watershed and the costs can be shared by all the communities who benefit.

The benefits throughout the watershed include:

1. localized protection from ever more frequent local flash floods;

2. reduction in nitrite pollution from fertilizer in the runoff;

3. stabilization of aquifers;

4. potential for irrigation during periods of dryness.

My research on upstream detention suggests that there is some quantity of low cost upstream detention (some on lands that the governments already own or control) that can give us some percentage of reduction in the risk of flood crest height at a cost effective level.

I believe that the first third of the acre feet of distributed detention needed can cost significantly less per unit than the last third, so we need to ask how does that cost compare to the cost of the reduction in the levee height that this much detention will allow.

In a system that is blending the alternatives, another important factor is the cumulative effects of river flow enhancements through the cities and all along the watershed. I believe that a conversion of most of the many dams of all kinds that exist throughout the Cedar watershed to adjustable dams can create a system of values that can be used to mitigate the height of flood crests. When the risk of flooding increases because watershed is becoming saturated, it is an important factor to drain as much water as possible before the next significant rain. Lowering these dams during high risk times due to high saturation allows a mitigation system to let as much water drain away as possible a little sooner than if the existing dams would stand as they currently do. By having an adjustable dam lowered this will reduce the height of the crest over this point, then after a crest has passed over an adjustable dam that had been lowered to facilitate faster flow, this dam could be slowly raised to hold the water at a height as high as possible without causing more damage at this point in the river. This holding back of the flow by raising the dam will reduce the head or speed of the crest flowing from this point. If distributed storage areas are like the parking lots for storm-runoff, then adjustable dams are like the speed bumps. If these two tools are used in a coordinated way, they can be complementary in challenge of the management of the traffic jam of the flowing stormwater known as flood crests.

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