CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

November 2010
Revised January 2011

US Army Corps
of Engineers ®
Rock Island District

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
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EXECUTIVE SUMMARY

The *Cedar River, Cedar Rapids, Iowa, Flood Risk Management Project Feasibility Study Report with Integrated Environmental Assessment* (Study) documents the plan formulation studies conducted by the US Army Corps of Engineers, Rock Island District (District) in close cooperation with the City of Cedar Rapids, Iowa (City). The City is the non-Federal Sponsor for this Study. The purpose of the Study is to identify, formulate and evaluate cost effective, environmentally-sensitive, and technically feasible flood risk management Federal alternatives for the City.

The Study is authorized by House Resolution adopted April 5, 2006, by the Committee on Transportation and Infrastructure, and Senate Resolution adopted May 23, 2006, by the Committee on Environment and Public Works. Both resolutions requested the review of past pertinent reports to determine whether any modifications to the recommendations are advisable in the interest of flood risk management, ecosystem restoration, recreation, and related purposes along the Cedar River in Cedar Rapids.

The primary problem is the risk of inundation and associated flood damages in the City. By Federal standards, the existing levee system within the Study area has an unacceptable risk of failure during flood events due to insufficient design and construction such as steep side slopes, poor levee construction materials, lack of interior drainage system, and an insufficient crown width.

Problems with the aquatic ecosystem within the Study area include degradation due to urban development. In addition, study information indicates Cedar Lake sediments may contain environmental contaminants. During infrequent high flow events, the City's Water Pollution Control Facilities are inundated and raw sewage must be discharged directly to the river. However, development of measures to address these problems is severely constrained by the lack of suitable and effective options in the urban corridor.

The primary goal of this specific Study is to identify, formulate, and evaluate Federal alternatives that could reduce the existing and future flood risk and damages to public and private infrastructure and facilities in the City. The ancillary goals of the Study would evaluate feasible recreational and ecosystem restoration opportunities that are compatible with the primary goal.
:

The water and related land resource problems and opportunities identified in this Study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities in the Study area and represent desired positive changes from the Future Without Project Condition.

The planning objectives are specified as follows:

- reduce the risk of flood damages to private and public infrastructure caused by Cedar River flooding in the City through 2060
- improve the response by local, state, and Federal agencies to all flood events in the City
- increase public awareness to the risk of flooding from the Cedar River in the City through 2060
- increase recreational opportunities in the City along the Cedar River that are compatible with an implementable FRM plan

The Study team collected and evaluated pertinent engineering, economic, social, and environmental information needed to accomplish the Study objectives. The Study's plan formulation is best described in terms of iterations of the planning process. Multiple iterations of the process were needed to evaluate the array of possible alternatives to providing the City with flood risk reduction. The figure on page ES V summarizes the iterations, the criteria used to evaluate and compare alternatives, the results of evaluation and comparison steps, and ultimately, the identification of the Recommended Plan.

In addition to a No Action Alternative, an array of dozens of possible FRM plans was evaluated in detail. The alternatives are differentiated by 1) level of flood risk management and location and 2) level of completeness. Nonstructural measures were considered as additional features to each alternative. The final array as discussed in Section 4.3 is as follows:

- The No Action Alternative assumes that no project would be implemented by the District to achieve the planning objectives. The No Action Alternative is analogous with the Future Without Project Condition.
- Alternative 1C affects both the east and west sides of the Cedar River in downtown Cedar Rapids including the Cedar Lake Area with a levee and floodwall.
- Alternative 1A-C affects both the east and west sides of the Cedar River in downtown Cedar Rapids excluding the Cedar Lake Area with a levee and floodwall.
- Alternative 4C affects the east side of the Cedar River, which includes a majority of the commercial and industrial structures in the downtown area with a levee and floodwall.
- Alternative 10E affects two separate industrial areas on the east side of the Cedar River in downtown Cedar Rapids using two ring levees.

Cost, benefits, and economic performance summaries of the alternatives in the Final Array are presented in the next three tables.

Total Project Costs for Final Array of Alternatives
Dollars Shown in ($000)

Alternative	**1C**	**1A-C**	**4C**	**10E**
Construction Cost – Measure [1]	$148,039	$142,504	$70,896	$40,321
Total Construction Costs	**$148,039**	**$142,504**		**$40,321**
PE&D (18%)	$26,647	$25,651	$12,761	$7,258
S&A (10%)	$14,804	$14,250	$7,090	$4,032
Subtotal	**$189,490**	**$182,405**	**$90,747**	**$51,611**
Real Estate [2, 3, 4]	$52,600	$49,800	$11,100	$4,400
Environmental Mitigation	$908	$0	$0	$0
Cultural Mitigation (1%)	$1,480	$1,425	$709	$403
Total	**$244,478**	**$233,630**	**$102,556**	**$56,414**
Annual O&M Costs	**$80**	**$75**	**$35**	**$17**

[1] Costs based on estimates from Stanley Consultants dated 2-2-2010, 2-8-2010, 2-11-2010, and 3-24-2010.
[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.

Annual Costs to Implement Final Array of Alternatives
Dollars Shown in ($000) [1]

Alternative	**1C**	**1A-C**	**4C**	**10E**
Construction Cost	$28,563	$28,563	$28,563	$40,321
PE&D	$5,141	$5,141	$5,141	$7,258
S&A	$2,856	$2,856	$2,856	$4,032
Year 1				
PE&D (50%)	$1,542	$1,542	$1,542	$3,629
Construction (20%)	$2,856	$2,856	$2,856	$8,064
S&A (20%)	$286	$286	$286	$806
Year 2				
PE&D (30%)	$1,542	$1,542	$1,542	$2,177
Construction (50%)	$7,141	$7,141	$7,141	$20,161
S&A (50%)	$714	$714	$714	$2,016
Year 3				
PE&D (20%)	$771	$771	$771	$1,452
Construction (30%)	$8,569	$8,569	$8,569	$12,096
S&A (30%)	$857	$857	$857	$1,210
Year 4				
PE&D (15%)	$771	$771	$771	
Construction (20%)	$5,713	$5,713	$5,713	
S&A (20%)	$571	$571	$571	
Year 5				
PE&D (10%)	$514	$514	$514	
Construction (15%)	$4,284	$4,284	$4,284	
S&A (15%)	$428	$428	$428	

[1] Assumes 5-year construction duration

Economic Performance of the Final Array of Alternatives [1]

Alternative	Total Residual EAD	Project First Costs	Total Annual Costs	Total Annual Benefits	BCR	Annual Net Benefits
10E	8,673	60,347	3,009	3,740	1.24	731
4C	6,269	115,760	5,774	6,144	1.06	370
1A-C	2,244	266,081	13,267	10,169	0.77	-3,098
1C	1,954	278,571	13,891	10,455	0.75	-3,436

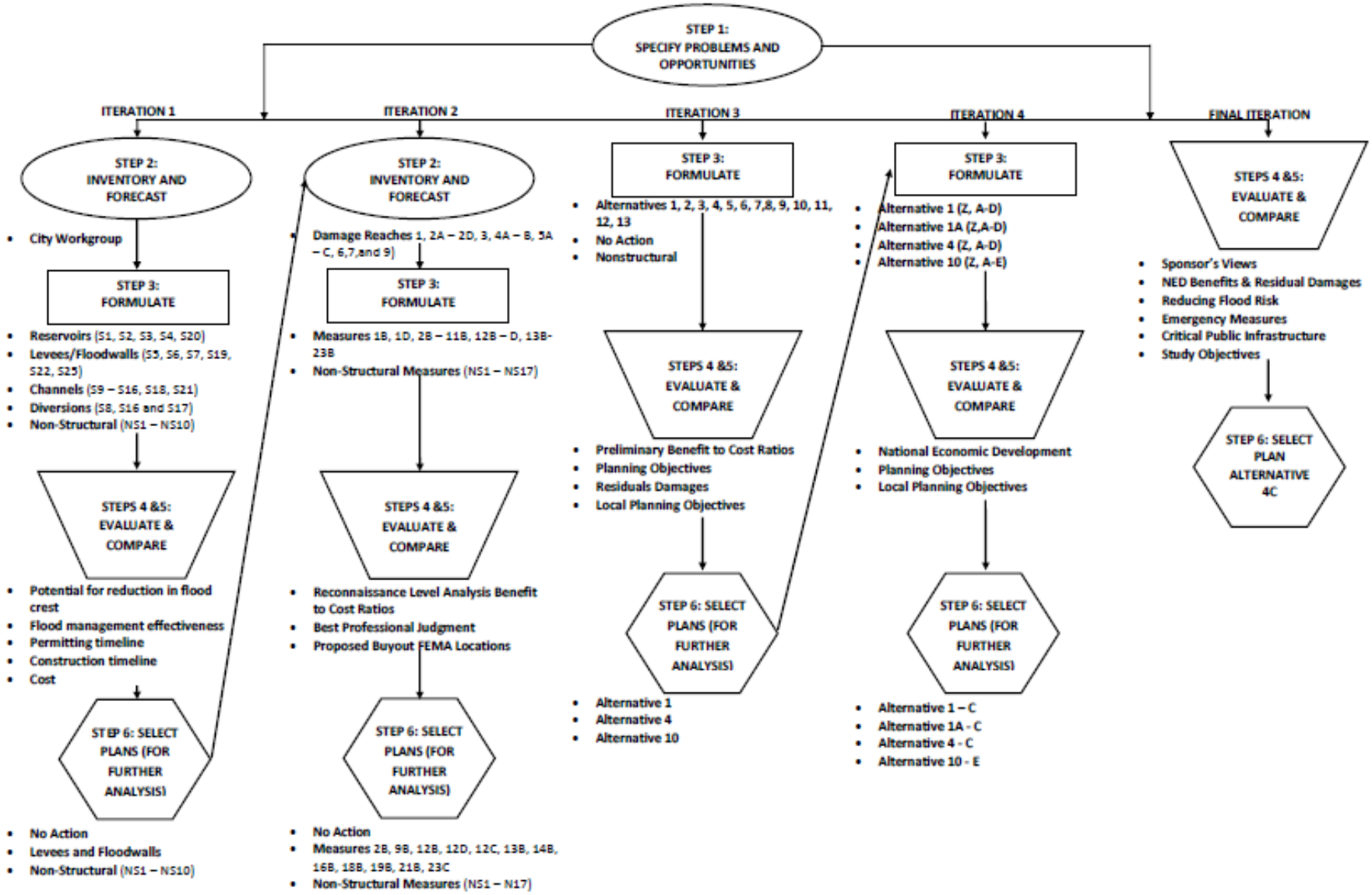
[1] Feb. 2010 Prices, 4.375% Interest Rate, 50 year period of analysis, $1,000's

Only two alternatives are economically justifiable, based on benefit-cost ratios greater than 1.0. Following detailed analysis, Alternative 4C was identified as the Recommended Plan. The Recreational Option 1 is not incrementally economically justified and therefore it is not recommended as part of the Recommended Plan.

The Recommended Plan, Alternative 4C, includes FRM features consisting of concrete floodwalls, earthen levees, closure structures and pump stations. 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, slightly higher than the June 2008 flood crest, providing a substantial degree of risk reduction. Concrete floodwalls comprise approximately two thirds of the total alignment length totaling 2.17 miles. The remainder of the alignment length includes 0.75 mile of earthen levee and a total length of 0.23 mile for all closure structures. All major components were developed as utilitarian designs in order to minimize estimated construction cost. The cost estimate for Alternative 4C is $99,004,000 (October 2010 prices), with the Federal and non-Federal shares estimated as follows:

Federal Share (65 percent)	$64,352,600
Non-Federal Share (City of Cedar Rapids 35 percent)	$34,651,400
Total Estimated Project Cost	**$99,004,000**

The annualized operation, maintenance, and replacement costs are $18,000. The Recommended Plan has an overall benefit-to-cost ratio of 1.2 and net annual benefits of $1,019,000.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*** Indicates traditional NEPA required chapters**

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1.0. STUDY INFORMATION

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> *"….that the Secretary of the Army is requested to review 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, to determine whether any modifications to the recommendations contained therein are advisable at the present time in the interest of flood damage reduction, ecosystem restoration, recreation, and related purposes along the Cedar River in Cedar Rapids, Iowa."*

1.2. Purpose and Scope. The purpose of this Study was to formulate and evaluate cost effective, environmentally-sensitive, and technically feasible flood risk management (FRM) alternatives for the City. This Study documents the plan formulation studies conducted by the US Army Corps of Engineers, Rock Island District (District) in close cooperation with the City of Cedar Rapids, Iowa (City). The City is the non-Federal Sponsor for this Study.

The primary goal of this specific Study is to evaluate alternatives for reducing the existing and future flood risk and damages to public and private infrastructure and facilities in the City. The ancillary goals of the Study include evaluating recreational facilities and ecosystem restoration opportunities that are compatible with primary goal.

The Study team collected and evaluated pertinent engineering, economic, social, and environmental information needed to accomplish the Study objectives. An array of possible FRM plans were considered and evaluated based on costs, benefits, and impacts to the project area.

The Study product is a decision document in the form of a feasibility study and integrated report and National Environmental Policy Act (NEPA) Environmental Assessment (EA) document in accordance with the Corps' Planning Guidance Notebook, Engineer Regulation (ER) 1105-2-100. The Study investigated measures to reduce flood risk and analyzed the potential for Corps participation in implementing an FRM project in the City.

1.3. Study Area and Location. Figure 1 shows the vicinity of the Study area, located in Linn County, Iowa. The Cedar River Watershed (figure 2) is in Northeastern Iowa, approximately 70 miles west of Dubuque, Iowa; 30 miles north of Iowa City, Iowa; and 130 miles northeast of Des Moines. The drainage area of the Cedar River at the City is 6,510 square miles.

1.4. History of the Study. Much of downtown Cedar Rapids lies within the 100-year floodplain of the Cedar River. Historically, major floods have been caused by a combination of rainfall and snowmelt or by heavy rainfall alone.

In October 2003, Cedar Rapids, in coordination with the District, initiated a Continuing Authorities Program Section 205-Flood Control Study (CAP Study), which resulted in recommending preparation of this Study. The CAP Study was completed in May of 2004 and approved by memorandum July 8, 2004. The CAP Study considered the Time Check Levee System, and the Indian Creek and Dry Creek Watersheds; the latter two are not covered in this document. The CAP Study indicated that a significant number of homes and businesses in the Time Check Neighborhood are within the 100-year floodplain of the Cedar River and the condition of the existing Time Check levee could result in these structures sustaining major flood damage. The CAP Study determined that an improved system would reduce potential flood damage to the Time Check Neighborhood of Cedar Rapids. The CAP Study concluded that an acceptable alternative could be developed that would indicate a Federal interest.

Following completion of the CAP Study, the District and the City entered into a Feasibility Cost Share Agreement (FCSA) in May 2008 to study FRM alternatives for the Time Check Neighborhood. Shortly after the signing of the FCSA, the City experienced a record flooding event in June 2008 that led to the expansion of the Study area to include the entire Cedar River-Cedar Rapids corridor. Figure 3 shows the 10-square-mile area of the City that was inundated by the Flood of June 2008.

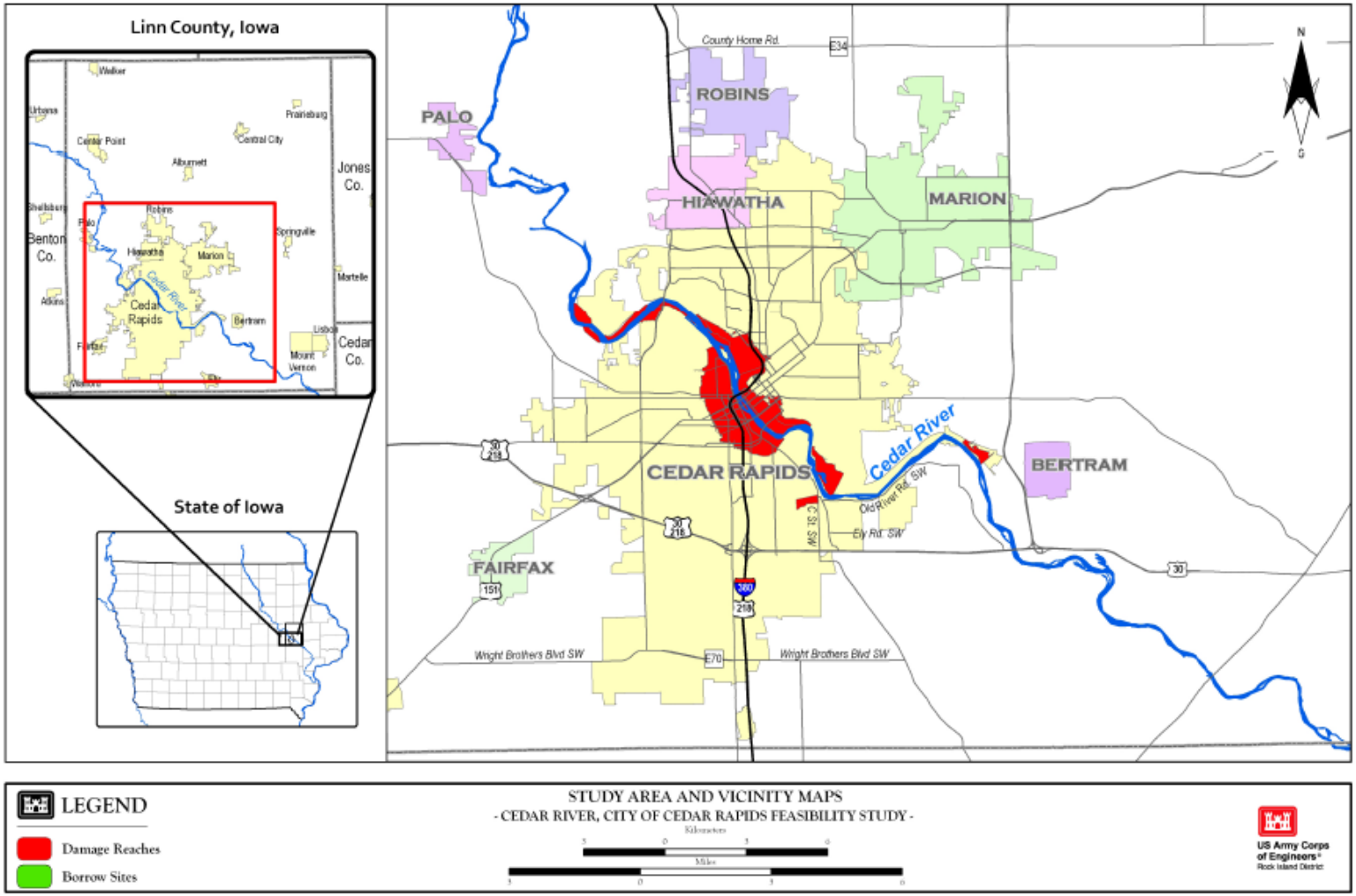

Figure 1. Vicinity Map

Figure 2. Watershed Map of the Cedar River Upstream of the City of Cedar Rapids

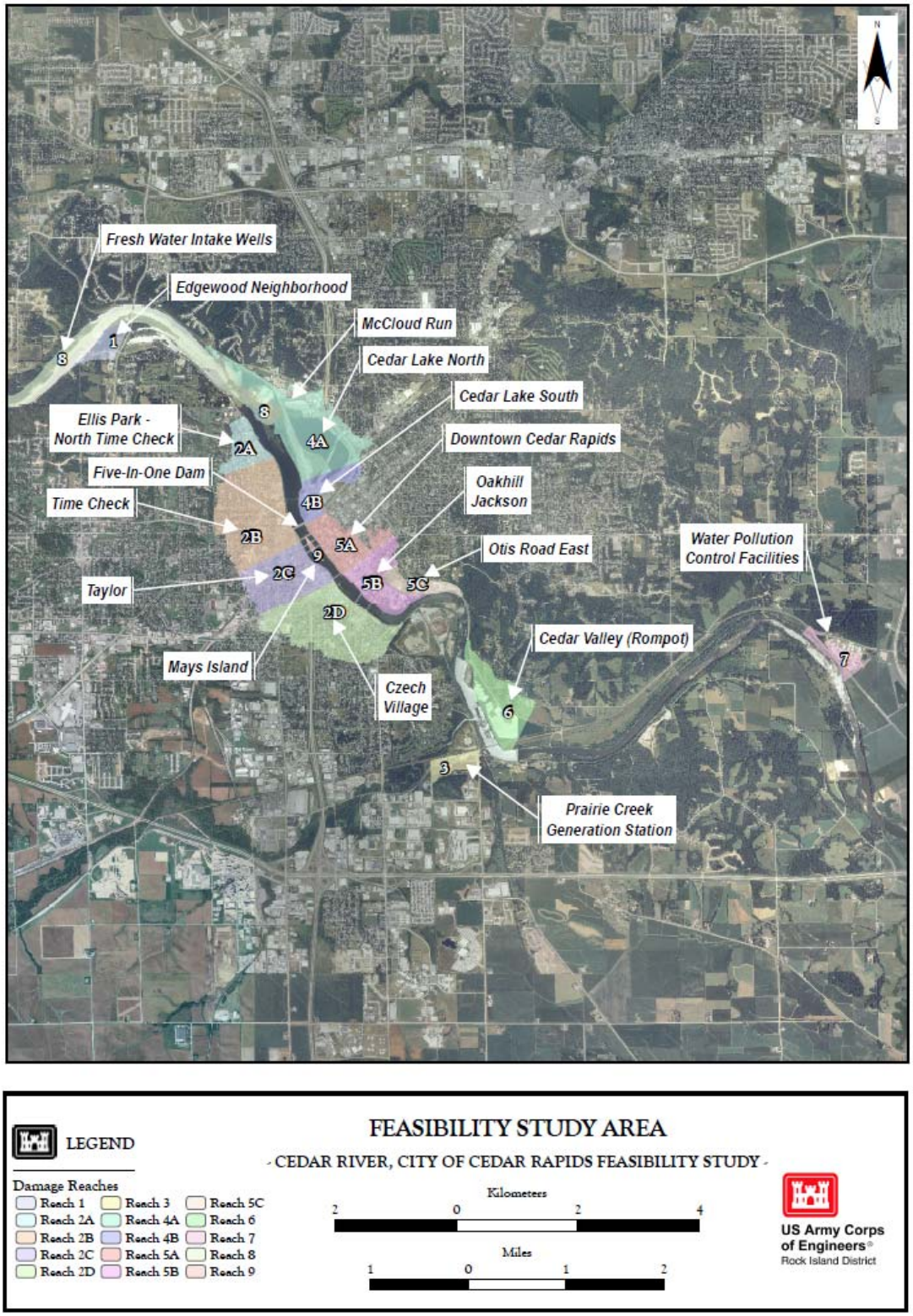

Figure 3. Study Area

1.5. Prior Reports and Existing Projects. Since the 1940s, the District and others have prepared numerous reports on the Cedar River and associated watershed. The following reports contain the most relevant information for the current effort:

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, 01 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 damage reduction alternatives for the City. After a review of the options and their adverse impact on the scenic attraction of the river, no flood damage reduction measures were implemented.

Floodplain 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 in the Time Check area.

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 FRM 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 FRM options with benefit-to-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 Report, June 1982, U.S. Army Corps of Engineers, Rock Island District. As it pertains to Cedar Rapids, this report supports the construction of a levee and floodwall protection 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 informed 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 informed decisions regarding land use and development in the floodplain.

Stormwater Master Plan, Cedar Rapids Metropolitan Area/Indian and Dry Run Watersheds Utility Study, Linn County Regional Planning Commission, Prepared by Camp Dresser & McKee (CDM) Inc., The Sears Tower, Suite 450, 233 South Wacker Drive, Chicago, Illinois, April 1998. This Stormwater Master Plan (SWMP) was prepared to provide the Cedar Rapids metropolitan area/Indian Creek and Dry Creek watersheds with guidance on how to accommodate future development and the resulting increase in stormwater runoff that would result without adversely impacting downstream areas. The SWMP's Study area included Cedar Rapids, Hiawatha, Robins, Marion, and portions of unincorporated Linn County.

Initial Assessment for Flood Damage Reduction – Section 205, Cedar Rapids, Linn County, Iowa, Cedar River, Indian Creek, and Dry Creek Watersheds and Time Check Levee, U.S. Army Corps of Engineers – Rock Island District, May 2004. The recommendation of the report was to initiate an FRM Study for the Time Check Area in Cedar Rapids. The assessment also recommended further study for the Indian and Dry Creek Watersheds.

City of Cedar Rapids – Framework Plan for the Reinvestment and Revitalization (River Corridor Redevelopment Plan) Sasaki and Associates, December 2008. The report documents the City's initiative to develop plans for flood mitigation options, neighborhood, facilities, transportation, and recreational planning after the June 2008 flood. The report includes appendices on flood mitigation options, transportation options, facilities program assessments, and disaster recovery planning.

Cedar Rapids River Corridor Redevelopment - Flood Mitigation Options-Stanley Consultants Inc., March 2009. As part of the Framework Plan, the City integrated planning efforts to develop flood mitigation options for the Cedar River corridor through Cedar Rapids. The report documents structural and nonstructural options while outlining a flood mitigation plan that includes a series of levees, floodwalls, and demountable walls.

City of Cedar Rapids, Flood Protection Study - Water Pollution Control Facilities, HDR Engineering, Inc., February 2009. The report documents the effects of the June 2008 flood event on the City's Water Pollution Control Facilities (WPCF). The report investigated six options for flood damage reduction and recommended further study on Option 5.

Flood Response Manual – City of Cedar Rapids, Iowa. Prepared By Cedar Rapids Public Works Department, March 2009. The manual documents flood-fighting options based on locations throughout the Cedar River corridor. The manual integrates new data for stage related flood fighting efforts, updating flood fighting maps, and evacuation plans.

Flood Abatement Study – Phase 1 - Alliant Energy Company, Prairie Creek Station, Cedar Rapids, Iowa. URS, October 2008. The Study documents options to preventing future flood damages in three plans. The plans include installing gatewells on an intake tunnel from the Cedar River, exterior flood control levees, and flood proofing the exterior of the main building.

Cedar Rapids Area Inspections - Inspections of Pipelines, Five-in-One Dam, and Cedar Rapids Flood Walls. Anderson-Bogart Engineers, Inc, and Lambourne Env. Diving Service, October 2008. The report documents damages to the sewer and water lines, the Five-in-One Dam, and Mays Island sheet-pile walls. The report also makes suggestions on remediation methods.

Background Cultural Research and Geomorphological Investigation of Measures for the Cedar River Flood Risk Management Feasibility Study, Linn County, Cedar Rapids, Iowa, [BCA 1620, April, 2010 (Bear Creek Report)]). This final report was 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 and authored by David W. Benn, Joe B. Thompson, Elmer A. Bettis III, and Derek V. Lee.

2.0. PURPOSE AND NEED*

The District and the City have joined in partnership to complete a Feasibility Study to formulate and evaluate FRM options on the Cedar River in Cedar Rapids, Iowa. The Study includes evaluating current and anticipated water resource problems and community needs while developing an array of alternatives for potential implementation. The criteria used to evaluate the alternatives are economic, balance between cost and benefit, a reduction or mitigation of environmental impacts, flood risk and floodplain management effectiveness, and engineering construction feasibility. The Federal objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders (EO), and other Federal planning requirements. The Federal government views prospective projects from a national point of view, including two requirements for Federal participation. The primary requirement calls for substantial benefits to FRM. The second requirement is to produce net benefits which exceed costs. “Federal Interest” in the project is identified when both requirements are satisfied. Environmental impacts are reduced with alternative designs or mitigated by replacement. The Federal objective is to alleviate problems and realize opportunities related to the output of goods and services or to increased economic efficiency.

The planning process consists of a series of steps that identifies or responds to problems and an opportunity associated with the Federal objective and specific state and local concerns, and culminates in the selection of a Recommended Plan. The process involves an orderly and systematic approach to making determinations and decisions at each step so that the interested public and decision-makers in the planning organization can be fully aware of the basic assumptions employed; the data and information analyzed; the areas of risk and uncertainty; the reasons and rationales used; and the significant implications of each alternative plan. This Study evaluated structural and nonstructural FRM alternatives. Project authorization also provided for ecosystem restoration and recreation feature components. This report will document Federal interest in FRM improvements and other water resources improvements within the City.

The City experienced record flooding in June of 2008, double any previous flood event based on period of record (approximately 100 years). The flood devastated the City with extensive damage to approximately 4,200 structures both public and private. Hospitals, schools, public transit, and businesses were negatively impacted by the flooding event. Nearly 10 square miles and 1,300 City blocks were impacted, displacing approximately 25,000 people. The 2008 flood illustrated the need for the evaluation and comparison of various FRM strategies in the Cedar Rapids area.

Since the record flooding event in June 2008, the District and the City have negotiated an expanded Project Management Plan and Scope of Services. The new Study area includes the entire Cedar River Corridor through downtown Cedar Rapids, starting in the north immediately upstream of the Edgewood Bridge and ending downstream of the WPCF.

2.1. National Objectives. The National or Federal objective of water and related land resources planning is to contribute to NED consistent with protecting the Nation's environment pursuant to national environmental statutes, applicable EOs, and other Federal planning requirements. Contributions to NED include increases in the net value of the national output of goods and services, expressed in monetary units. These contributions are the direct net benefits that accrue in the Study area and the rest of the Nation.

2.2. 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 interim 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 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 FRM measures used 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

2.3. Problems and Opportunities. The evaluation of public concerns reflects a range of needs and desires perceived by the public. This section describes these needs in the context of problems and opportunities.

The primary problem that this Study is addressing is a discontinuous levee FRM system that does not provide flood risk reduction. The City must perform emergency flood fighting activities to protect gaps in the system. During flood events, public and private infrastructure and facilities are inundated. Opportunities exist to provide a more comprehensive FRM plan. This could be accomplished by providing flood risk reduction in order to reduce the risk of inundation and associated flood damages. Providing a more continuous levee system at a high elevation would reduce the risk of damages.

The existing levee system has an unacceptable risk of failure during flood events due to insufficient design and construction such as steep side slopes, levee construction materials, lack of internal system, and an insufficient crown width. In addition, insufficient vegetation control on the slopes has further increased this risk. This system has withstood past events due to effective emergency flood fighting efforts. However, the risk of failure of this system is considered high. Opportunities exist to reduce the risk of failure of the existing levee system by removing the existing system and providing a more reliable system that does not require extreme flood fighting and maintenance efforts. The opportunity to repair the existing system to does not exist due to severe design deficiencies.

Prior to the record flood event of 2008, the City did not have a comprehensive and updated floodplain management plan. Lack of a formal plan caused a delayed response to the 2008 flood event. The public was largely unaware of the risk of severe flooding, because prior to the 2008 event the area had not experienced a flood event greater than the 1 percent chance event in the over 100 years of gage records. Many impacted citizens did not have flood insurance. Several pieces of a plan existed prior to 2008 but there is not a cohesive vision for management of the floodplain within the City of Cedar

Rapids. The existing emergency flood fighting plan, municipal code flood management ordinance, comprehensive land use plan, and a comprehensive storm water report are being used in place of a comprehensive plan. As the result of the 2008 event, the City has taken steps towards resolving this problem by preparing an updated and detailed emergency flood response manual to be updated yearly. The opportunity exists to provide a comprehensive floodplain management plan by further refining the City's existing efforts, developing a plan for coordination with other local, state, and Federal agencies, incorporating new flow frequency data, and updating land use as the result of implementation of non structural measures by the City.

The existing trail system within the City does not provide the public suitable access to the Cedar River. Additionally, the system lacks connectivity and has safety issues with road and bridge crossings. The opportunity exists to provide a continuous system of trails along the river with safe access points, road/bridge crossings and enhanced amenities such as parking and benches. Development of this system is ancillary and must be within the footprint of an implementable FRM plan.

The aquatic ecosystem within the City is degraded due to urban development. Sediment in Cedar Lake contains polychlorinated biphenyls (PCBs) and chlordane. The mouth of McLoud Run is an unnatural concrete lined channel. The Five-in-One Dam limits connectivity on the Cedar River. The City's WPCF is inundated during low frequency high flow events such as 2008 and raw sewage must be discharged directly to the river. Limited opportunities do exist to improve the aquatic ecosystem within the City by restoring the mouth of McLoud Run, improving connectivity to the river, and reducing the need for sewage discharge. However, development of measures to address these problems is severely constrained by the lack of suitable and effective options in the urban corridor.

Because of contamination issues in Cedar Lake, the City is not interested in pursuing a restoration option. Additionally, Hazardous, Toxic, Radioactive Waste (HTRW) clean-up is a local responsibility. Improving the connection of McLoud Run with the Cedar River would likely result in a degradation of the upper portions of the stream due to the increased fish passage of invasive species such as carp. Dam removal to improve connectivity would cause unacceptable socio-economic impacts to the recreational opportunities above the dam. Given the low frequency of the inundation of the WPCF, it is not anticipated that options to reduce the discharge of sewage would be cost effective. Additionally, during events such as 2008, several other public facilities also discharge sewage. Due to these constraints, the Study did not further analyze ecosystem restoration measures.

2.4. Planning Objectives. The national objectives are general statements that are not specific enough for direct use in plan formulation; maximizing NED is the overarching goal of this Study. The water and related land resource problems and opportunities identified in this Study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities in the Study area and represent desired positive changes from the Future Without Project Condition. The planning objectives are specified as follows:

- Reduce flood damages to private and public infrastructure caused by Cedar River flooding greater than the 1 percent chance event in the City through 2060.
- Improve the response by local, state, and Federal agencies to the all flood events along the Cedar River in the City.

- Increase public awareness to the risk of flooding from the Cedar River in the City through 2060.
- Increase recreational opportunities in the City along the Cedar River that is compatible with an implementable FRM plan.

Local Planning Objectives. The City's goals and objectives have been developed from direction derived from the City Council, City workgroup sessions, and the workshops that have been conducted for public input. The City's FRM goals are to:

- implement a comprehensive FRM project;
- enhance floodplain management – Community Rating System (CRS) and National Flood Insurance Program (NFIP)
    - reduce flood looses
    - facilitate accurate flood insurance rating
    - promote awareness of flood insurance
- enhance recreational opportunities throughout the Cedar Rapids-Cedar River floodplain;
- expand housing options throughout the City, including quick implementation of affordable, replacement housing;
- minimize the impacts of the 4th Street Corridor on downtown traffic and development;
- redefine the City as a community connected to the outdoors, including an improved system of trails;
- strengthen downtown as the commercial, institutional, and cultural center of the City. In so doing, broaden the diversity of options offered downtown, such as more downtown housing and entertainment and retail options;
- strengthen the arts and culture community of downtown, including protecting and preserving historic resources, as one of the pillars of downtown;
- strengthen the Medical District;
- focus on developing 1st Avenue as the main street of Cedar Rapids. With this, improve transit on 1st Avenue, and implement a downtown circulator;
- improve the transportation system for everyday use, as well as for emergency flood response;
- reconstruct Edgewood Bridge approaches and the southwest arterial;
- preserve industry;
- keep neighborhoods intact; and
- enhance floodplain management through the Federal Emergency Management Agency (FEMA) CRS.

2.5. Planning Constraints. Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. Further, plan formulation must provide safe conditions in the interest of public safety and be socially acceptable to the community. Planning constraints considered to this point are as follows:

- **Hazardous, Toxic, Radioactive Waste (HTRW):** Alternatives cannot cause disturbance of HTRW to minimize and prevent Federal liability under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- **Flood Heights:** Alternatives cannot negatively impact the 100-year flood profile.
- **Environmental and Cultural Resources:** Alternatives should be designed to minimize negative impacts to these resources.
- **FEMA Voluntary Acquisition Program:** Alternatives will not be developed that interfere with restrictive use guidelines established for properties purchased with Hazard Mitigation Grant Program funding.

3.0. AFFECTED ENVIRONMENT *

The environmental settings for both the Existing and the Future Without Project Condition are described in this section.

3.1. Environmental Setting (Existing Conditions). Cedar Rapids is recovering from the 2008 flood event and continued to do so throughout the Study. Changes to the existing conditions took place in the Study area daily. The property inventory and damage surveys began in June 2009 and were completed in October 2009. The limited Study schedule and the continuous changes occurring as the City recovers resulted in the Study team deciding on Study assumptions in October 2009. The Study assumptions are described further in Section 3.2.

To fully understand the existing conditions within the floodplain, Feasibility Study Damage Reaches (figure 1) were established to present the geographic context of the Study area and provide a framework for analysis. Detailed economic, cultural resources, engineering, hydrology/hydraulics, and other pertinent data were collected. The Study Damage Reaches (figure 3, page 5) were re-evaluated and modified as new data became available. Figure 3 and table 1 define the Study Damage Reaches.

Table 1. Cedar Rapids Damage Reach Information [1]

Study Damage Reaches	Description	Approximate. Elevation of Significant Damage	Existing Condition Elevation by Selected Flood Event			
			50-yr	100-yr	500-yr	2008 Flood
1 Edgewood	Right Bank - Area upstream of Edgewood Drive	726	730.5	732.9	736.9	739.2
2A Ellis Park-North Time Check	Right Bank - Ellis Lane to O Avenue	725	727.2	730.0	733.7	735.7
2B Time Check	Right Bank - O Avenue to 1st Avenue	723	725.8	728.8	732.9	734.9
2C Taylor	Right Bank - 1st Avenue to 8th Avenue	721	722.9	725.1	729.6	732.2
2D Czech Village	Right Bank – 8th Avenue to Skejskal Park	720	721.9	724.0	728.2	731.3
3 Prairie Creek	Right Bank - Area at mouth of Prairie Creek	717	716.6	718.2	722.2	725.0
4A Cedar Lake North	Left Bank - Long Bluff Rd. to southern edge of Cedar Lake	726	726.0	729.1	733.3	735.3
4B Cedar Lake South	Left Bank - Southern edge Cedar Lake to I-380	722	725.4	728.4	732.5	734.3
5A Downtown Cedar Rapids	Left Bank - I-380 to 8th Avenue	721	722.9	725.1	729.6	732.2
5B Oakhill Jackson	Left Bank - 8th Avenue to 12th Avenue SE	718	722.2	724.3	728.5	731.5
5C Otis Road East	Left Bank - 12th Avenue SE to Van Vechten Park	716	719.6	721.5	725.5	728.2
6 Cedar Valley (Rompot)	Left Bank - Otis Road to Otis Avenue	716	717.5	719.3	723.2	725.7
7 Water Pollution Control Facilities (WPCF)	Left Bank - Bertram Road - WPCF	711	711.3	712.8	717.6	720.4
8 Fresh Water Intake Wells	Both Banks - Area upstream and adjacent to Reaches 1, 2A, and 4A					
9 Mays Island	Middle of River - Mays Island similar to Reach 5A	723	722.3	724.5	728.7	731.5

[1] This table summarizes the without project elevations representative within each damage reach. Approximate Elevation of Significant Damage was calculated in the Hydraulic Engineering Center- Flood Damage Reduction Analysis (HEC-FDA) program. It is the stage at the index station of each study damage reach associated with 5% of the total damage for the 1% event. See also Appendix A, *Hydrology and Hydraulics* and Appendix E, *Economics*.**"**

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). In April 2010, revised FEMA Digital FIRM [(DFIRM)(figure 5)]floodplain maps were adopted by the City. The Study used new data to develop the USACE 2010 Floodplain Delineations 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.

3.1.2. Existing Flood Risk Management. Six distinct FRM systems currently exist along the Cedar River through the central core of Cedar Rapids (figure 7). These systems were all locally built by the City or private entities. None of these existing systems are included in the Public Law 84-99 Rehabilitation and Inspection Program. No as-builts or specifications are available. Past inspections of the existing systems by the Corps revealed many items that do not meet Federal design standards. Significant flood fighting efforts take place by the City during floods such as the building of sand bag tie-offs at elevations that are below the 1 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.

Existing levee/floodwall systems in Cedar Rapids are lacking permanent pump stations and closure structures on storm sewers. Storm sewers pipes flow freely underneath existing levee/floodwall systems and require major flood fighting efforts in an attempt to prevent flood waters from backing up through existing storm intake grates and manholes located at ground level throughout areas within the floodplain. Since these existing systems lack basic features necessary for a comprehensive line of protection and instead rely on major flood fighting efforts to fill in these gaps, a risk-based analysis of the existing systems was not warranted. Therefore, no measurable level of flood protection is accounted for within this feasibility report for existing conditions. More specifics regarding this conclusion can be found in Appendix G, *Geotechnical Engineering*.

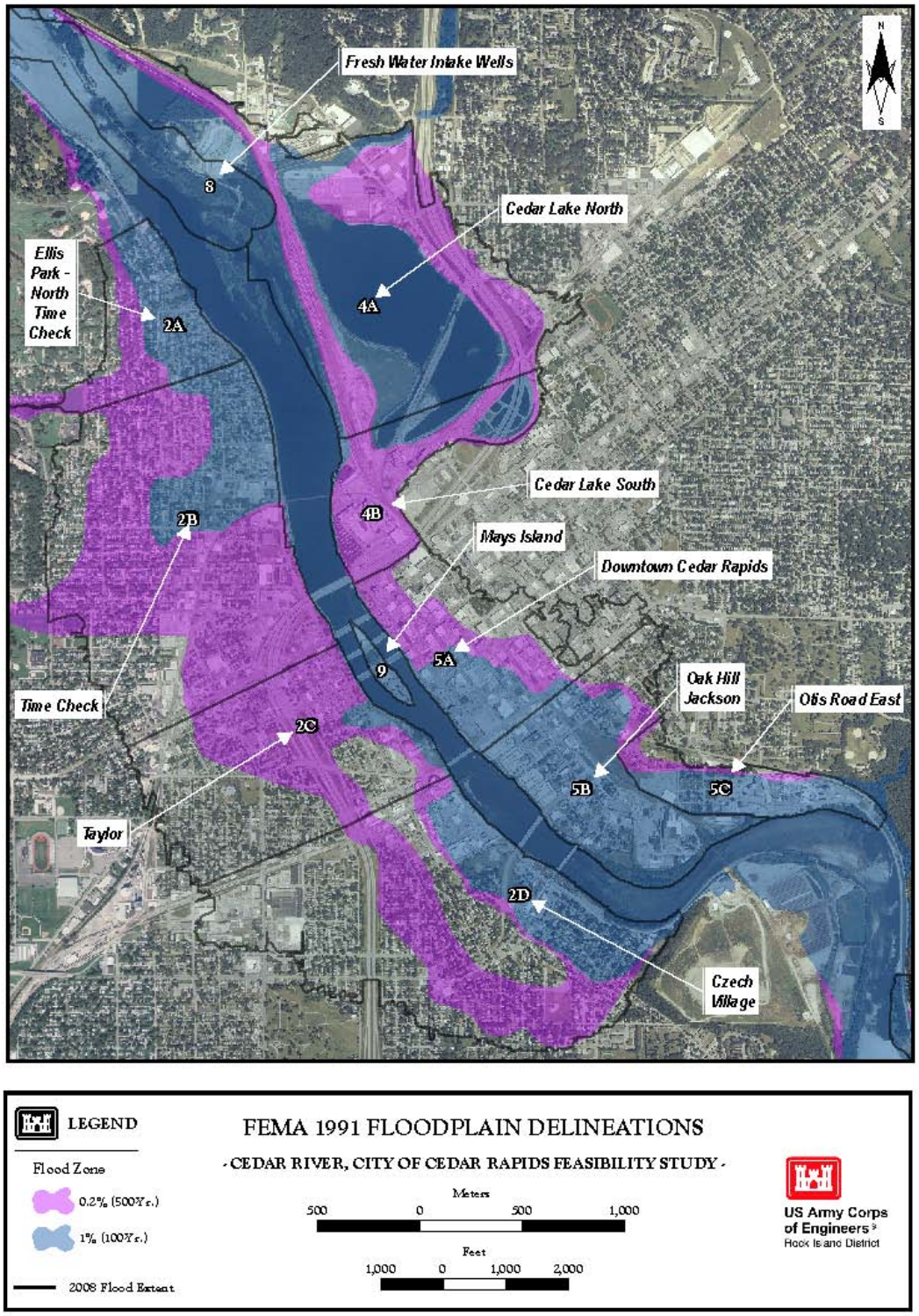

Figure 4. FEMA 1991 Floodplain Delineations

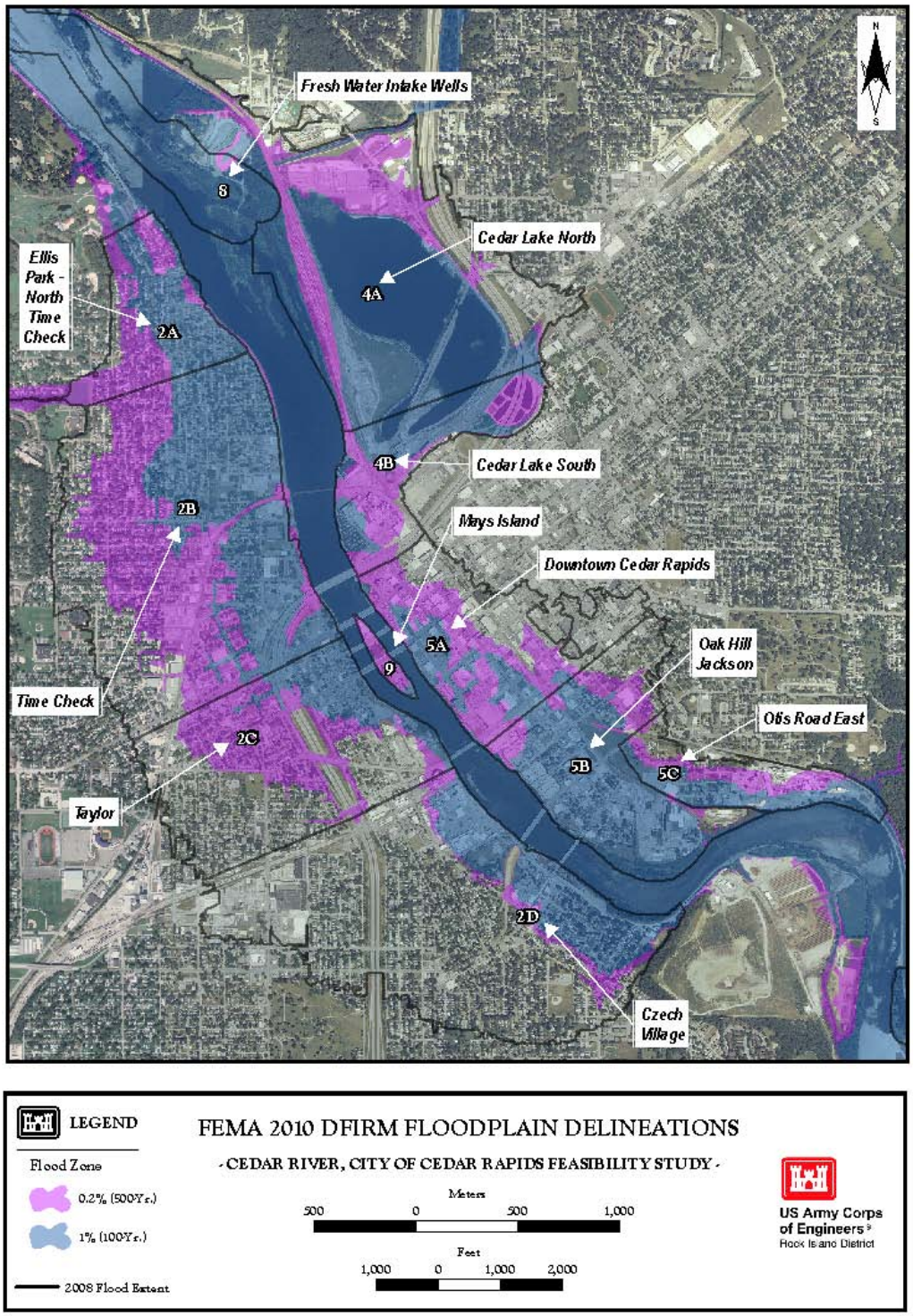

Figure 5. FEMA 2010 DFIRM Floodplain Delineations

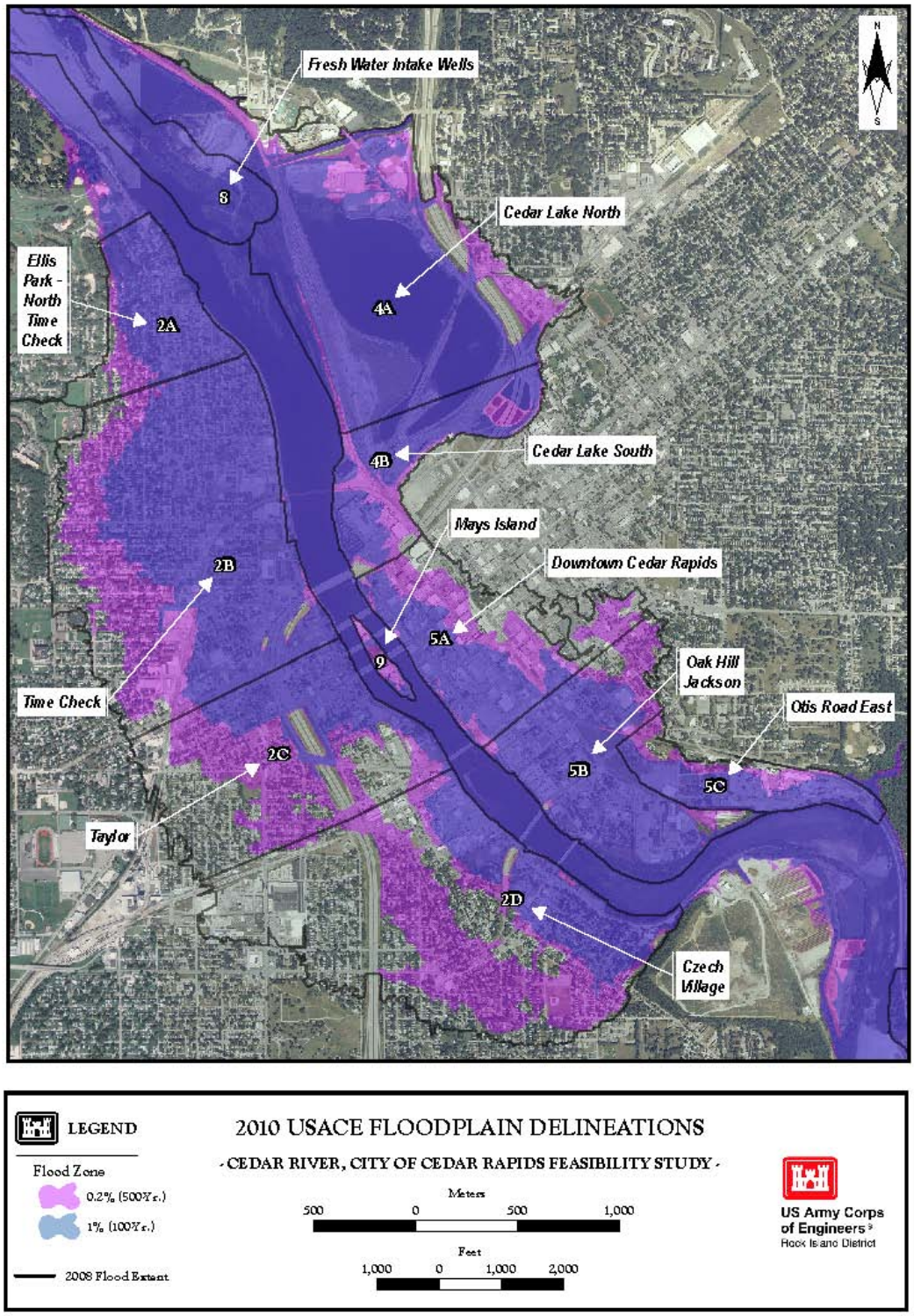

Figure 6. 2010 USACE Floodplain Delineations

Table 2. Study Area - Parcels Per Reach

	FIRM 1991 Percent Chance Event			DFIRM 2010 Percent Chance Event			USACE 2010 Percent Chance Event		
Study Damage Reach	100-yr	500-yr	>500-yr	100-yr	500-yr	>500-yr	100-yr	500-yr	>500-yr
1	22	0	0	22	0	0	22	0	0
2A	232	124	31	242	136	9	300	49	38
2B	346	972	320	654	655	329	1048	439	151
2C	28	350	538	79	348	489	191	419	306
2D	265	462	602	226	20	1083	269	574	486
3	6	2	1	4	0	5	5	4	0
4A	50	46	66	21	23	118	67	66	29
4B	3	12	2	1	6	10	16	1	0
5A	131	102	95	39	164	125	194	93	41
5B	274	38	63	191	97	87	287	65	23
5C	49	24	3	19	26	31	55	16	5
6	65	51	22	4	54	80	63	51	24
7	3	0	0	0	0	3	3	0	0
8	9	0	0	4	0	5	7	0	2
9	2	0	0	2	0	0	2	0	0
Totals	**1485**	**2183**	**1743**	**1508**	**1529**	**2374**	**2529**	**1777**	**1105**

Table 3. Study Area - Reach Acres Per Percent Chance Event

	FIRM 1991 Percent Chance Event			DFIRM 2010 Percent Chance Event			USACE 2010 Percent Chance Event		
Study Damage Reach	100-yr	500-yr	>500-yr	100-yr	500-yr	>500-yr	100-yr	500-yr	>500-yr
1	44.5	3.2	2.3	44.7	3.2	2.1	46	3.4	0.7
2A	39.3	25.5	7.6	34.1	34.2	4.1	53.7	9.1	9.6
2B	56.3	159.7	52.5	107	101.5	60.1	169.2	67.2	32.2
2C	9.1	51.3	76.5	24.2	38.7	74	36.4	48.2	52.3
2D	68	78.4	136.1	62.5	13.5	206.6	67.8	86.1	128.6
3	23.8	2.2	31.6	7.8	0.9	48.9	7.5	33.7	16.4
4A	223.9	96.1	18.5	229.4	74.9	34.1	281.6	42.6	14.2
4B	19.6	49.7	1.2	40.7	25.8	4.1	53.9	15.3	1.4
5A	192.5	29.2	36.8	95.4	126	37.1	208	30.1	20.3
5B	124.4	5.7	12.5	115.7	13.9	13.1	126.4	10.9	5.3
5C	41.2	6.9	3.6	27.3	14.9	9.6	37.9	9.8	4.1
6	148.4	31.1	13.1	114	49.4	29.2	149.3	11.2	32
7	19.9	47.6	0	18	10.7	38.9	26.3	29	12.2
8	201.9	0.5	0	201.2	1.2	0	106.6	0.7	95.1
9	6.7	0	0	1.2	5.5	0	2.4	4.3	0
Totals	**1219.5**	**587.1**	**392.3**	**1123.2**	**514.3**	**561.9**	**1373**	**401.6**	**424.4**

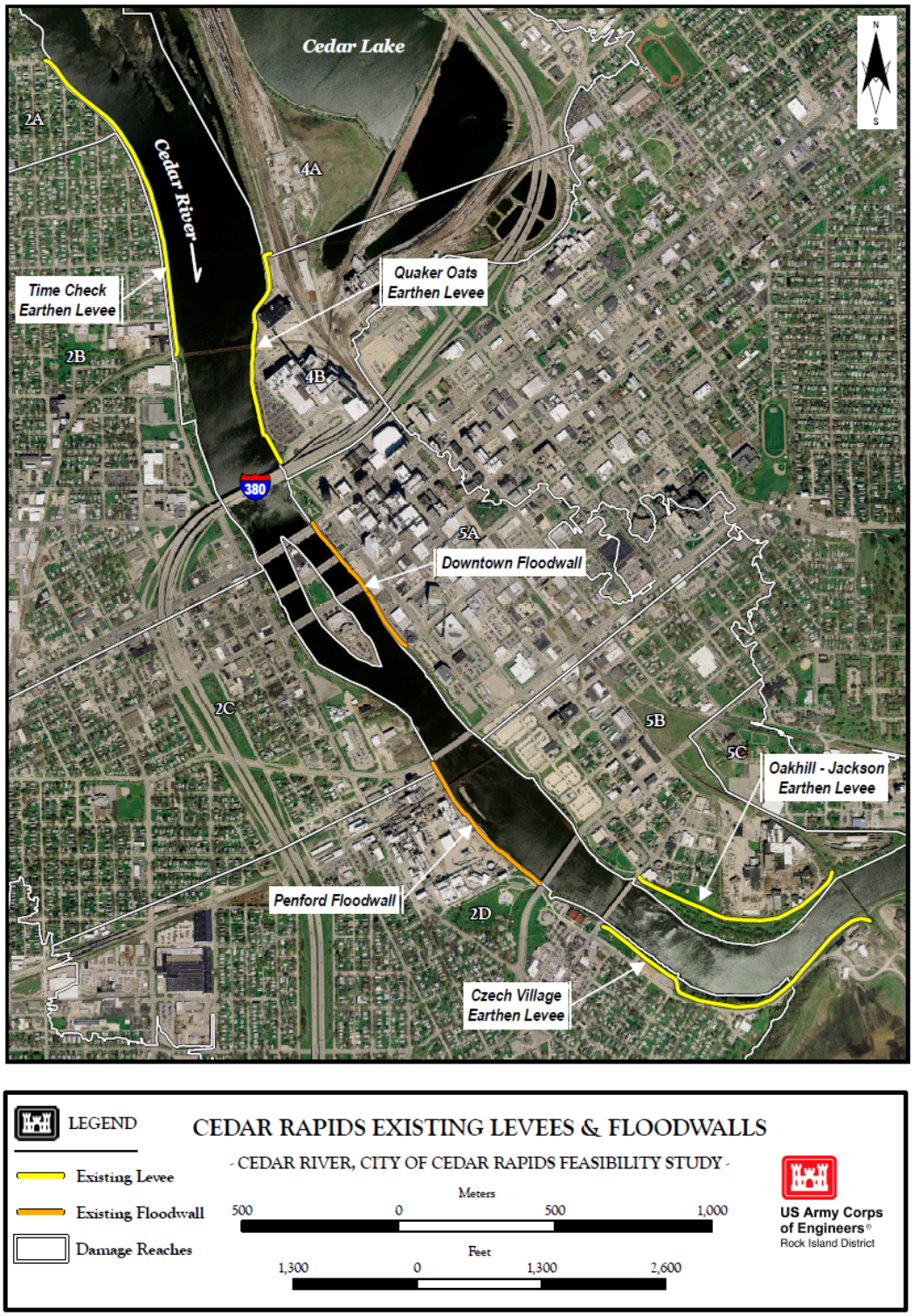

Figure 7. Existing Flood Risk Management Systems

3.1.3. Estimated Annual Damages-Benefit Analysis. The benefit categories considered in the economic analysis were: Flood Damage Deduction to Residential and Nonresidential Properties, Public Damage Reduction, National Flood Insurance Program Administrative Cost Savings, and Recreation Benefits. Public Damage Reduction benefits include debris removal, emergency FRM measures, roads and bridges, utilities, and parks and recreation.

Table 4 provides existing structure inventory per damage category per reach.

Table 4. HEC-FDA Structure Inventory - Number of Structures by Category

Damage Reach	Commercial/ Industrial	Public	Residential	Total
West Bank				
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
West Bank Total	**276**	**75**	**3,294**	**3,645**
East Bank				
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			0	
9	0	3	0	3
East Bank Total	**202**	**77**	**277**	**556**
Entire Study Area	**478**	**152**	**3,571**	**4,201**

Expected annual damages (EAD) are defined as the monetary value of NED flood losses in any given year based on the magnitude and probability of loss from all possible flood events. The calculation of expected annual damages, under the Hydraulic Engineering Center Flood Damage Assessment (HEC-FDA) model, involves using computerized Monte Carlo simulation for computing expected annual flood damages (mean damage obtained by integrating the damage exceedance probability curve for each study reach). Uncertain parameters (error distributions around the mean) such as flow-frequency, flow-stage, and stage-damage are sampled during the simulation. HEC-FDA output includes best estimate (mean) of expected annual damage and a distribution of possible values about the mean. Table 5 provides a listing of expected annual damage by study damage reach and damage category. For further information, see Appendix B, *Economics*.

Table 5. Estimated Annual Damages by Reach and Damage Category for the Without Project Alternative - $000's (Analysis 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 and a discount rate of 4.375%.

Public Damages. The 2008 flood event was a rare and locally disastrous occurrence. Many public facilities 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 were used to identify direct flood-related costs incurred by public entities located in the Study area. The worksheets are an objective and verifiable source of post-flood data that was employed to help estimate public damages for the full range of potential flood events. Table 6 reports the 2008 event public damages by category. This table is based upon the City's accounting for damage categories and repair costs under the FEMA post-disaster declaration public assistance program.

Table 6. 2008 Flood Event – Public Damage Costs by Category

FEMA Category	2008 Event Amount
Debris Removal	$7,654,100
Emergency FRM 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**

The following paragraphs describe the methods used for quantifying damages for public categories including debris removal, emergency FRM measures, roads and bridges, water control facilities, buildings and content, utilities, and parks and recreation.

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 majority of this cost was for pick up and hauling of the debris by truck, 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 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.

Emergency FRM Measures. The 2008 flood event caused more than $85,700,000 in costs for emergency FRM 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 WPCF, and for the emergency demolition and removal of destroyed houses and buildings. To estimate stage-damage relationships for emergency measures, District planning personnel consulted directly with knowledgeable City 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.

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.

Water Pollution 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. Stage-damage relationships for the full range of possible flood events were constructed in a similar manner to that used for debris removal and emergency FRM measures.

Buildings, Equipment, and Content. The 2008 event caused more than $121,400,000 in damages.

Utilities. The majority of the damages and costs to utilities incurred were at the WPCF.

Parks and Recreation. The majority of the damages in this category were to the Jones Golf Course, Ellis Harbor facilities, Cheyenne Park, and City trails.

3.1.4. Damage Reaches. Figure 3 identifies 15 damage reaches within the Study area. Damage reaches were delineated based on relative topography, geographic area, and street boundaries. Discussion for each damage reach outlines the estimated annual damages, approximate flood depths per chance events, topography, critical public infrastructure, the City's flood response actions, natural resources of interest, and residential properties with greater than 50 percent damage (as defined in the City tax assessor database). The elevations expressed in table 1 and in the following descriptions are based on 1988 North America Vertical Datum (NAVD). A detailed analysis of the estimated annual damage for each Reach is available in Appendix B, *Economic*s.

3.1.4.1. Damage Reach 1 - Edgewood Neighborhood. The Edgewood neighborhood consists of eight residential properties; three commercial/industrial properties; Cedar Rapids Community School District Bus Facility; Morgan Creek Lift Station; and the Edgewood Bridge Approach, a main traffic artery in the western part of Cedar Rapids (figure 8). For purposes of the economic analysis, these properties were either assumed to be elevated above the base floodplain and repaired or repaired at grade (according to the assumptions listed in section 3.2) in the Future Without Project Condition.

Damage Reach Details

- The topography of the Reach is shown in figure 9. The area starts receiving significant flood damage impact at an elevation of approximately 726. The 2008 flood of record elevation for this Reach was 739.
- The commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 7. Because of the proximity to the Cedar River, structures are impacted by the higher frequency events.
- There were eight properties that were considered substantially damaged (greater than 50 percent damage) by the 2008 event and are shown in figure 10.
- The Estimated Annual Damages for this Reach are $15,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.

- **Cedar Rapids Community School District Bus Facility:** The facility serves as a storage area for school buses. The parking lot was empty when flooding occurred in June 2008 and there was little damage.
- **Morgan Creek Lift Station:** The station was inundated by the flood and was lost from service. The effect of the inundation was the release of raw sewage from much of the northwest section and some of the northeast sections of the City into the flood flow upstream of downtown Cedar Rapids.
- **The Edgewood Bridge Approach:** This is the only major traffic bridge connection in the western portion of Cedar Rapid; all other access across the Cedar River within City limits is in the downtown area. During the 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 City priority 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 1 to 5 days.

Table 7. Properties Impacted – Reach 1

Commercial & Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-3.0 to 0	0	1	1	2	3	0	0	0
>0 to 2	0	0	0	0	0	3	0	0
>2 to 4	0	0	0	1	0	0	3	0
>4 to 6	0	0	0	0	1	0	0	3
>6 to 8	0	0	0	0	0	1	0	0
>8 to 10	0	0	0	0	0	0	1	0
>10 to 11	0	0	0	0	0	0	0	1

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.0 to 0	0	0	0	0	0	7	0	1
>0 to 2	0	0	0	0	0	0	7	0
>2 to 4	0	0	0	0	0	0	0	7
>4 to 6	0	0	0	0	0	0	0	0
>6 to 8	0	0	0	0	0	0	0	0
>8 to 10	0	0	0	0	0	0	0	0
>10	0	0	0	0	0	0	0	0

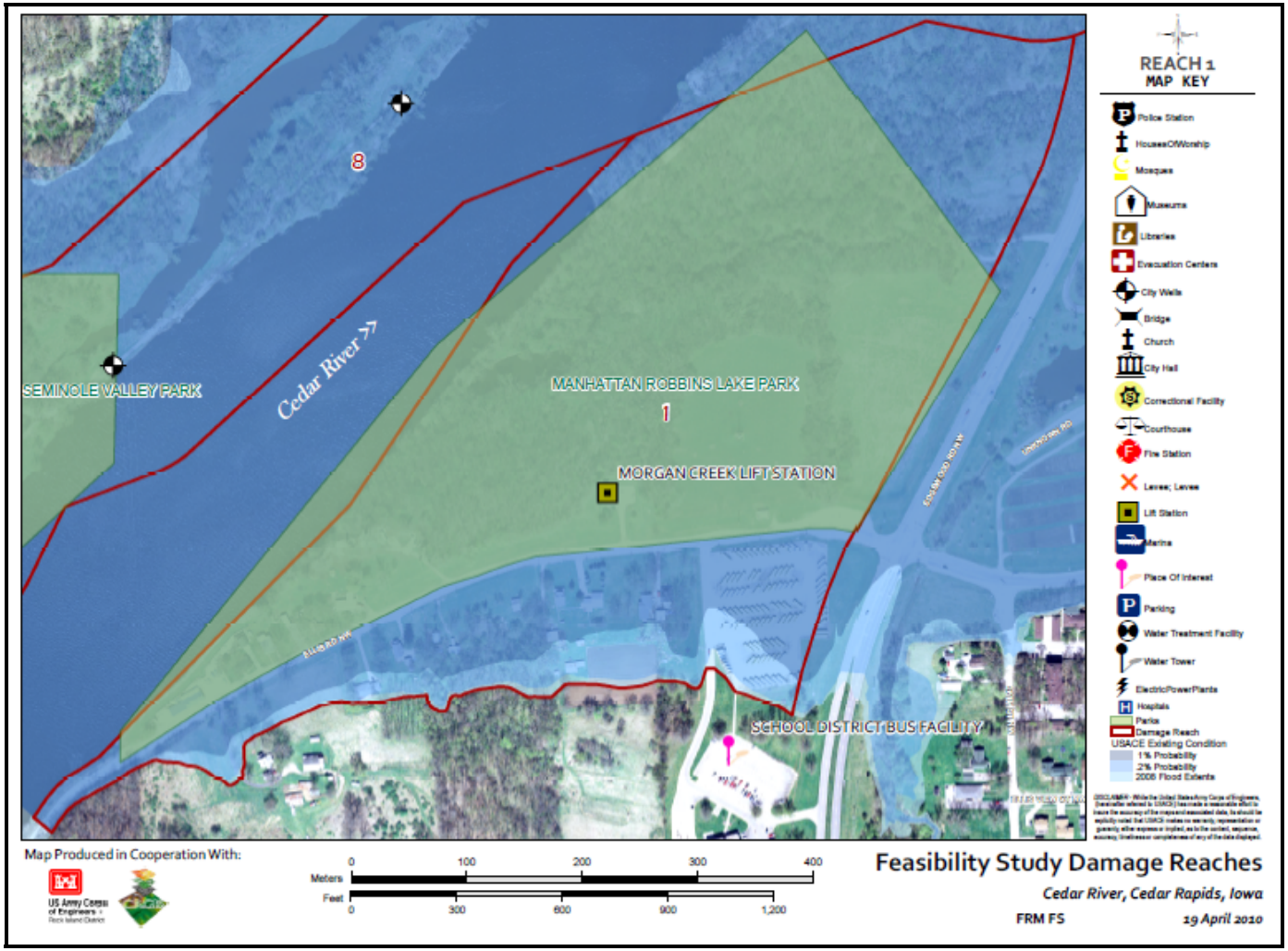

Figure 8. Damage Reach 1-Edgewood Neighborhood

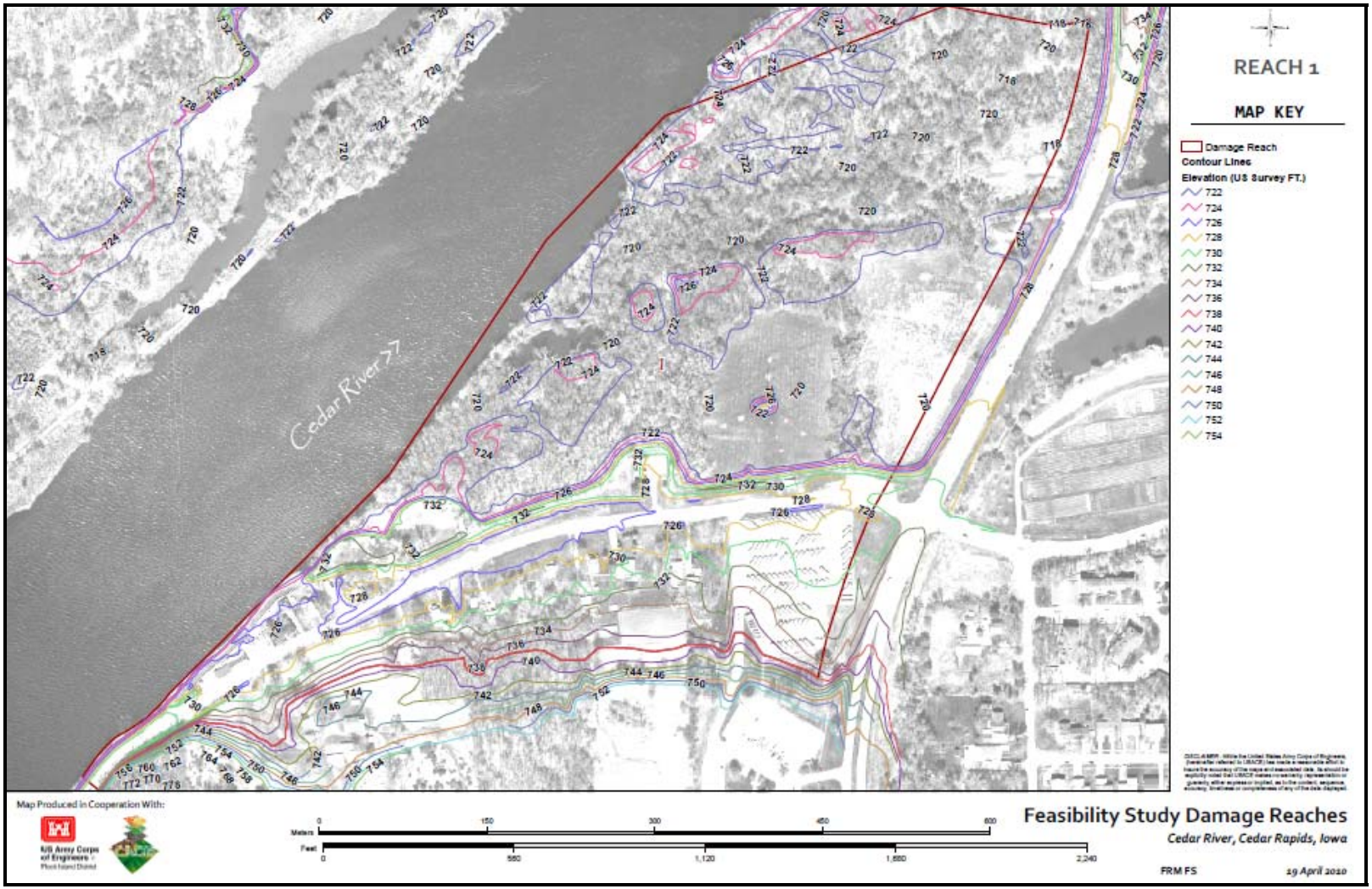

Figure 9. Topography, Reach 1

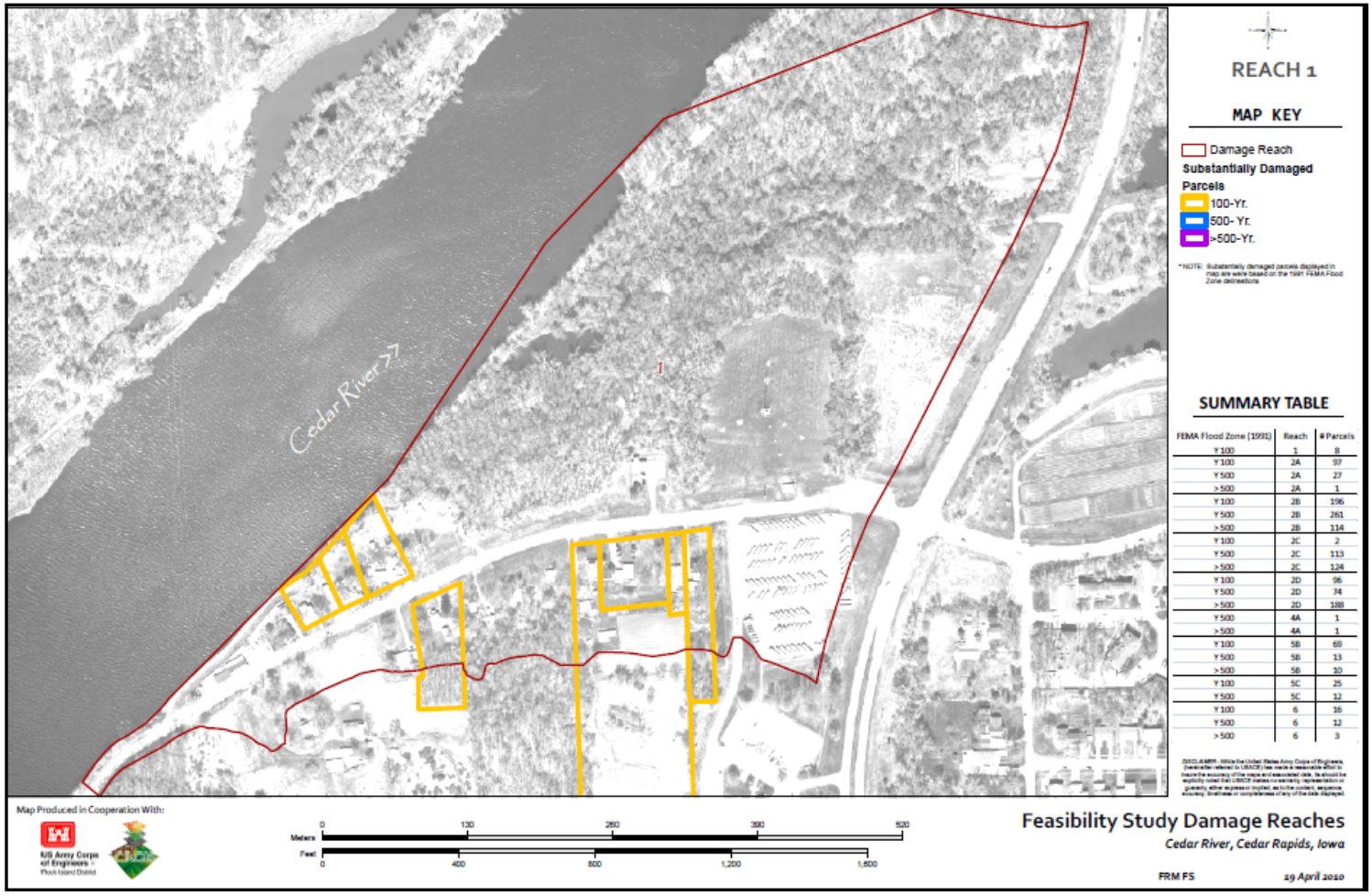

Figure 10. Substantially Damaged Parcels, Reach 1

3.1.4.2. Damage Reach 2A - Ellis Park and North Time Check Neighborhoods. Reach 2A (figure 11) is the northwestern most reach in the downtown Cedar River corridor and consists largely of residential properties. There are 4 commercial/industrial properties, 2 public, and 303 residential properties in this Reach.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $262,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 12. The area starts receiving significant flood damage impacts at an elevation of approximately 725. The 2008 flood of record elevation for this Reach was 735.7. 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. For more detail, see Section 3.1.2, *Existing Flood Risk Management*.
- The City's flood fighting actions begin by inserting a plug into the storm sewer at a flood stage of 10 feet (approximate elevation of 718.9). Building approximately 12 wells and 2 standpipes on the storm sewer system begin at a flood stage of 15 feet (approximate elevation 721.4). Road closures begin at a flood stage of 24 feet (approximate elevation 729.95) as long as storm sewer plugs, wells and standpipes held. The City's Flood Response Manual (2010) which is updated on an annual basis has more detailed information on flood fighting efforts.
- There were 105 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 13.
- The commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 8. The majority of structures are impacted by the lower frequency events.

Table 8. Properties Impacted – Reach 2A

Commercial & Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-3.0 to 0	0	0	0	2	4	0	0	0
>0 to 2	0	0	0	0	2	3	0	0
>2 to 4	0	0	0	0	0	2	3	1
>4 to 6	0	0	0	0	0	1	2	2
>6 to 8	0	0	0	0	0	0	1	2
>8 to 10	0	0	0	0	0	0	0	1
>10	0	0	0	0	0	0	0	0

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.5 to 0	0	0	0	12	78	113	31	35
>0 to 2	0	0	0	3	12	65	95	30
>2 to 4	0	0	0	0	3	28	64	101
>4 to 6	0	0	0	0	0	4	41	65
>6 to 8	0	0	0	0	0	0	8	24
>8 to 10	0	0	0	0	0	0	0	5
>10	0	0	0	0	0	0	0	0

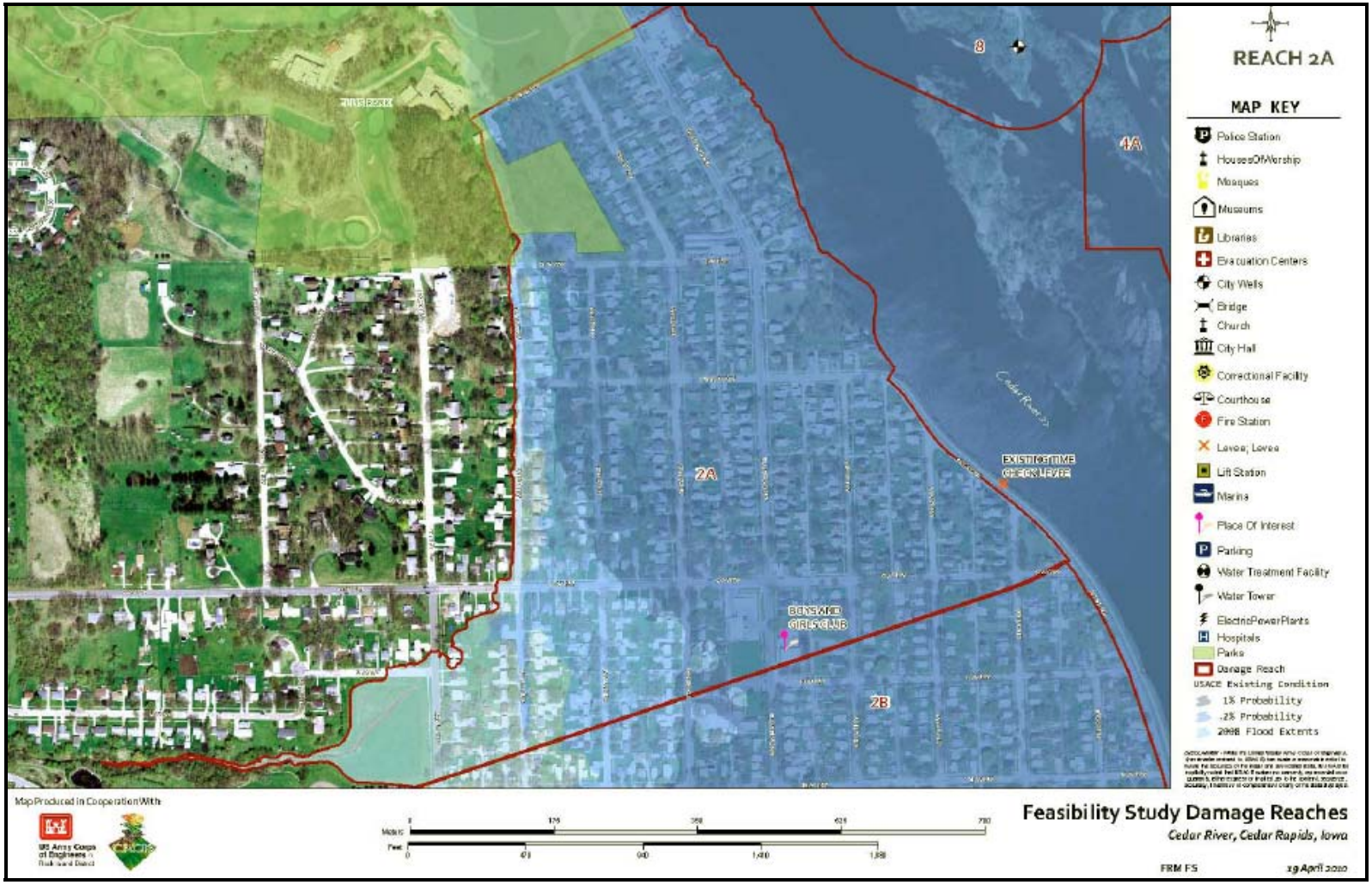

Figure 11. Damage Reach 2A - Ellis Park and North Time Check Neighborhoods

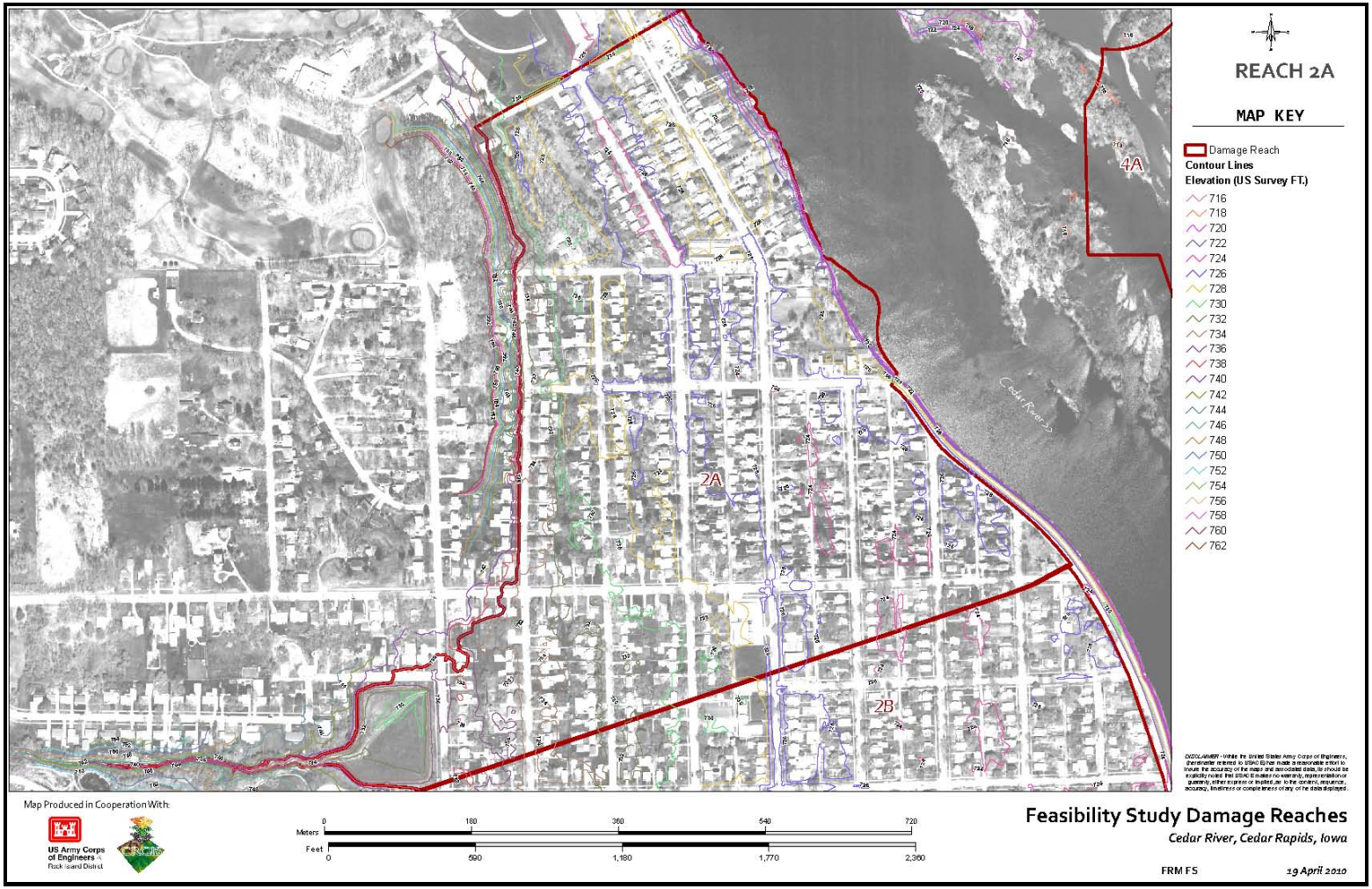

Figure 12. Topography, Reach 2A

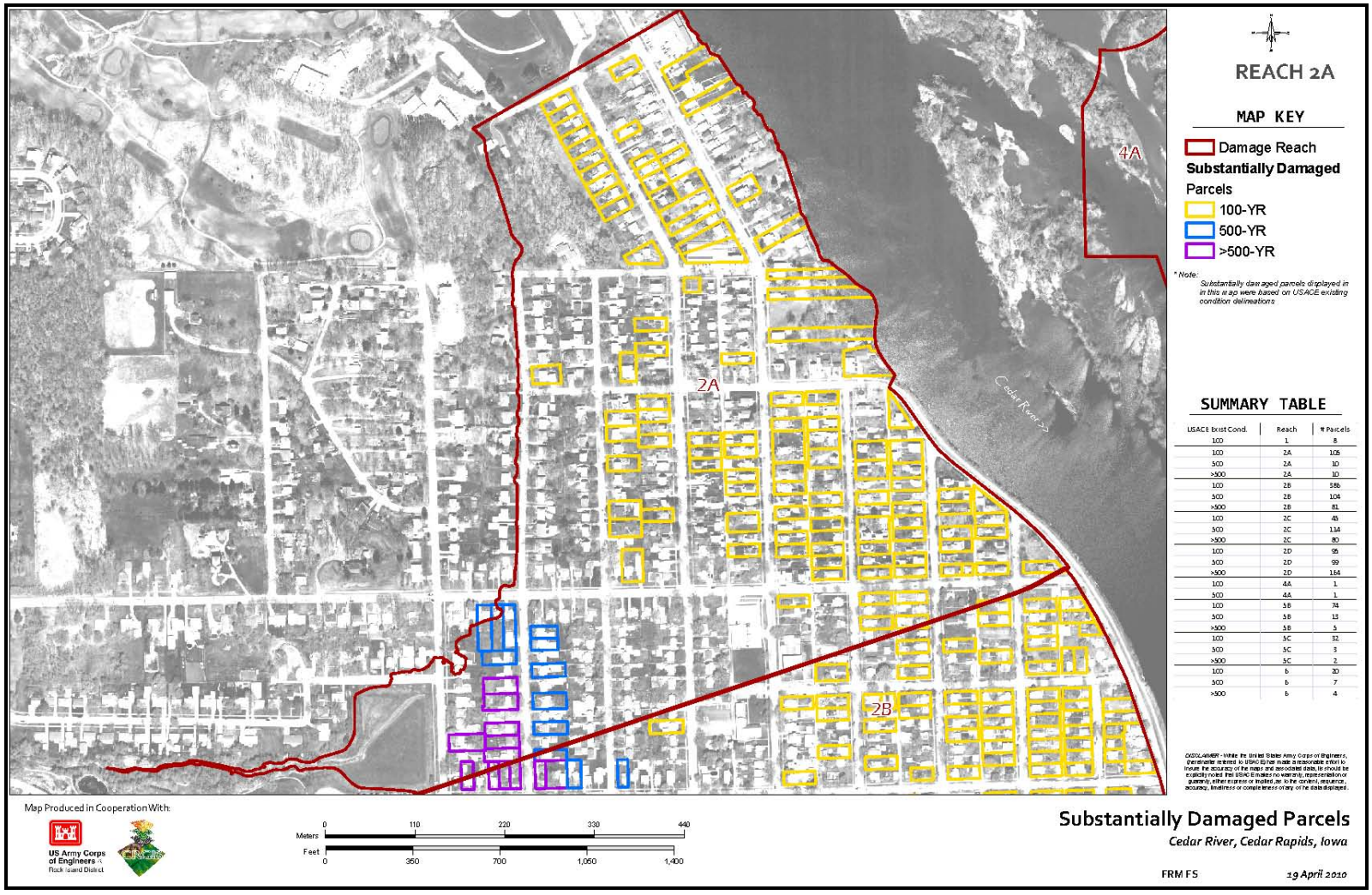

Figure 13. Substantially Damaged Parcels, Reach 2A

3.1.4.3. Damage Reach 2B - Time Check Neighborhood. Reach 2B (figure 14) 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 identified for analysis include 84 commercial/industrial properties, 31 public facilities, and 1,277 residential.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $1,472,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 15. The area starts receiving significant flood damage impacts at an elevation of approximately 723. The 2008 flood of record elevation for this Reach was 735. The existing Time Check Levee continues through this reach and ties into high ground in the I-380 area. For more detail, see Section 3.1.2, *Existing Flood Risk Management*.
- Flood fighting efforts begin in this Reach at flood stage of 15 feet (Approximate elevation 719.3) with placement of a standpipe on a culvert through the levee. Approximately 40 wells are built at storm sewer intakes and manholes beginning at flood stage of 17 feet (approximate elevation 720.3). Streets begin to close at flood stage of 18 feet (approximate elevation 721.3). An earthen levee is constructed with sandbags or fill at flood stage of 19 feet (approximate elevation 722.6).
- There are many critical public infrastructure facilities located in the Reach: the Cedar Rapids Transit Administration Office, Central Fire Station, evacuation centers, and places of worship.
- The apartment, commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 9. The majority of structures are impacted by the lower frequency events.
- There were 386 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 16.

Table 9. Properties Impacted – Reach 2B

Apartments

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	0	0	0	0
>0 to 2	0	0	0	1	0	9	0	1
>2 to 4	0	0	0	0	1	0	9	0
>4 to 6	0	0	0	0	0	0	0	9
>6 to 8	0	0	0	0	0	1	0	0
>8 to 10	0	0	0	0	0	0	1	0
>10 to 11	0	0	0	0	0	0	0	1

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	1	4	3	5	3
>0 to 2	0	0	0	2	18	27	14	9
>2 to 4	0	0	0	0	3	16	23	13
>4 to 6	0	0	0	0	0	9	17	26
>6 to 8	0	0	0	0	0	1	13	16
>8 to 10	0	0	0	0	0	0	2	10
>10 to 11	0	0	0	0	0	0	0	1

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	2	2	6	1	0
>0 to 2	0	0	0	2	3	8	1	2
>2 to 4	0	0	0	0	4	4	14	3
>4 to 6	0	0	0	0	0	4	4	11
>6 to 8	0	0	0	0	0	1	3	4
>8 to 10	0	0	0	0	0	0	2	3
>10 to 11	0	0	0	0	0	0	0	2

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.5 to 0	0	0	0	56	228	331	271	287
>0 to 2	0	0	0	3	61	183	286	163
>2 to 4	0	0	0	0	5	136	193	301
>4 to 6	0	0	0	0	0	19	155	184
>6 to 8	0	0	0	0	0	0	25	140
>8 to 10	0	0	0	0	0	0	3	19
>10 to 12	0	0	0	0	0	0	0	2

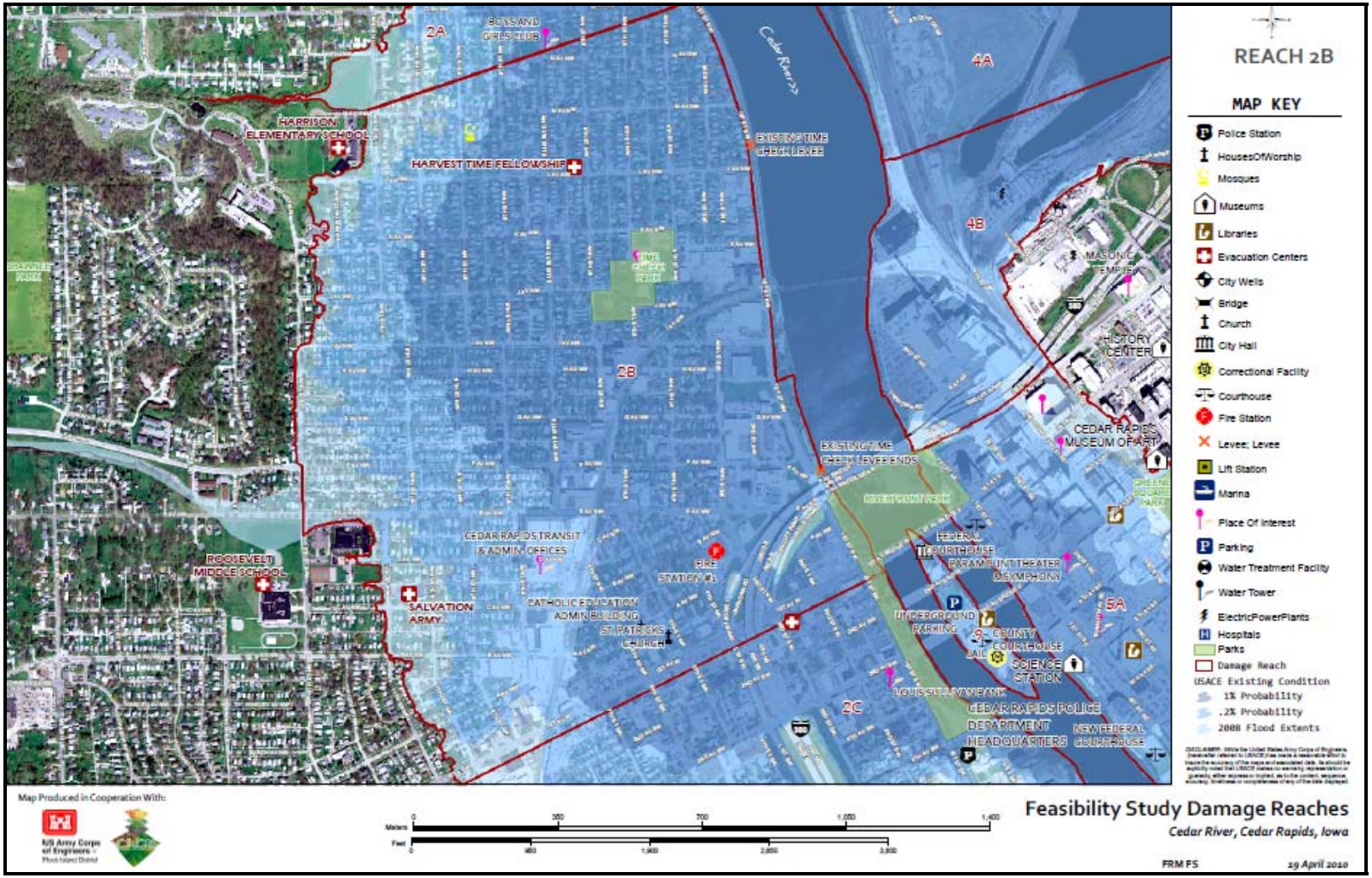

Figure 14. Damage Reach 2B -Time Check Neighborhood

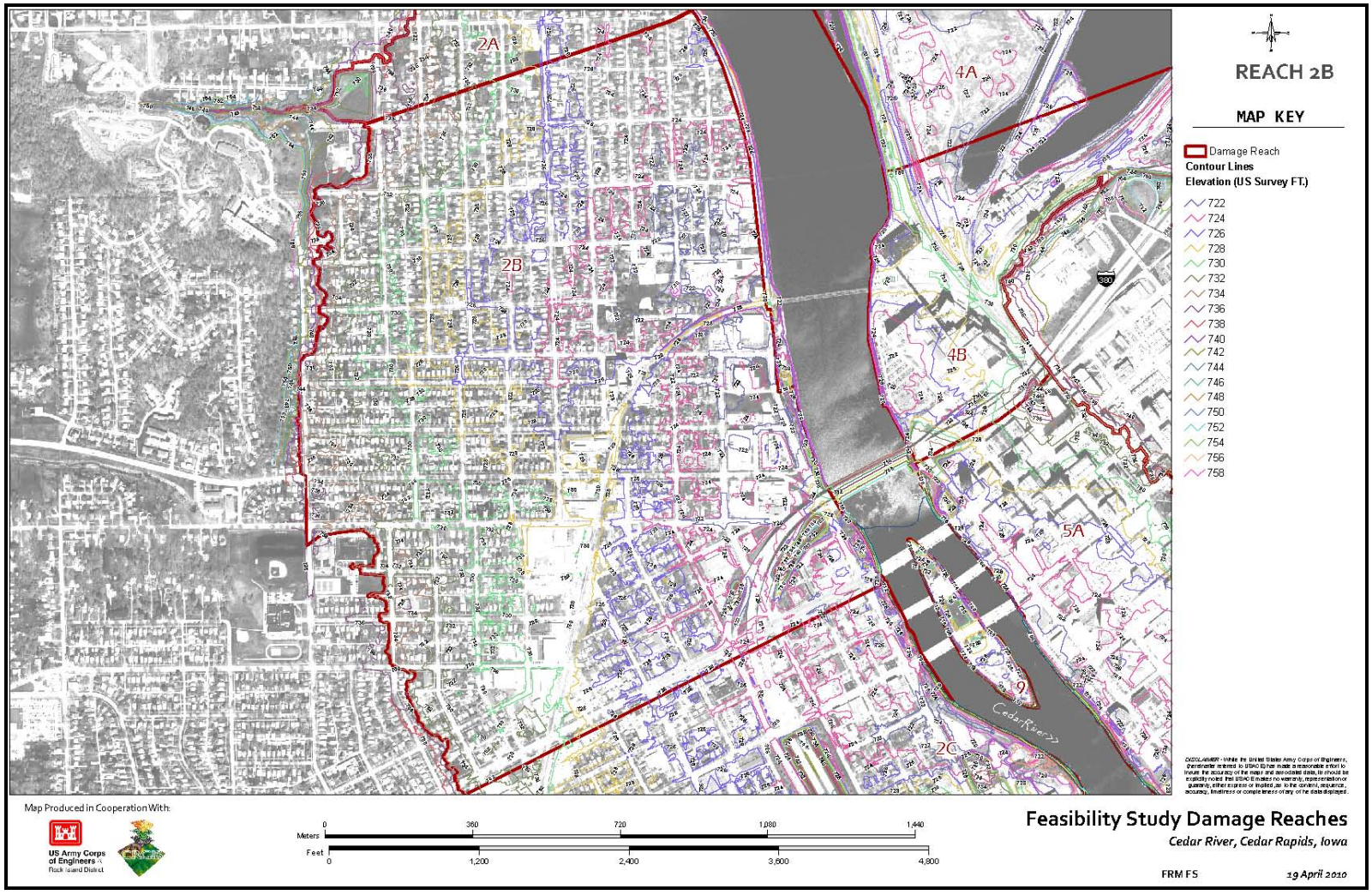

Figure 15. Topography, Reach 2B

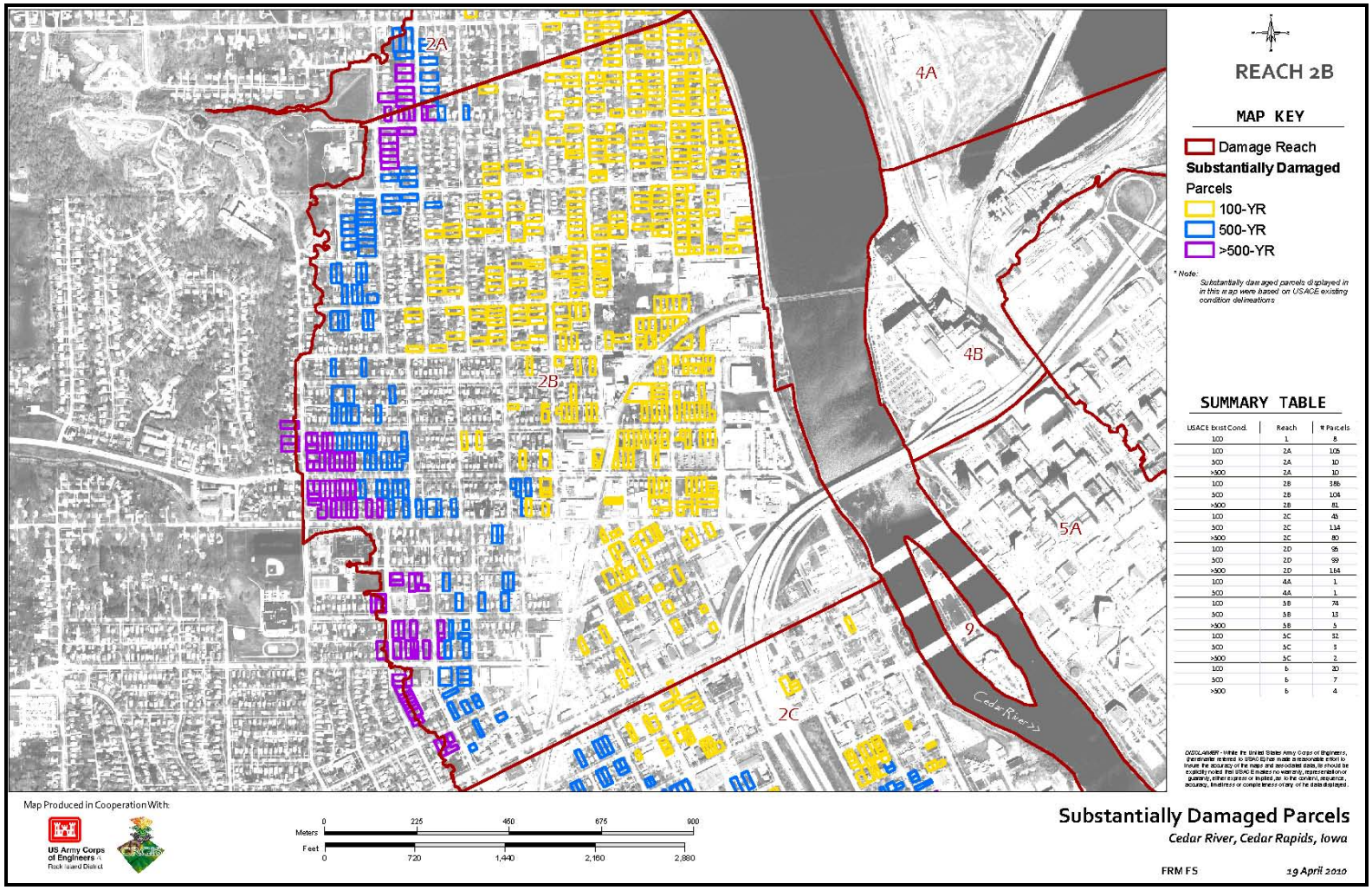

Figure 16. Substantially Damaged Parcels, Reach 2B

3.1.4.4. Damage Reach 2C - Taylor Neighborhood. Reach 2C (figure 17) 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 Details

- The Estimated Annual Damages for this Reach are $478,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 18. The area starts receiving significant flood damage impacts at an elevation of approximately 721. The 2008 flood of record elevation for this Reach was 732. Elevation ranges from 704 to 744 in this Reach.
- In this Reach flood fighting efforts begin at a 17 feet (Approximate elevation 716.0) flood stage and includes placing plugs in storm sewers and placing approximately 14 wells over storm sewer manholes and intakes. 1st Street closes at 20 feet (approximate elevation 721.7) flood stage.
- There are critical public infrastructure facilities located in the Reach. They are the Cedar Rapids Police Department Headquarters, Taylor School-evacuation center, and a church.
- The apartment, commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 10. The majority of structures are impacted by the lower frequency events.
- There were 45 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 19.

Table 10. Properties Impacted – Reach 2C

Apartments

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	0	0	1	0
>0 to 2	0	0	0	0	0	1	2	0
>2 to 4	0	0	0	0	0	0	1	3
>4 to 6	0	0	0	0	0	0	0	1
>6 to 8	0	0	0	0	0	0	0	0

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-1.0 to 0	0	0	0	0	18	9	5	9
>0 to 2	0	0	0	1	2	24	17	9
>2 to 4	0	0	0	0	1	9	23	15
>4 to 6	0	0	0	0	0	1	10	18
>6 to 8	0	0	0	0	0	0	1	18
>8 to 10	0	0	0	0	0	0	0	1
>10	0	0	0	0	0	0	0	0

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-1.0 to 0	0	0	0	0	3	4	0	0
>0 to 2	0	0	0	0	0	4	6	1
>2 to 4	0	0	0	0	0	3	4	4
>4 to 6	0	0	0	0	0	0	3	6
>6 to 8	0	0	0	0	0	0	0	3
>8 to 10	0	0	0	0	0	0	0	0
>10 to 11	0	0	0	0	3	4	0	0

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.5 to 0	0	0	0	0	8	54	149	206
>0 to 2	0	0	0	0	0	8	32	123
>2 to 4	0	0	0	0	0	0	9	46
>4 to 6	0	0	0	0	0	0	0	13
>6 to 8	0	0	0	0	0	0	0	0

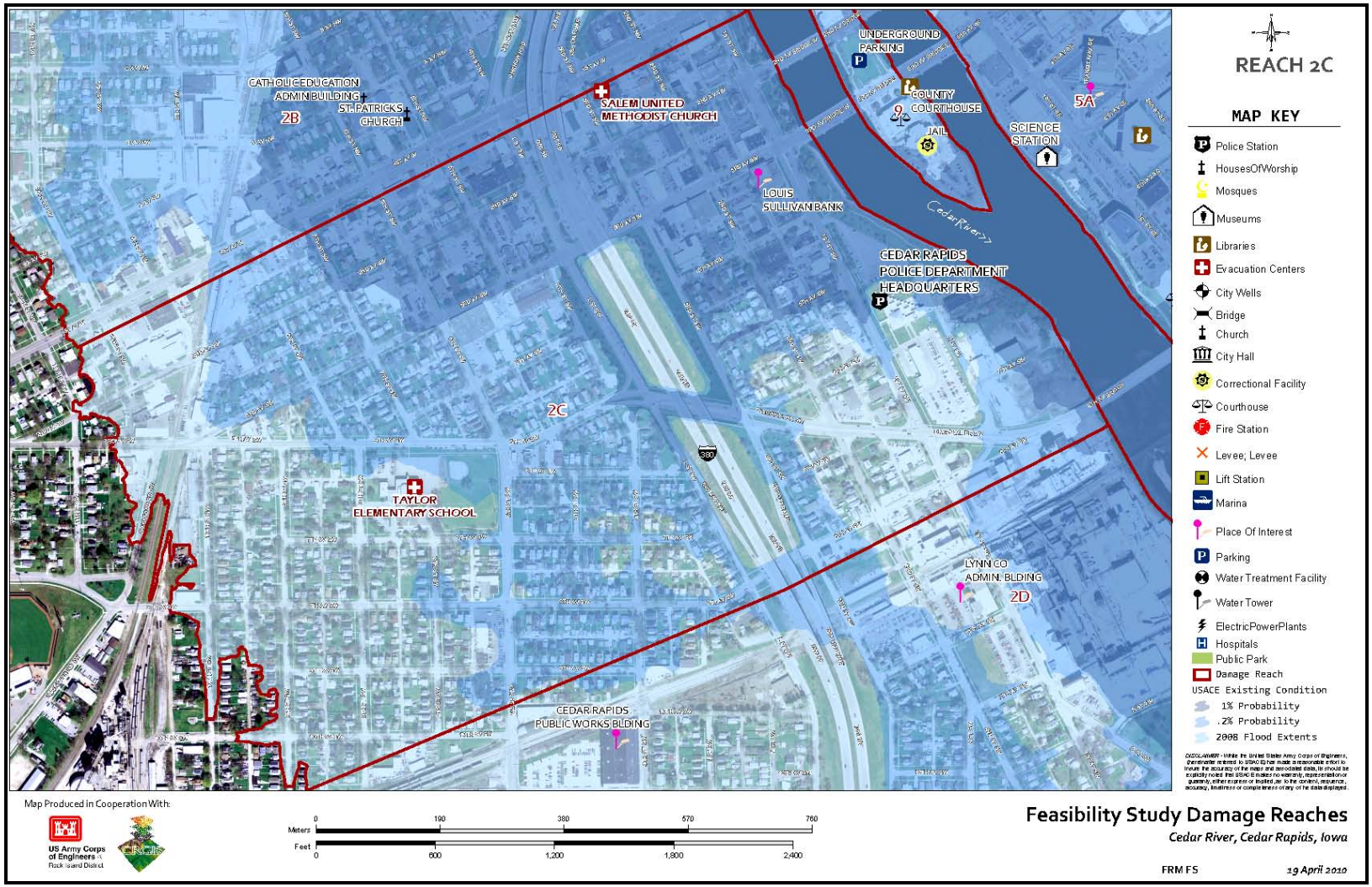

Figure 17. Damage Reach 2C - Taylor Neighborhood

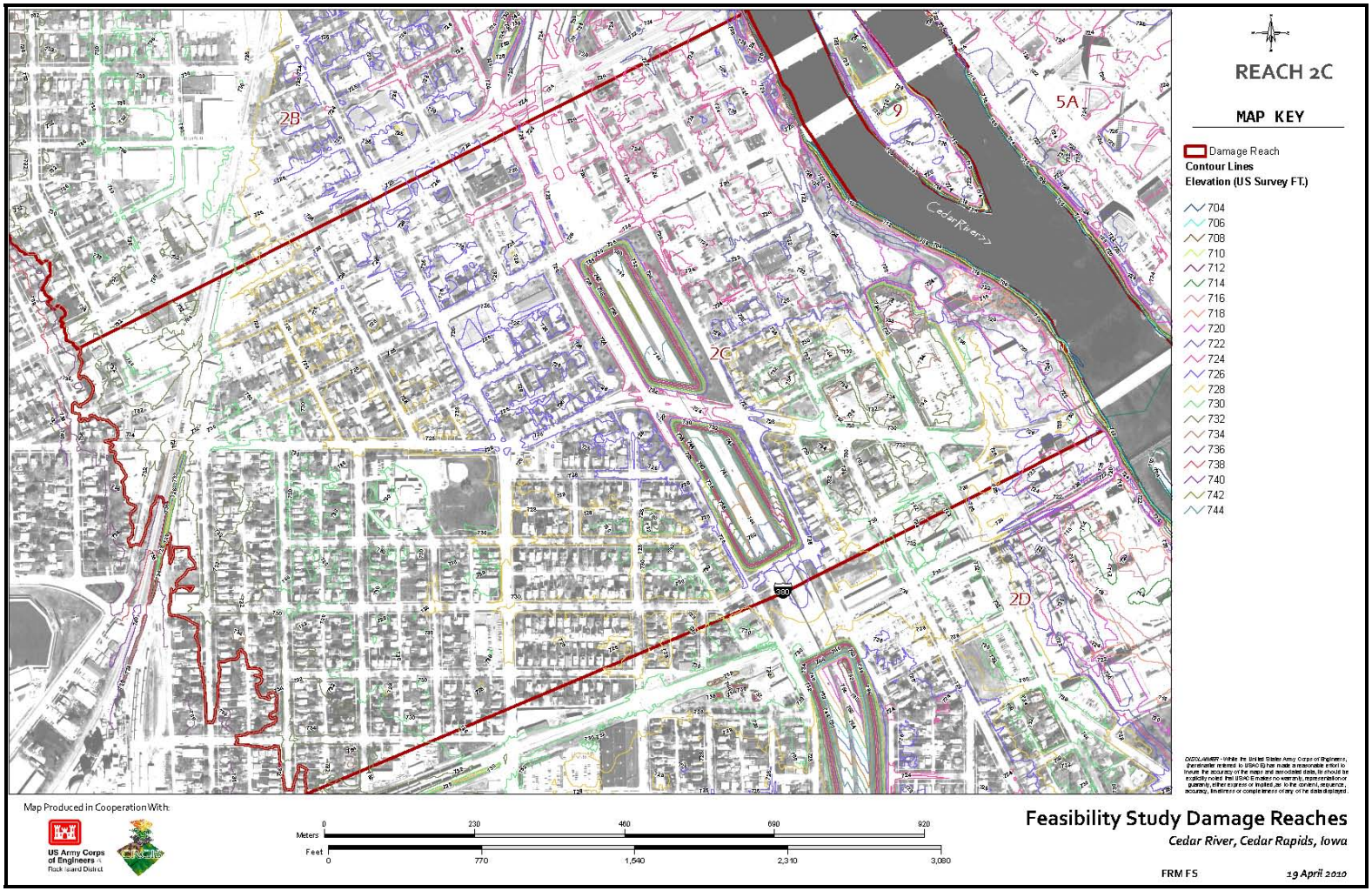

Figure 18. Topography, Reach 2C

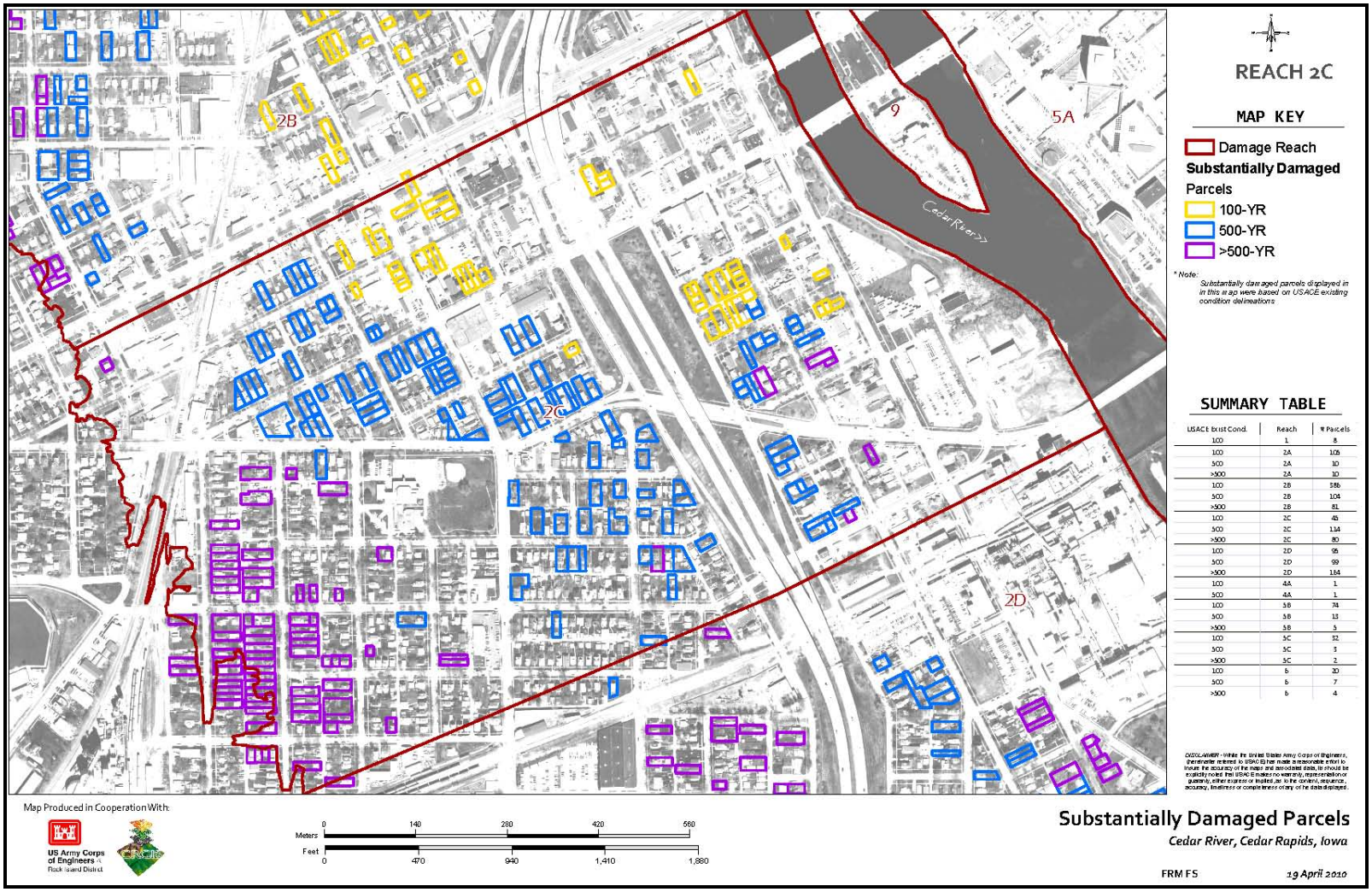

Figure 19. Substantially Damaged Parcels, Reach 2C

3.1.4.5. Damage Reach 2D - Czech Village Neighborhood. Reach 2D (figure 20) 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.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $1,005,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 21. The Reach starts receiving significant flood damage impacts at an elevation of approximately 720. The 2008 flood of record elevation for this Reach was 731. Elevation on the map ranges from 704 to 744. This Reach has an existing floodwall and levee; Penford Floodwall and the Czech Village Levee alignments run adjacent to the Cedar River. For more detail, see Section 3.1.2, *Existing Flood Risk Management*.
- The Reach includes the Czech Village and the residential area to the east and has the most flood fighting efforts of all the damage reaches. The flood fighting actions begin at a 10 feet (Approximate elevation 717.2) flood stage by plugging storm sewers in Riverside Park. Approximately 50 wells over storm intakes and manholes are installed beginning at a 14 feet (approximate elevation 714.1) flood stage. At 18 feet (approximate elevation 718.2) flood stage, an earthen berm is constructed across A Street SW to tie into the landfill and a berm is built in Riverside Park. Street closures begin at 19 feet (approximate elevation 719.2) flood stage.
- There are critical public infrastructure facilities located in the Reach. They are the Linn County Administration Building, Cedar Rapids Public Properties Works Building, and the Historical Czech Village located adjacent too and southwest of the Czech & Slovak Museum & Library.
- The apartment, commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 11. The majority of structures are impacted by the lower frequency events. The residential properties start being impacted at the 10 percent chance event.
- There were 95 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 22.

Table 11. Properties Impacted – Reach 2D

Apartments

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-1.0 to 0	0	0	0	0	0	0	3	0
>0 to 2	0	0	0	0	1	0	0	4
>2 to 4	0	0	0	0	0	1	0	0
>4 to 6	0	0	0	0	0	0	1	0
>6 to 8	0	0	0	0	0	0	0	1
>8 to 10	0	0	0	0	0	0	0	0

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-1.0 to 0	0	0	0	1	15	3	5	8
>0 to 2	0	0	0	1	6	22	5	8
>2 to 4	0	0	0	0	1	6	22	5
>4 to 6	0	0	0	0	0	1	5	19
>6 to 8	0	0	0	0	0	0	1	9
>8 to 10	0	0	0	0	0	0	0	1
>10	0	0	0	0	0	0	0	0

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	3	0	0	2
>0 to 2	0	0	0	2	1	6	1	3
>2 to 4	0	0	0	1	2	1	6	1
>4 to 6	0	0	0	0	1	2	1	5
>6 to 8	0	0	0	0	0	1	2	2
>8 to 10	0	0	0	0	0	0	1	2
>10 to 11	0	0	0	0	0	0	0	1

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-3.0 to 0	0	0	4	32	119	226	247	384
>0 to 2	0	0	0	4	23	18	149	174
>2 to 4	0	0	0	0	6	24	18	167
>4 to 6	0	0	0	0	0	4	24	20
>6 to 8	0	0	0	0	0	0	4	21
>8 to 10	0	0	0	0	0	0	0	10
>10	0	0	0	0	0	0	0	0

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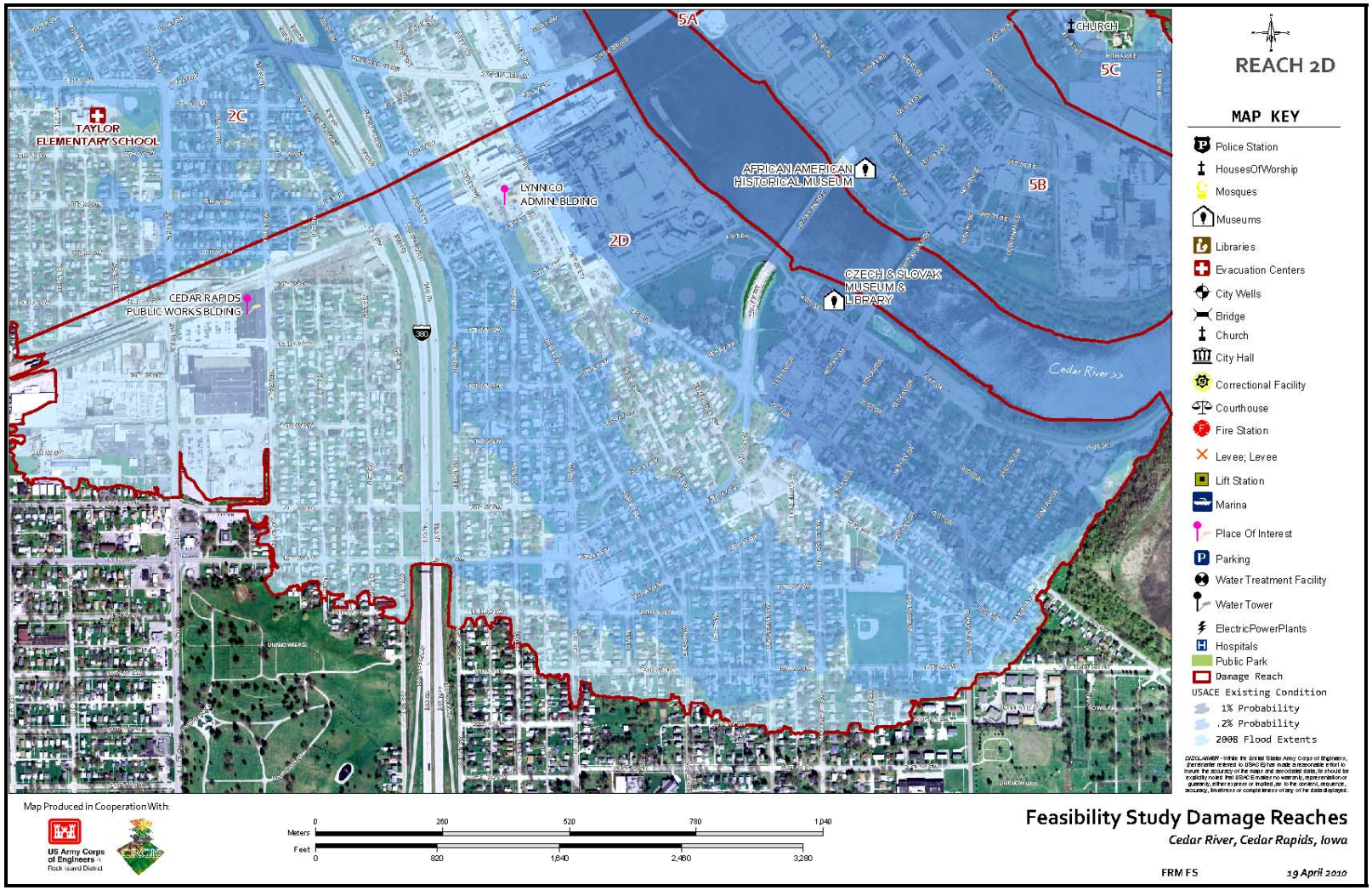

Figure 20. Damage Reach 2D - Czech Village Neighborhood

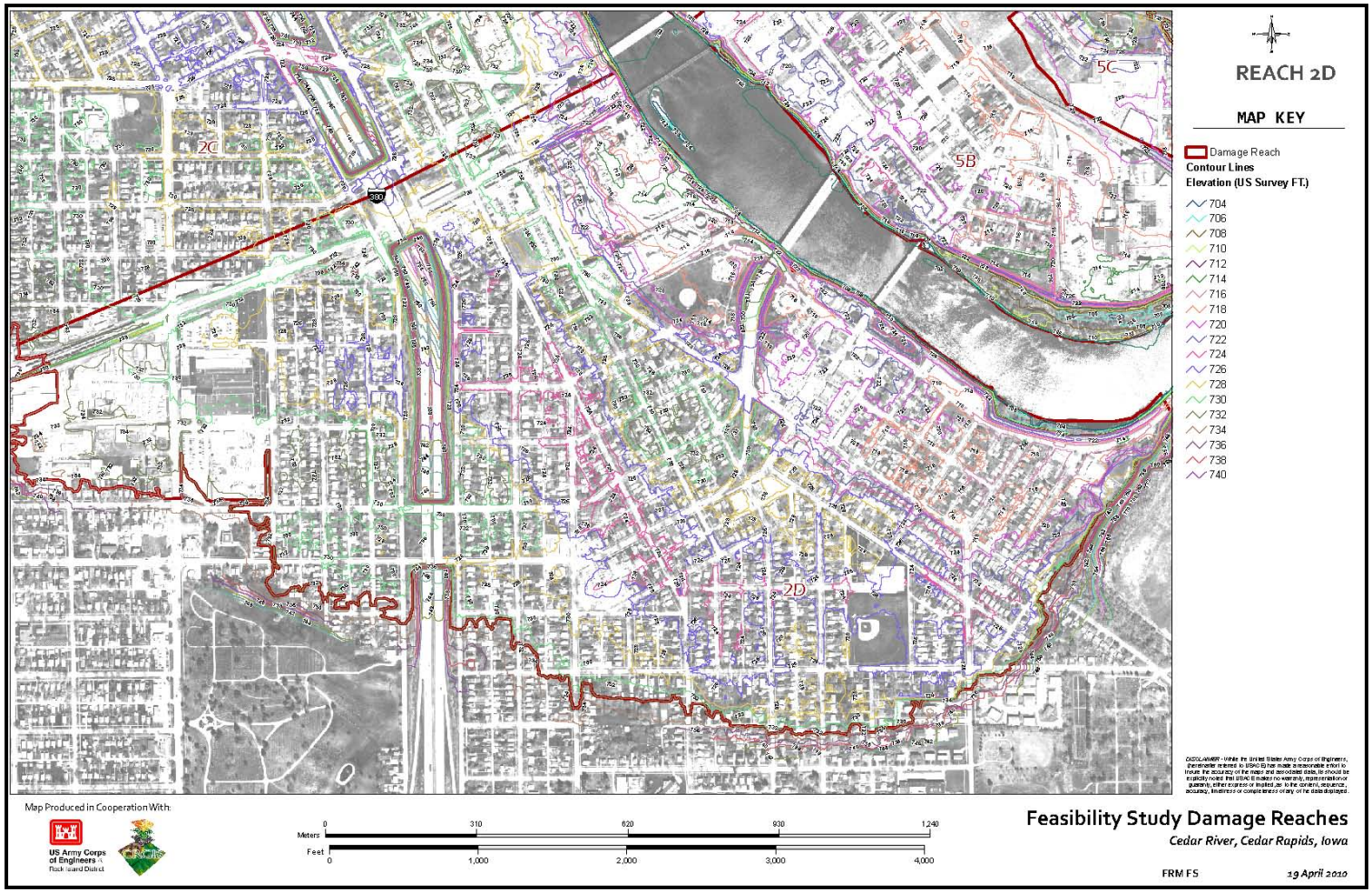

Figure 21. Topography, Reach 2D

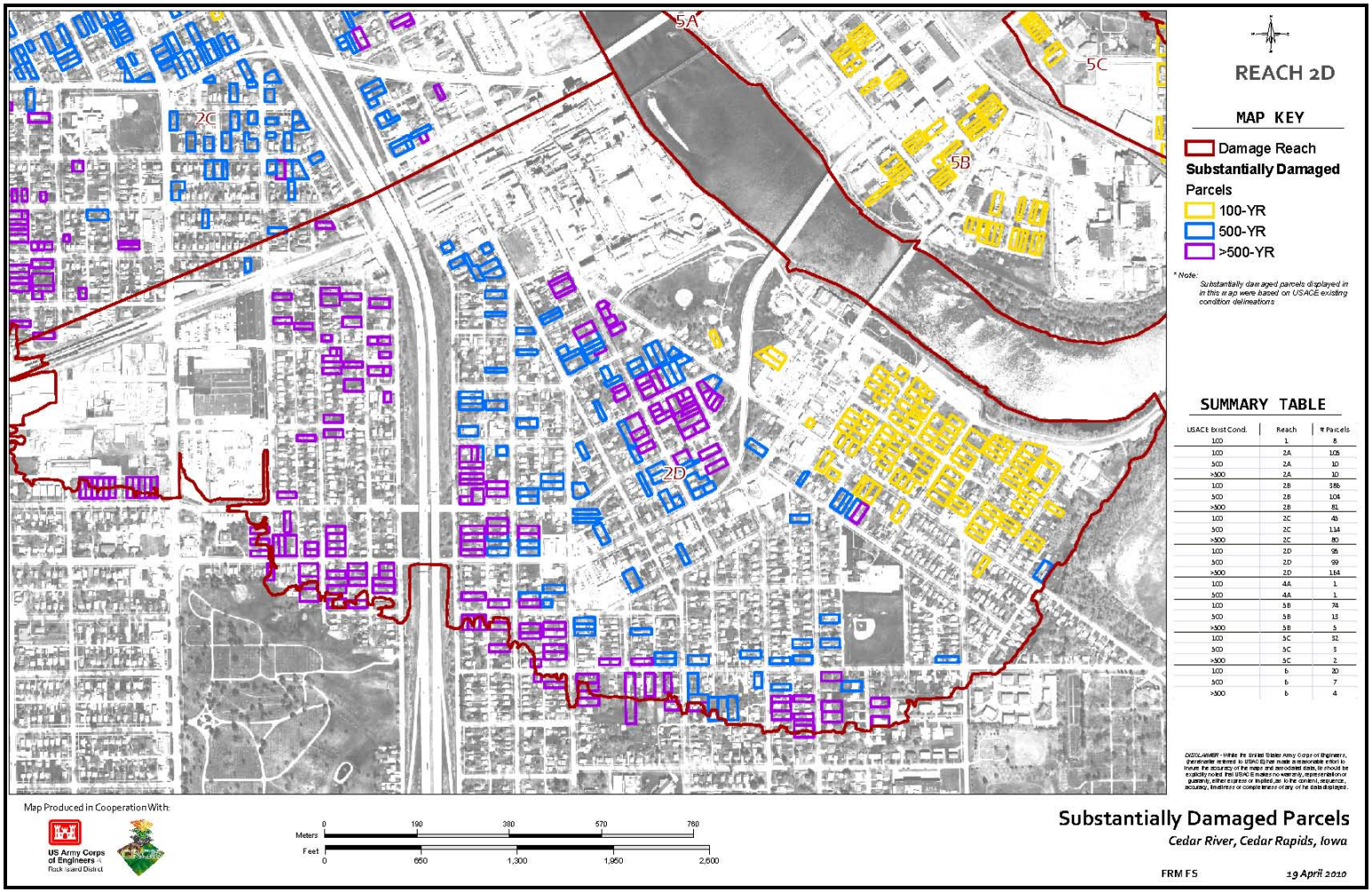

Figure 22. Substantially Damaged Parcels, Reach 2D

3.1.4.7. Damage Reach 3 - Prairie Creek. This damage reach (figure 23) is comprised of one main industry that supplies electricity and steam power to residential and commercial consumers.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $292,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The Prairie Creek Generation Station is considered critical public infrastructure and is located in the Reach.
- The topography of the Reach is shown in figure 24. The area starts receiving significant flood damage impacts at an elevation of approximately 717. The approximate 2008 flood of record elevation for this Reach was 725. Elevations on the map range from 708 to 760.

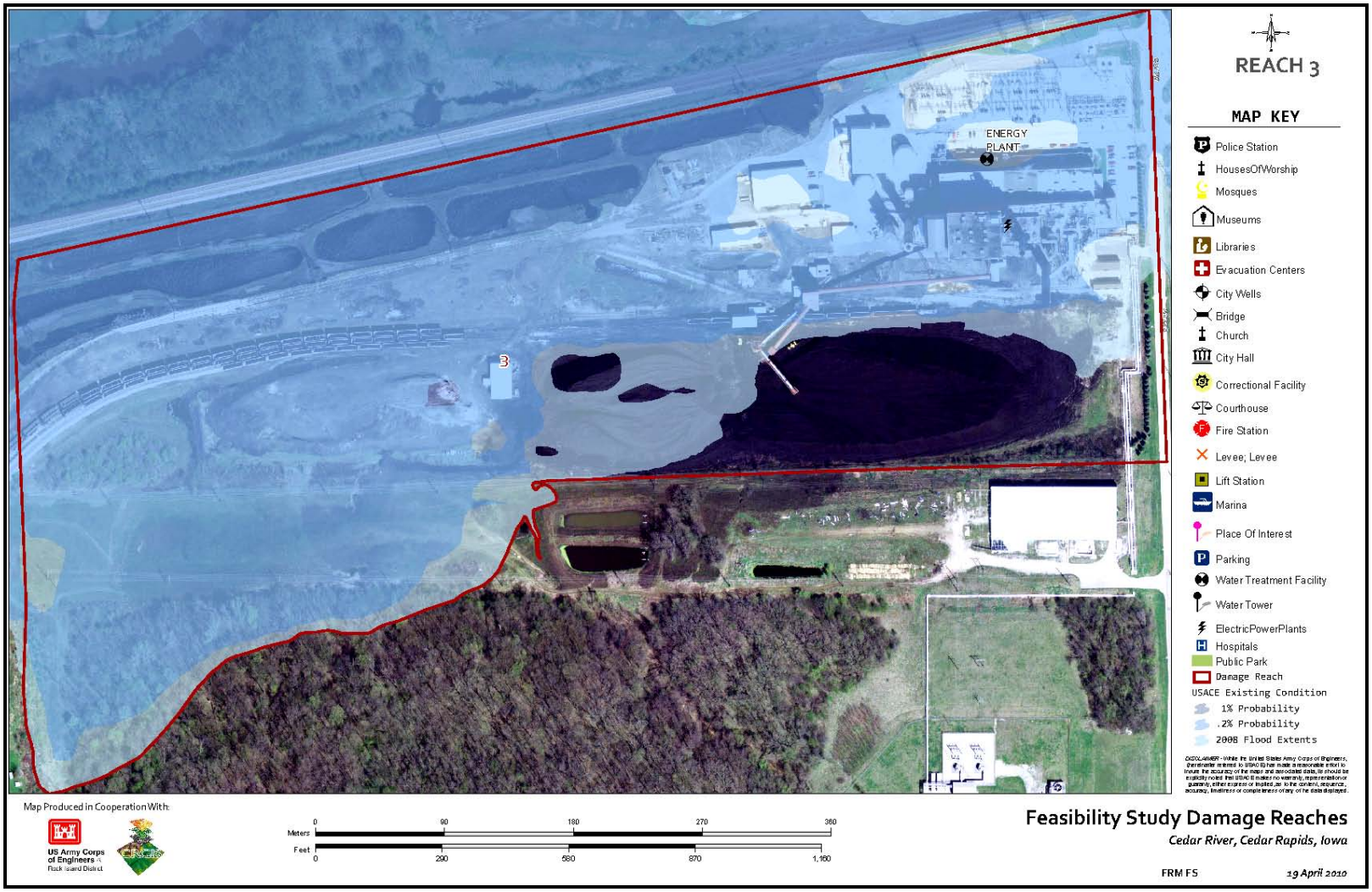

Figure 23. Damage Reach 3 – Prairie Creek

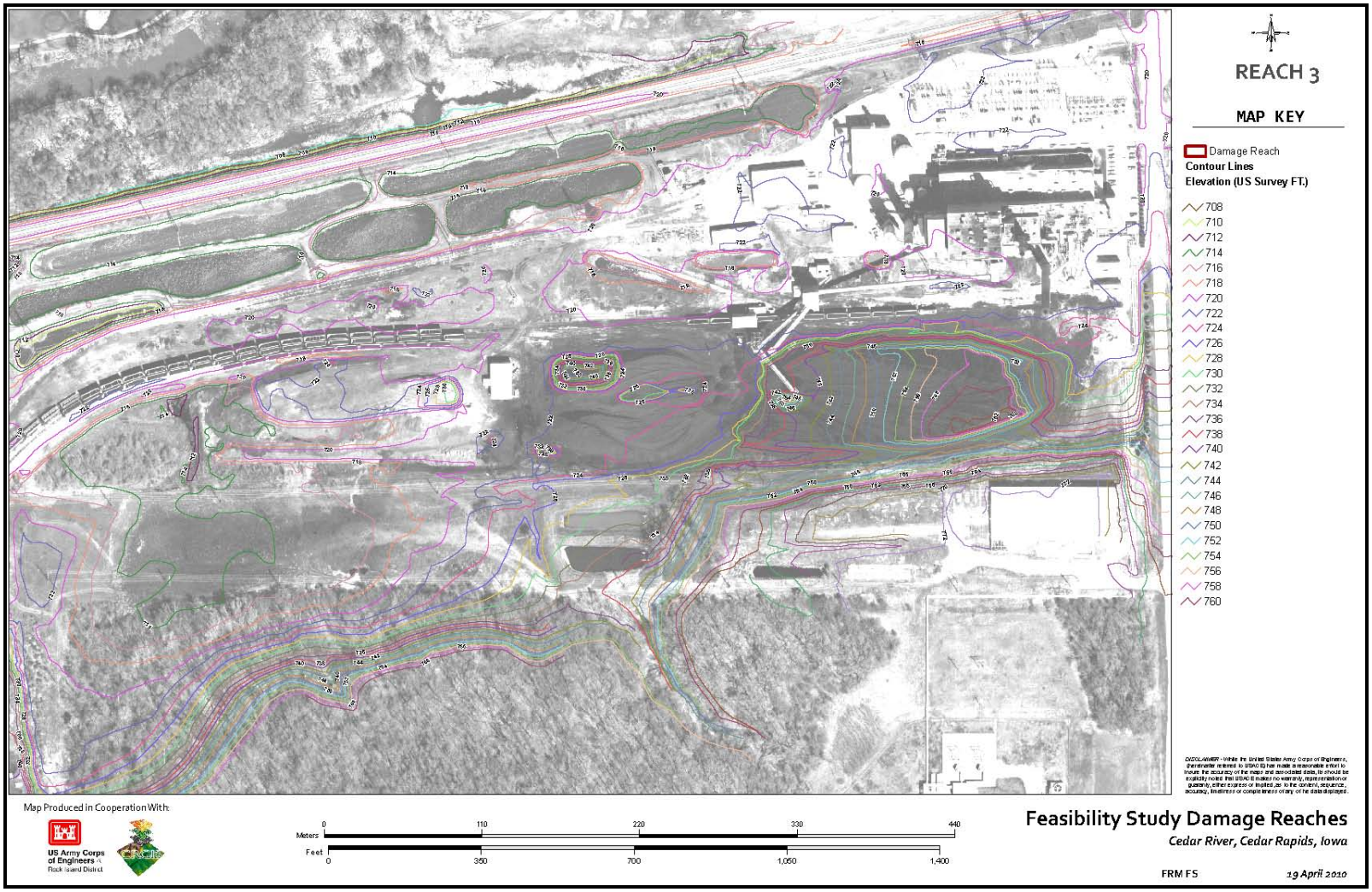

Figure 24. Topography, Reach 3

3.1.4.8. Damage Reach 4A - Cedar Lake North. Reach 4A (figure 25) is the northern reach on the east side of downtown. The reach includes 41 commercial/industrial, 7 public, and 44 residential properties.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $226,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 26. The area starts receiving significant flood damage impacts at an elevation of approximately 726. The 2008 flood of record elevation for this Reach was 735. Elevations on the topography map range from 718 to 760.
- There is no detailed flood response actions needed in this Reach except for flood risk reduction of a water well transformer at 17 feet flood stage (approximate elevation 720.7).
- The City's Water Treatment Plant, a critical public infrastructure facility, is located in the Reach.
- Natural Resources interests within the Reach include McLoud Run and Cedar Lake.
- The apartment, commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 12. The majority of structures are impacted by the lower frequency events.
- One property in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event is shown in figure 27.

Table 12. Properties Impacted – Reach 4A

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	2	1	2	1
>0 to 2	0	0	0	0	1	6	13	6
>2 to 4	0	0	0	0	0	4	7	13
>4 to 6	0	0	0	0	0	0	4	6
>6 to 8	0	0	0	0	0	0	0	4
>8 to 10	0	0	0	0	0	0	0	0

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	0	0	0	0
>0 to 2	0	0	0	0	0	2	1	0
>2 to 4	0	0	0	0	0	0	2	1
>4 to 6	0	0	0	0	0	0	0	2
>6 to 8	0	0	0	0	0	0	0	0

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.5 to 0	0	0	0	0	1	1	14	10
>0 to 2	0	0	0	0	0	2	1	8
>2 to 4	0	0	0	0	0	1	2	0
>4 to 6	0	0	0	0	0	0	1	2
>6 to 8	0	0	0	0	0	0	0	1
>8 to 10	0	0	0	0	0	0	0	0

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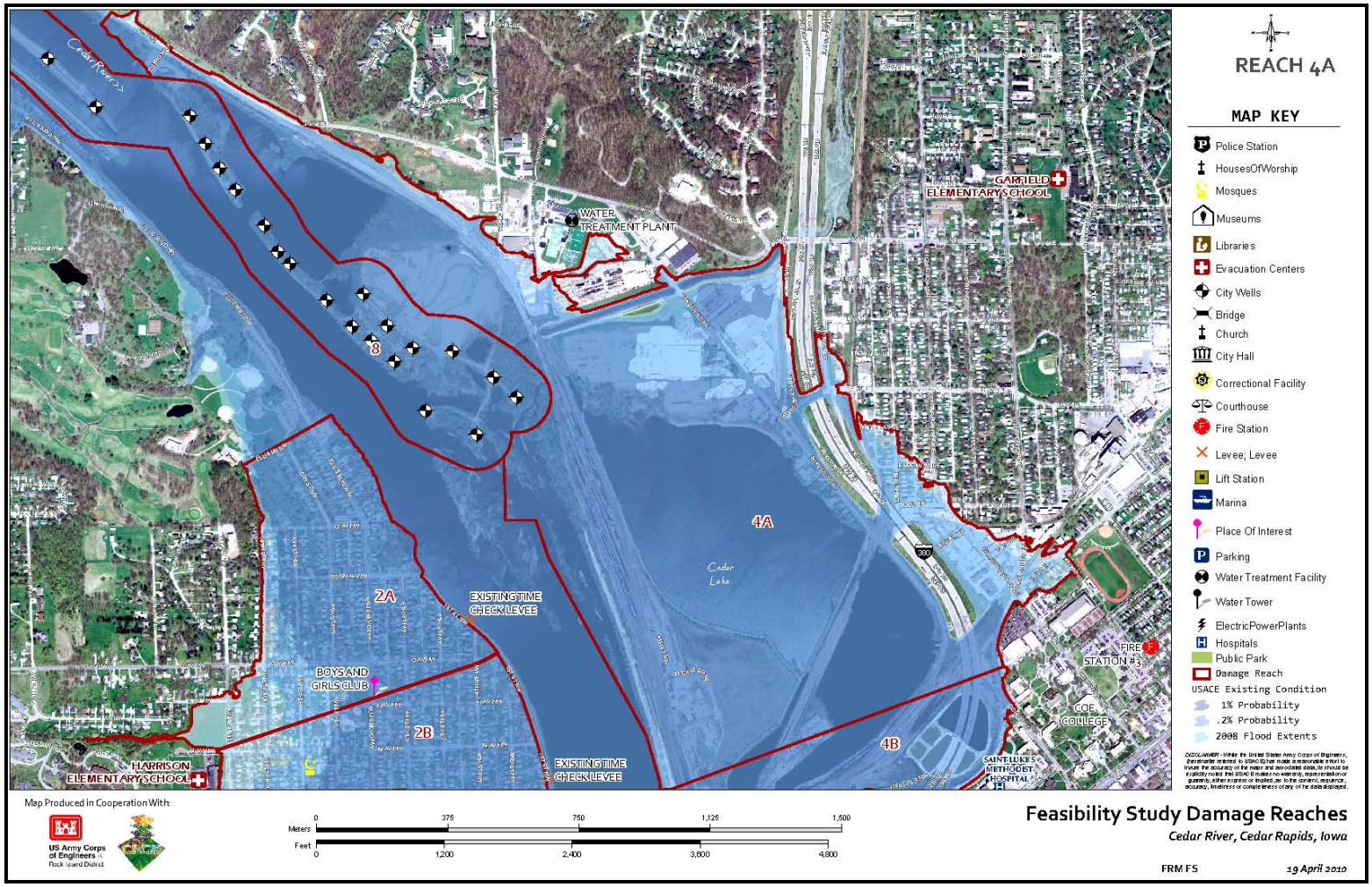

Figure 25. Damage Reach 4A – Cedar Lake North

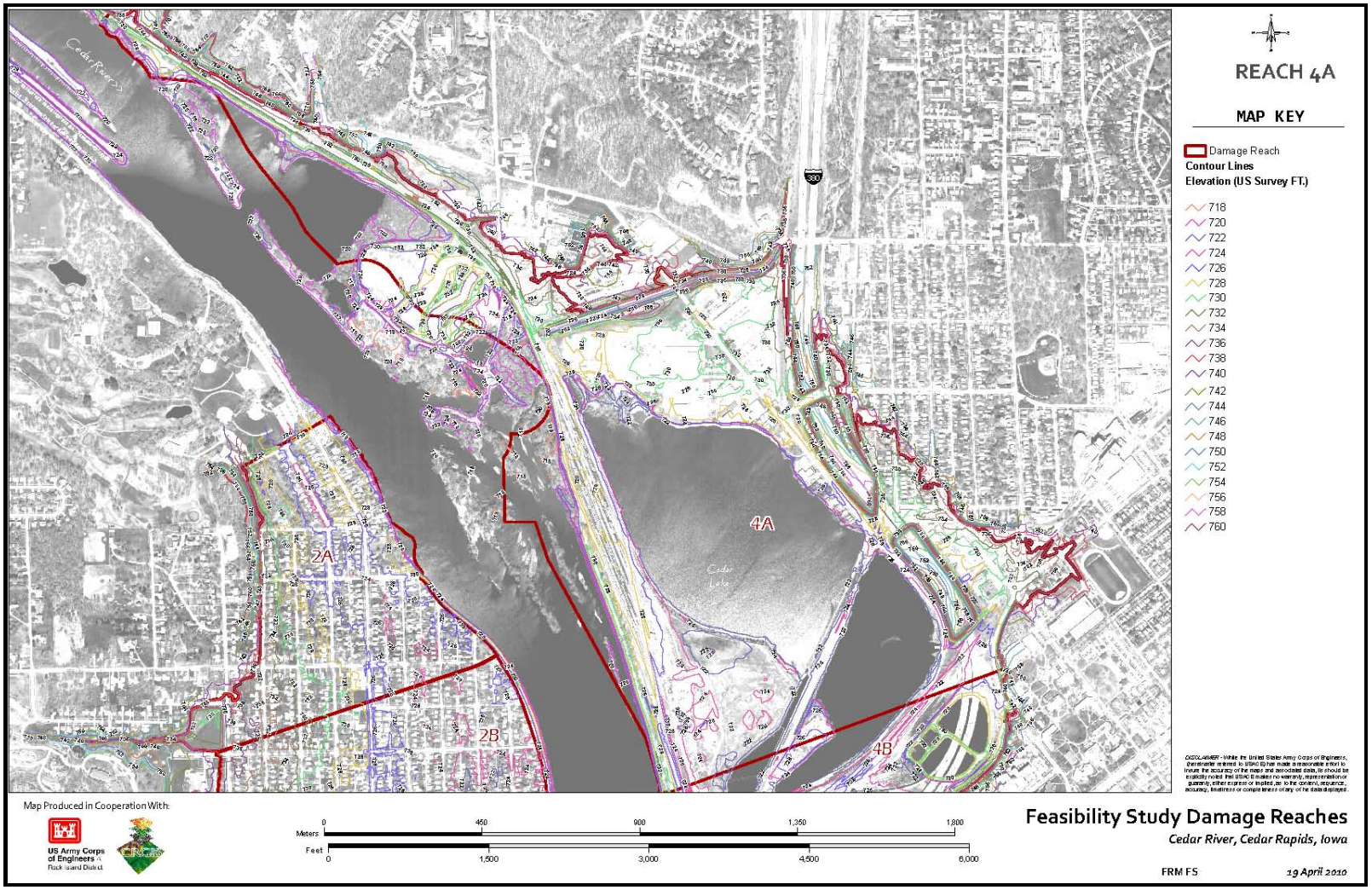

Figure 26. Topography, Reach 4A

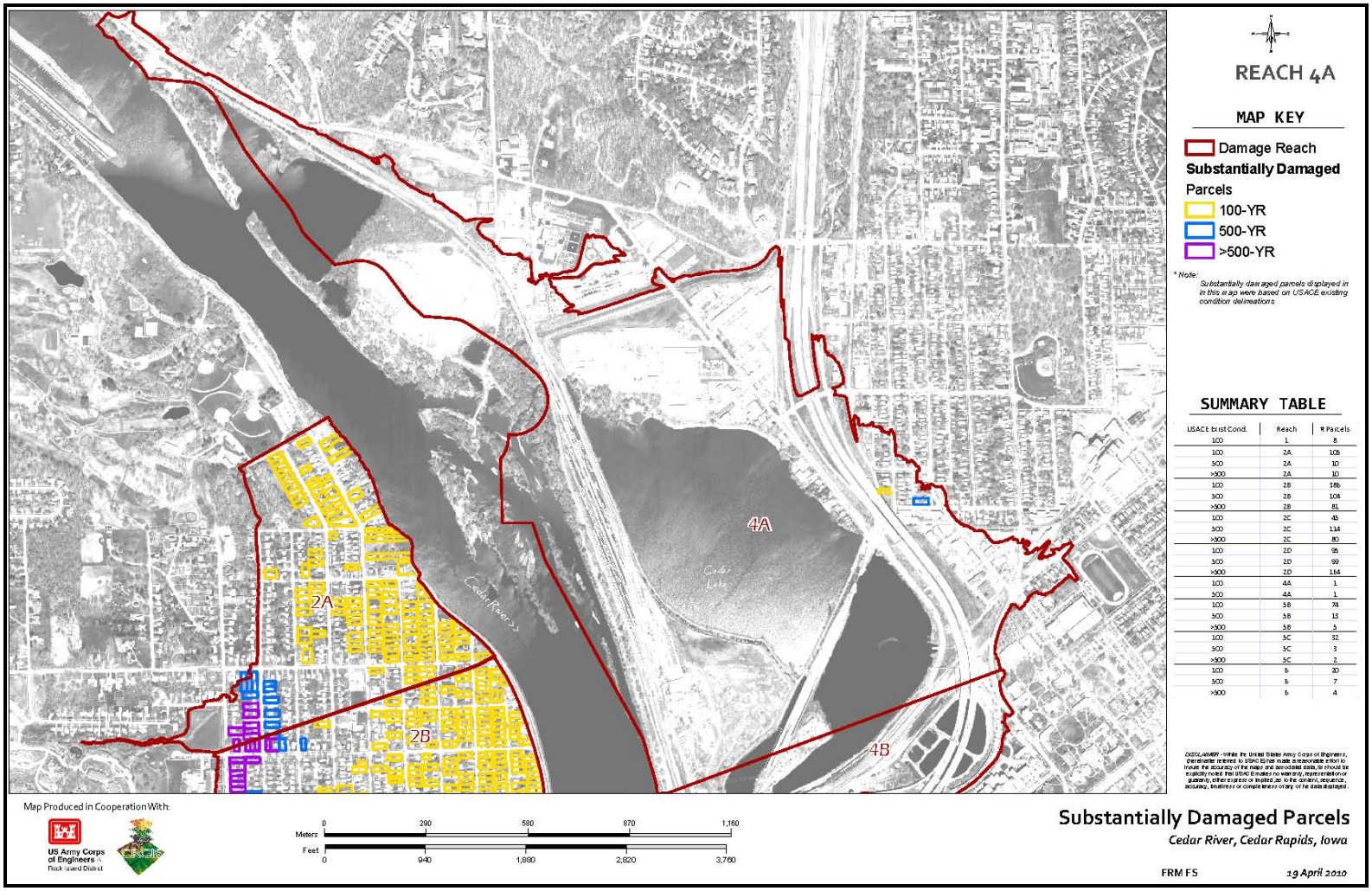

Figure 27. Substantially Damaged Parcels, Reach 4A

3.1.4.9. Damage Reach 4B - Cedar Lake South. Reach 4B (figure 28) is the on the east side of downtown Cedar Rapids and includes three commercial/industrial properties.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $2,648,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 29. The area starts receiving significant flood damage impacts at an elevation of approximately 722. The 2008 flood of record elevation for this Reach was 734. Elevations on the map range from 720 to 744. This Reach has an existing levee; Quaker Oats Earthen Levee, which is adjacent to the Cedar River. For more detail, see Section 3.1.2, *Existing Flood Risk Management*.
- There is no public flood response actions needed in this area though the businesses have their own FRM plans.
- The Alliant Energy 6th Street Power Plant sustained damage in the 2008 flood event. After the flood Alliant installed temporary equipment at the plant to provide steam to downtown businesses. At the time of study the future use of this plant was uncertain. Due to this uncertainty, an assumption was made in the economic analysis that the plant would be used as an industrial facility in the without and With Project conditions. In August 2010 Alliant Energy publically announced it had stopped producing steam at the plant. The future use of the plant is still in question.
- The Reach consists of only commercial properties. They are impacted with varying degrees of flood depths versus percent chance event as shown in table 13. The structures are impacted by a mix of frequency events, some flooding occurring at the 10.0 percent chance event and others not until the 0.2 percent chance events.
- There were no properties that had greater than 50 percent damage from the 2008 event in this Reach.

Table 13. Properties Impacted – Reach 4B

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-1.0 to 0	0	0	1	0	0	0	0	0
>0 to 2	0	0	0	1	1	0	1	1
>2 to 4	0	0	0	1	1	1	0	0
>4 to 6	0	0	0	0	1	0	1	0
>6 to 8	0	0	0	0	0	1	0	1
>8 to 10	0	0	0	0	0	1	1	0
>10 to 13	0	0	0	0	0	0	1	2

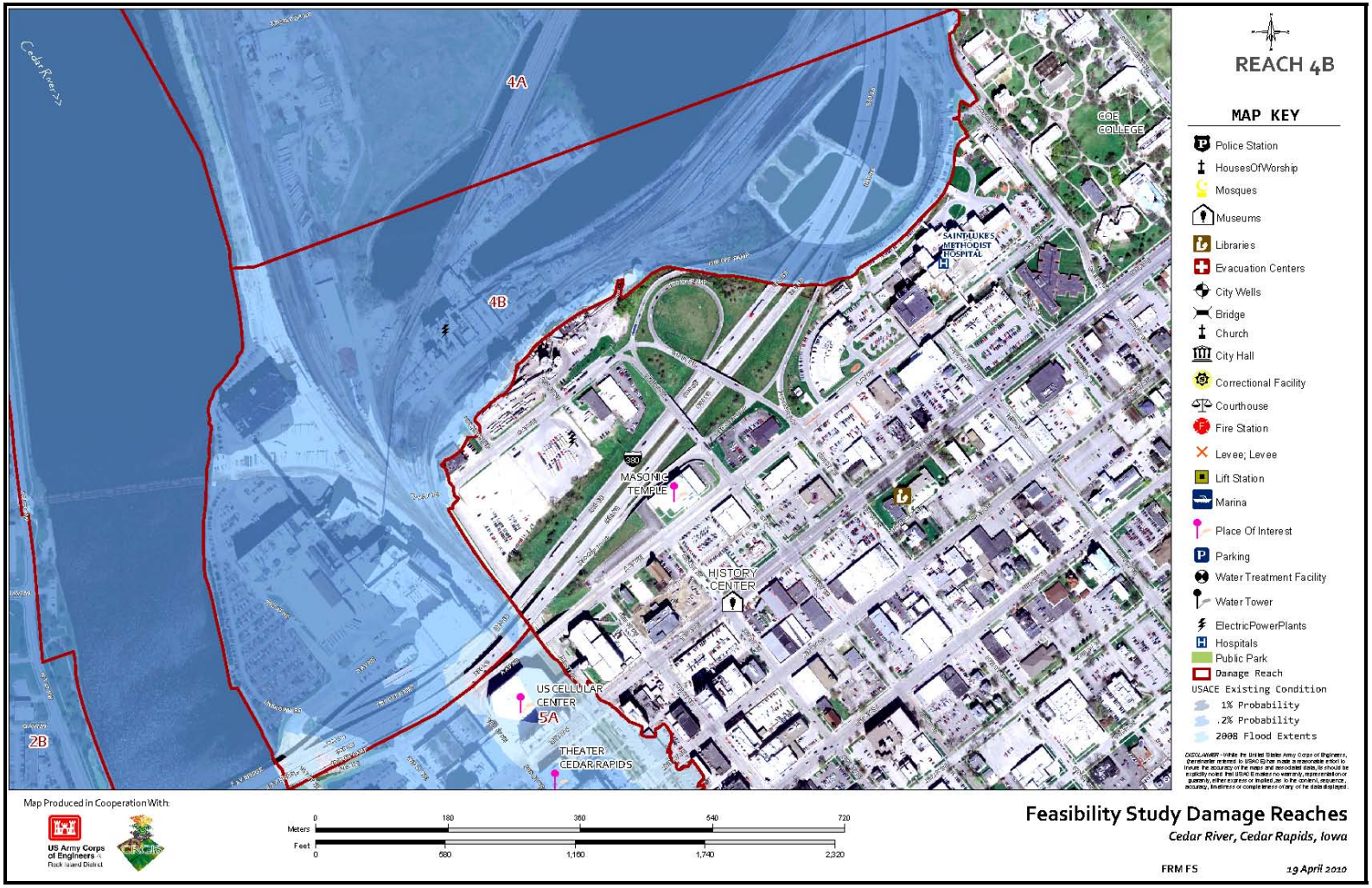

Figure 28. Damage Reach 4B - Cedar Lake South

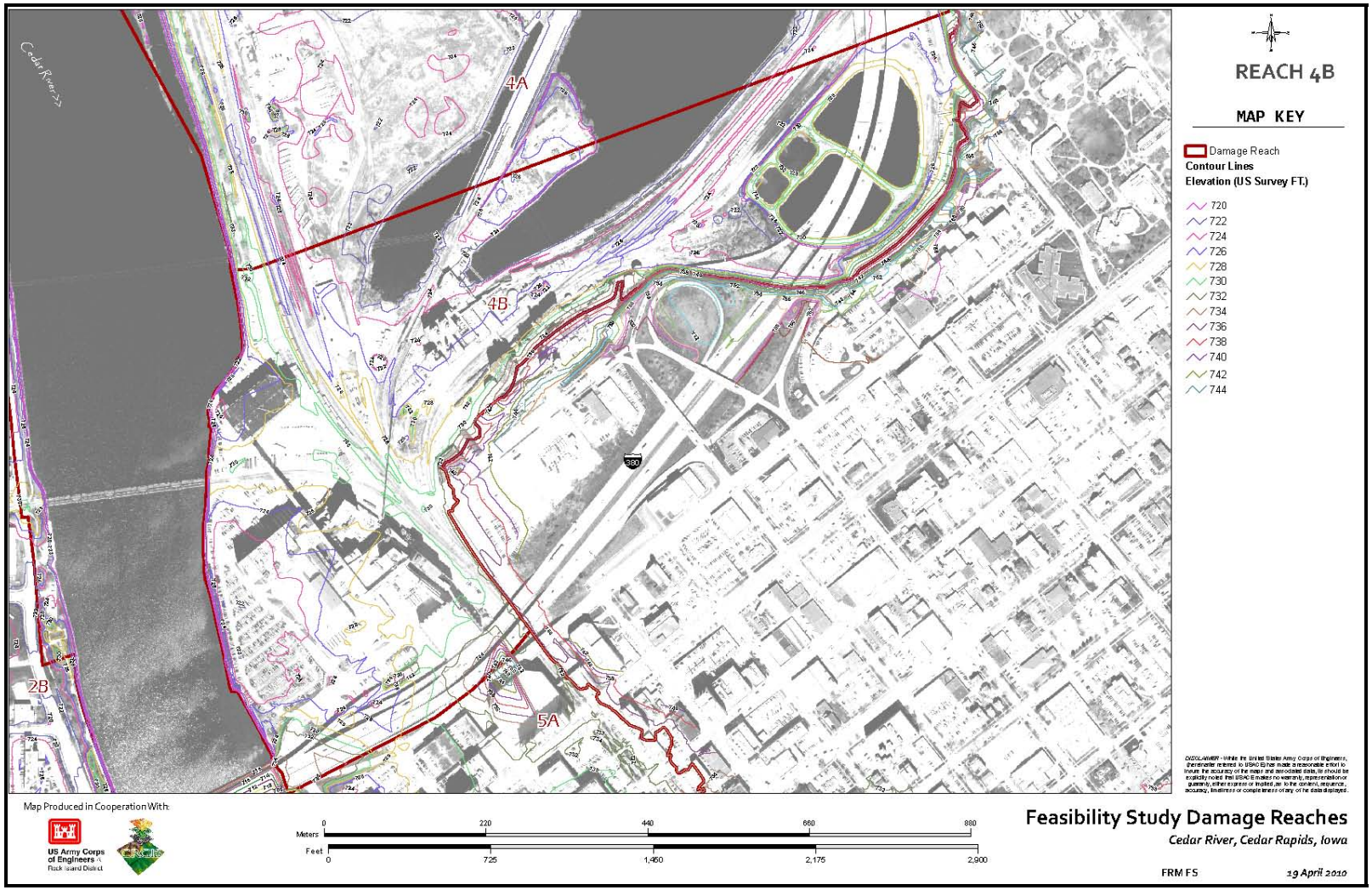

Figure 29. Topography, Reach 4B

3.1.4.10. Damage Reach 5A – Downtown Cedar Rapids. Reach 5A (figure 30) is the northern reach on the east side of downtown Cedar Rapids. The reach includes 89 commercial/industrial and 27 public properties.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $1,044,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 31. The area starts receiving significant flood damage impacts at an elevation of approximately 721. The 2008 flood of record elevation for this Reach was 732. Elevations on the map range from 714 to 740. There is an existing floodwall located adjacent to the Cedar River between 1st Ave and 4th Ave. For more detail, see Section 3.1.2, *Existing Flood Risk Management*.
- The City's flood response actions include installing gates in the river wall at flood stage of 20 feet (approximate elevation 721.7). Roads begin to close at 22 feet flood stage (approximate elevation 722.8) and traffic department starts to remove signal parts that could be damaged.
- There are critical public infrastructure facilities located in the Reach. They are the existing Federal Courthouse, New Federal Courthouse, U.S. Cellular Center, Cedar Rapids Ground Transportation Center, US Post Office, Mercy Medical Hospital, and other downtown facilities.
- The apartment, commercial, and public properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 14. The majority of structures are impacted by the lower frequency events.
- There are no residential properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event.

Table 14. Properties Impacted – Reach 5A

Apartments

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	0	2	0	1
>0 to 2	0	0	0	0	0	2	3	1
>2 to 4	0	0	0	0	0	0	3	2
>4 to 6	0	0	0	0	0	0	0	3
>6 to 8	0	0	0	0	0	0	0	0

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	4	5	3	2
>0 to 2	0	0	0	0	5	24	32	14
>2 to 4	0	0	0	0	0	7	23	32
>4 to 6	0	0	0	0	0	0	8	22
>6 to 8	0	0	0	0	0	0	0	9
>8 to 10	0	0	0	0	0	0	0	0

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	1	0	1	2
>0 to 2	0	0	0	0	0	14	2	2
>2 to 4	0	0	0	0	0	0	14	2
>4 to 6	0	0	0	0	0	0	0	11
>6 to 8	0	0	0	0	0	0	0	3
>8 to 10	0	0	0	0	0	0	0	0

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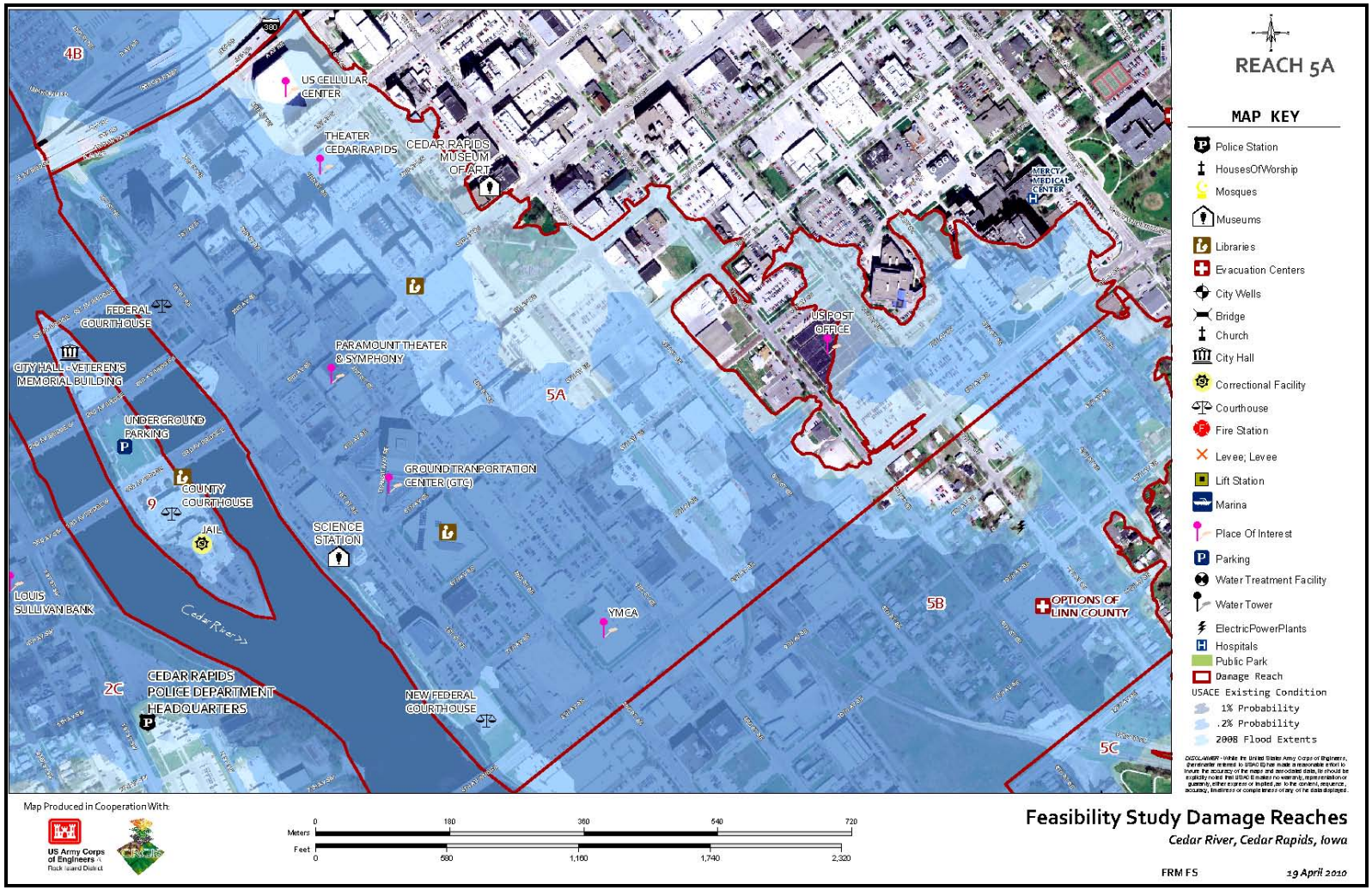

Figure 30. Damage Reach 5A - Downtown Cedar Rapids

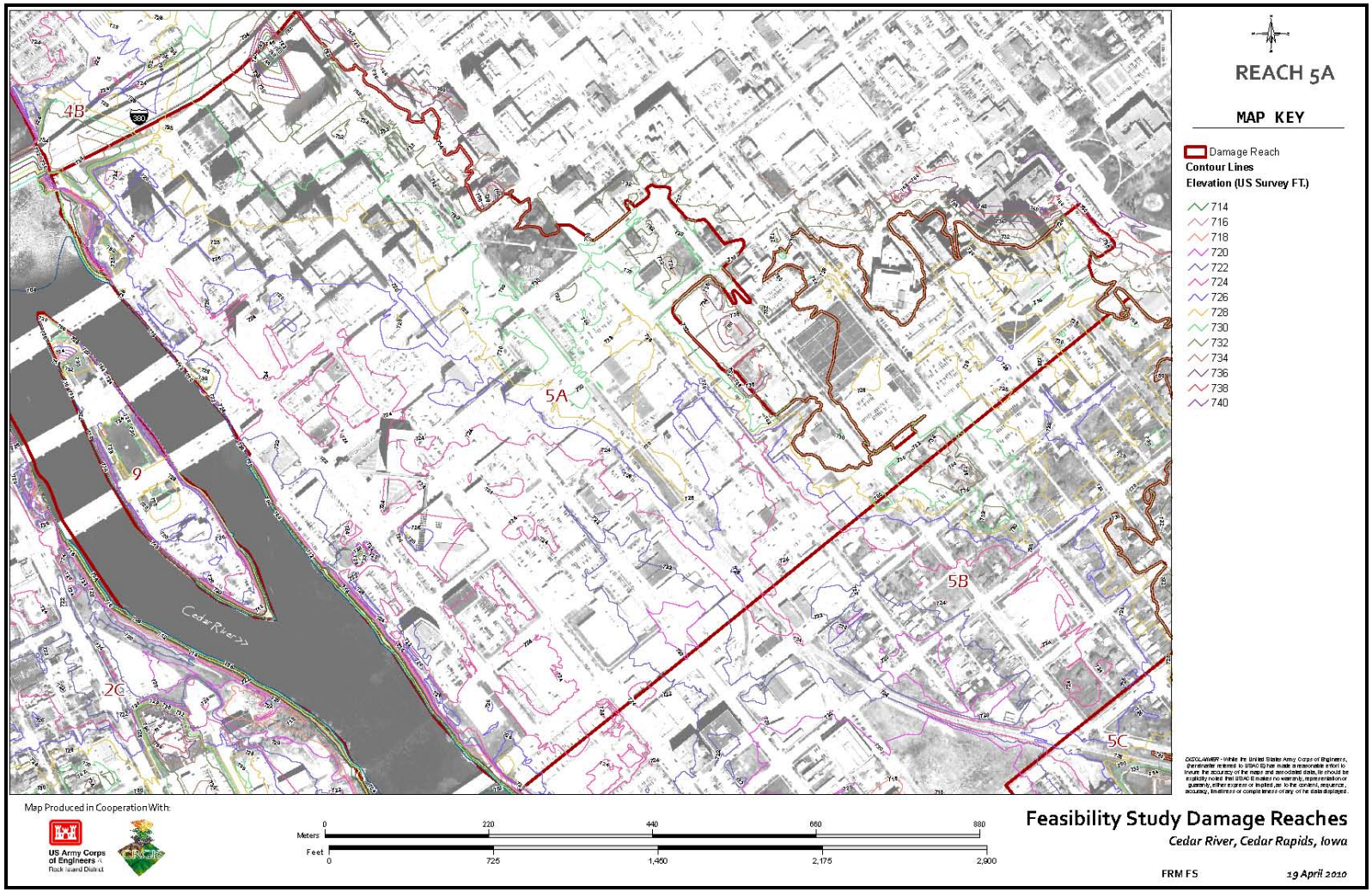

Figure 31. Topography, Reach 5A

3.1.4.11. Damage Reach 5B – New Bohemia/Sinclair Neighborhoods. Reach 5B (figure 32) is on the east side of downtown Cedar Rapids and includes 61 commercial/industrial, 14 public, and 110 residential properties.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $1,105,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 33. The area starts receiving significant flood damage impacts at an elevation of approximately 718. The 2008 flood of record elevation for this Reach was 732. Elevations on the map range from 704 to 730. There is an existing Oakhill Jackson Levee located adjacent to the Cedar River downstream of the 16th Avenue Bridge. For more detail, see Section 3.1.2, *Existing Flood Risk Management.*
- This Reach has some of the most intense flood fighting actions, including:
    - Plugging five storm sewers beginning at a flood stage of 10 feet (Approximate Elevation 710.2)
    - Building 22 wells at storm sewer intakes and manholes beginning at a flood stage of 17 feet (approximate elevation 717.4)
    - Raising low areas of dike at trail by placing earth and/or sandbags at a flood stage of 20 feet (approximate elevation 720.5)
    - As long as storm sewer plugs, wells, and standpipes hold, closing streets and removing traffic signal box equipment at a flood stage of 22 feet (approximate elevation 722.2)
- The only critical public facility is Options of Linn County. The African-American Historical Museum is also located in this Reach.
- The apartment, commercial, and public properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 15. The majority of structures are impacted by the lower frequency events. The commercial structures are impacted by a mix of frequency events, some flooding occurring at the 10.0 percent chance event and others not until the 0.2 percent chance events.
- There are 74 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 34.

Table 15. Properties Impacted – Reach 5B

Apartments

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	2	0	0	0
>0 to 2	0	0	0	0	0	2	0	1
>2 to 4	0	0	0	0	0	0	2	0
>4 to 6	0	0	0	0	0	0	0	0
>6 to 8	0	0	0	0	0	0	0	2
>8 to 10	0	0	0	0	0	0	0	0

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	1	4	9	4	0	1	0
>0 to 2	0	0	1	11	27	12	1	0
>2 to 4	0	0	1	5	11	28	12	2
>4 to 6	0	0	0	1	5	11	29	10
>6 to 8	0	0	0	0	1	5	10	22
>8 to 10	0	0	0	0	0	1	5	19
>10 to 14	0	0	0	0	0	0	1	6

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	2	1	0	0
>0 to 2	0	0	0	2	0	2	2	4
>2 to 4	0	0	0	0	2	0	2	1
>4 to 6	0	0	0	0	0	2	0	1
>6 to 8	0	0	0	0	0	0	2	2
>8 to 10	0	0	0	0	0	0	0	1
>10 to 11	0	0	0	0	0	0	0	1

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.5 to 0	0	0	0	6	3	54	11	16
>0 to 2	0	0	0	0	6	3	53	8
>2 to 4	0	0	0	0	0	6	2	54
>4 to 6	0	0	0	0	0	0	6	3
>6 to 8	0	0	0	0	0	0	0	6
>8 to 10	0	0	0	0	0	0	0	0

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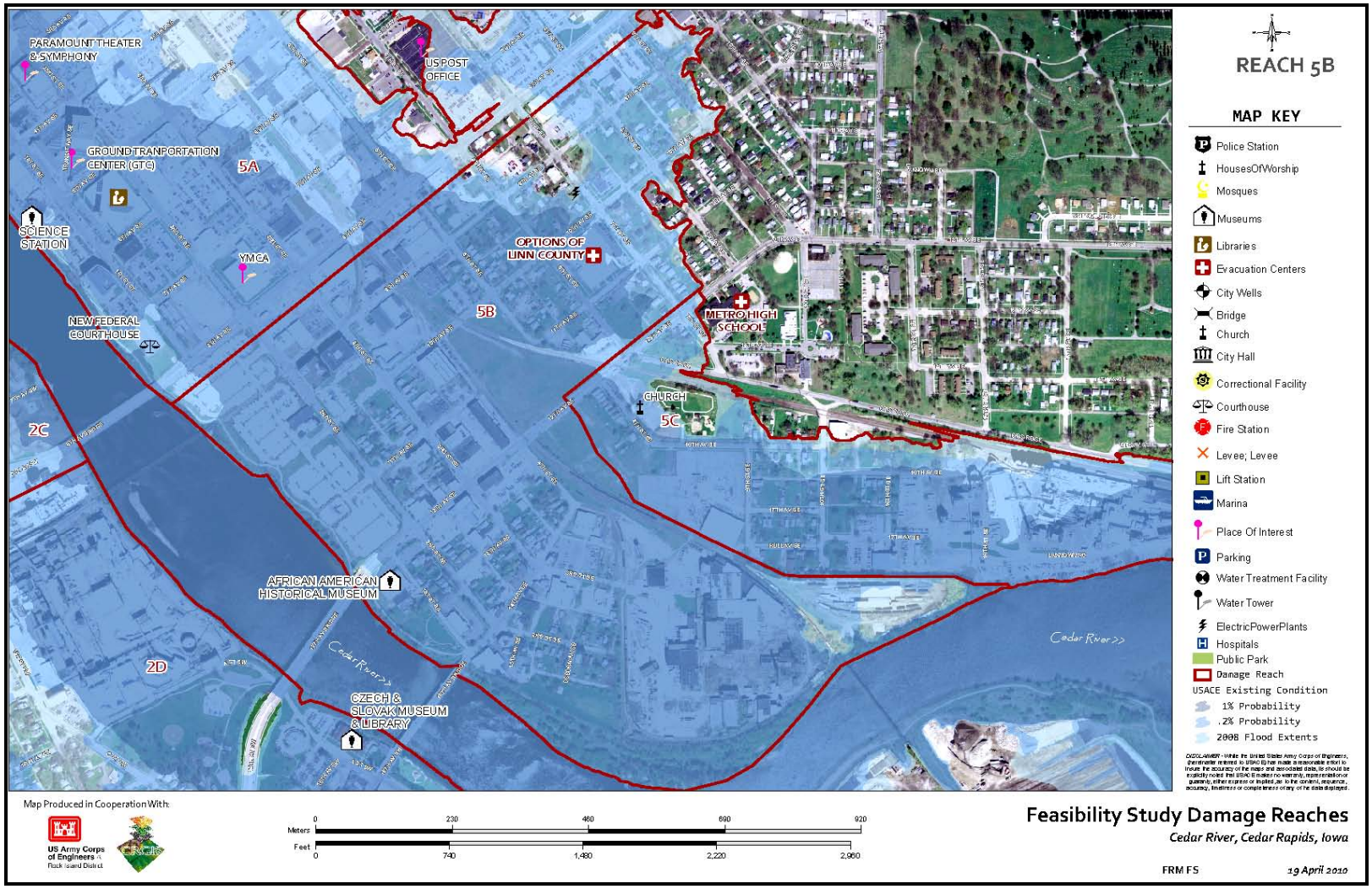


Figure 32. Damage Reach 5B – New Bohemia/Sinclair Neighborhoods

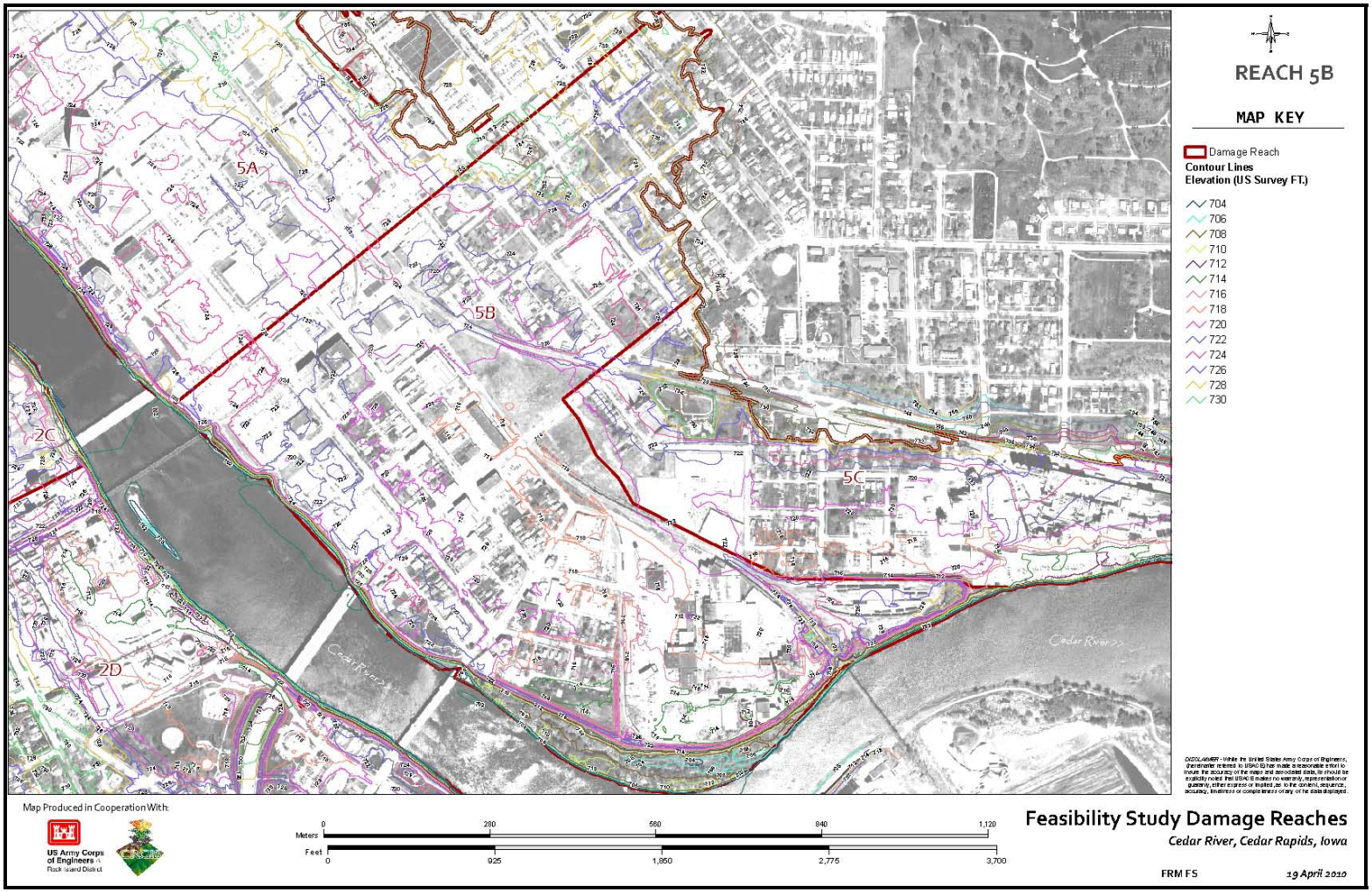


Figure 33. Topography, Reach 5B

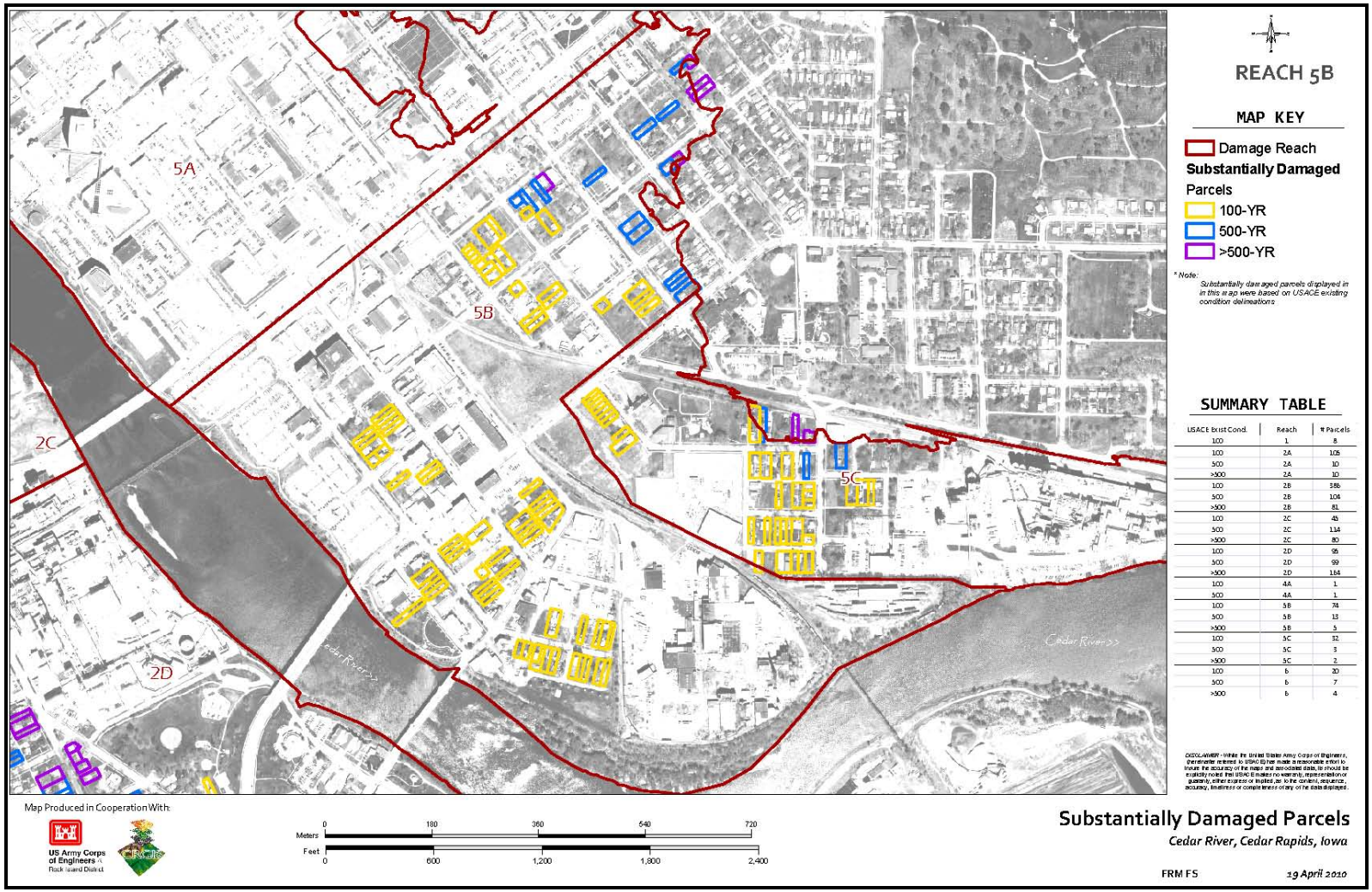


Figure 34. Substantially Damaged Parcels, Reach 5B

3.1.4.12. Damage Reach 5C – Otis Road East. Reach 5C (figure 35) is on the east side of downtown Cedar Rapids and includes 2 commercial/industrial, 4 public, and 35 residential properties.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $1,631,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The topography of the Reach is shown in figure 36. The area starts receiving significant flood damage impacts at an elevation of approximately 716. The 2008 flood of record elevation for this Reach was 728. Elevations on the map range from 704 to 730.
- There is very little flood actions in this area though the private industry has their own FRM plan. Otis Road closes at a flood stage of 10 feet (approximate elevation 708.4) just to the east and downstream of this Reach.
- The commercial, public, and residential properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 16. The majority of structures are impacted by the lower frequency events. The commercial structures are impacted by higher frequency events with the majority of inundation occurring between 50.0 and 2.0 percent chance events.
- There are 32 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 37.

Table 16. Properties Impacted – Reach 5C

Commercial Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-15 to 0	2	2	2	2	2	1	0	0
>0 to 2	0	0	0	0	0	1	1	0
>2 to 4	0	0	0	0	0	0	1	1
>4 to 6	0	0	0	0	0	0	0	1
>6 to 8	0	0	0	0	0	0	0	0

Public Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-2.0 to 0	0	0	0	0	0	0	0	0
>0 to 2	0	0	0	0	0	0	0	2
>2 to 4	0	0	0	0	0	0	0	0

Residential Properties

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50%**	**20%**	**10%**	**4%**	**2%**	**1%**	**0.5%**	**0.2%**
-1.5 to 0	0	0	0	0	0	23	1	2
>0 to 2	0	0	0	0	0	0	24	1
>2 to 4	0	0	0	0	0	0	0	24
>4 to 6	0	0	0	0	0	0	0	1
>6 to 8	0	0	0	0	0	0	0	0

.

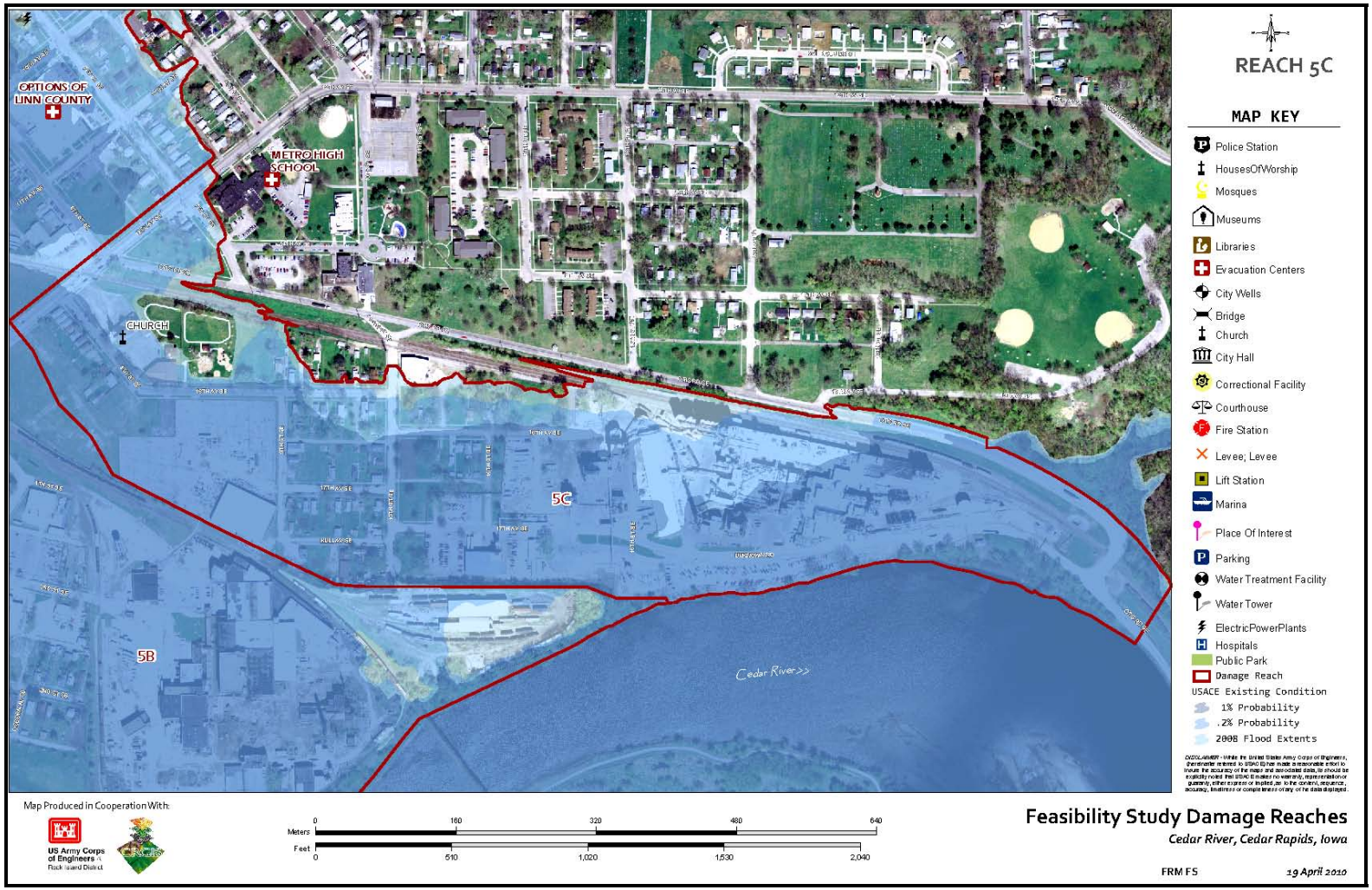


Figure 35. Damage Reach 5C – Otis Road East

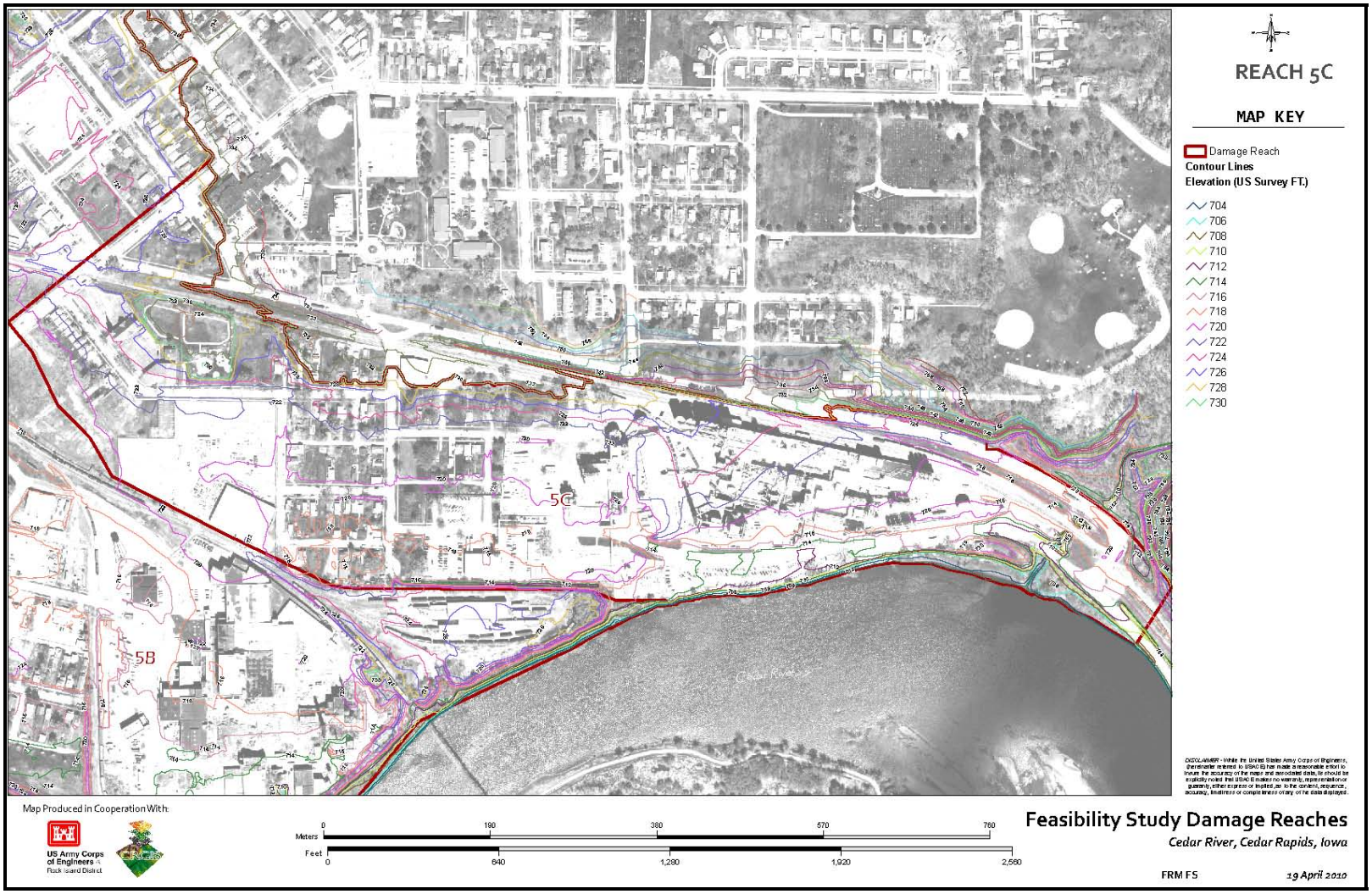


Figure 36. Topography, Reach 5C

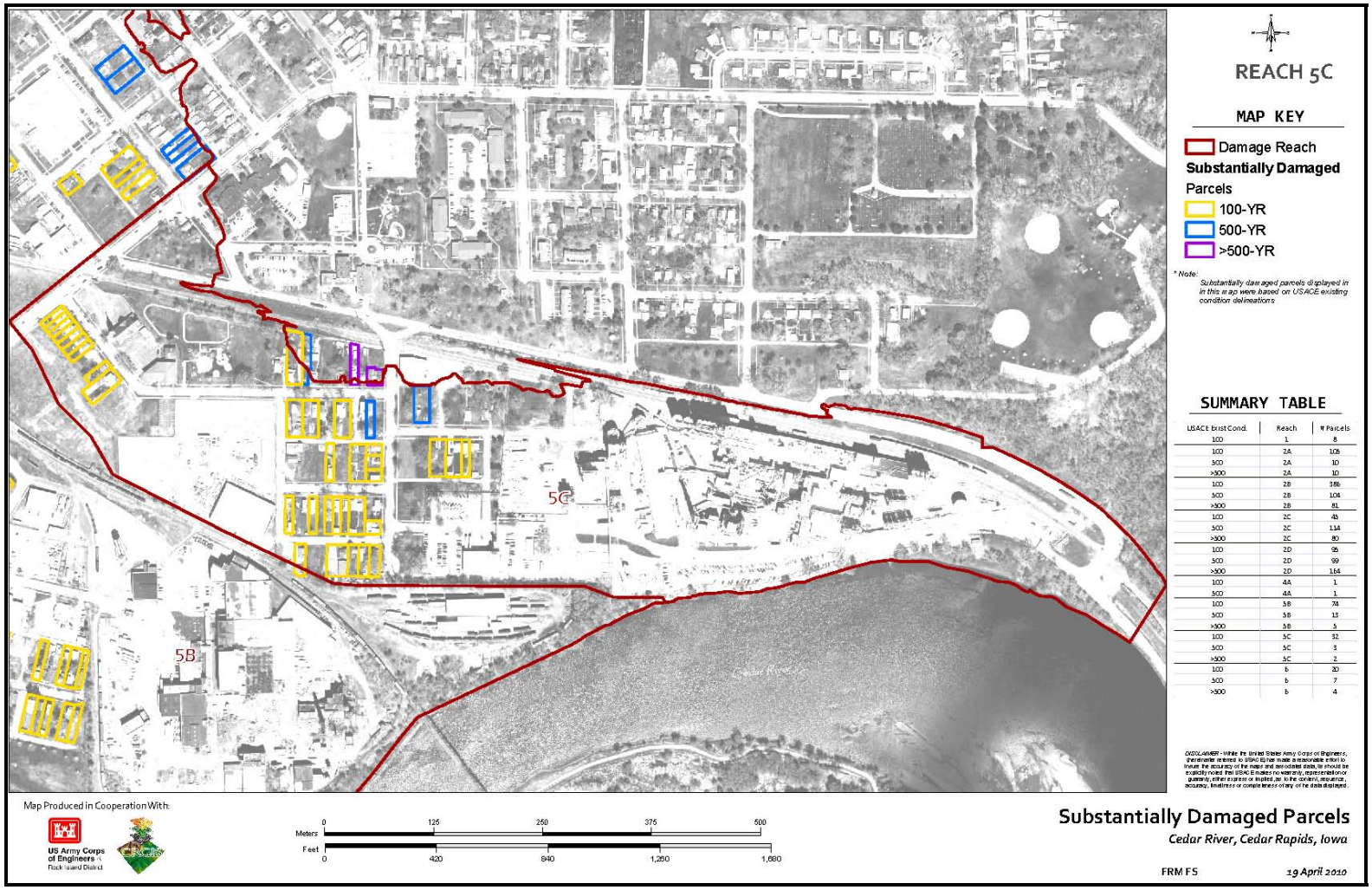


Figure 37. Substantially Damaged Parcels, Reach 5C

3.1.4.13. Damage Reach 6 - Cedar Valley (Rompot) Neighborhood. The Cedar Valley Neighborhood consists of 1 public and 78 residential properties (figure 38).

Damage Reach Details

- The Estimated Annual Damages for this Reach are $25,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- There are no critical facilities located in this Reach.
- The Reach consists of residential properties with flood impacts starting with the lower frequency events as shown in table 17. The majority of flood inundation occurs at the 1.0, 0.5, and 0.2 percent chance events.
- The topography of the Reach is shown in figure 39. The area starts receiving significant flood damage impacts at an elevation of approximately 716. The 2008 flood of record elevation for this Reach was 726. Elevations on the map range from 702 to 730.
- There are 20 properties in the 1 percent chance event floodplain with greater than 50 percent damage from the 2008 event and are shown in figure 40.

Table 17. Properties Impacted – Reach 6

Only Residential

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50.0%**	**20.0%**	**10.0%**	**4.0%**	**2.0%**	**1.0%**	**0.5%**	**0.2%**
-2.5 to 0	0	0	0	0	9	26	18	12
>0 to 2	0	0	0	0	0	4	21	17
>2 to 4	0	0	0	0	0	0	4	22
>4 to 6	0	0	0	0	0	0	0	4
>6 to 8	0	0	0	0	0	0	0	0

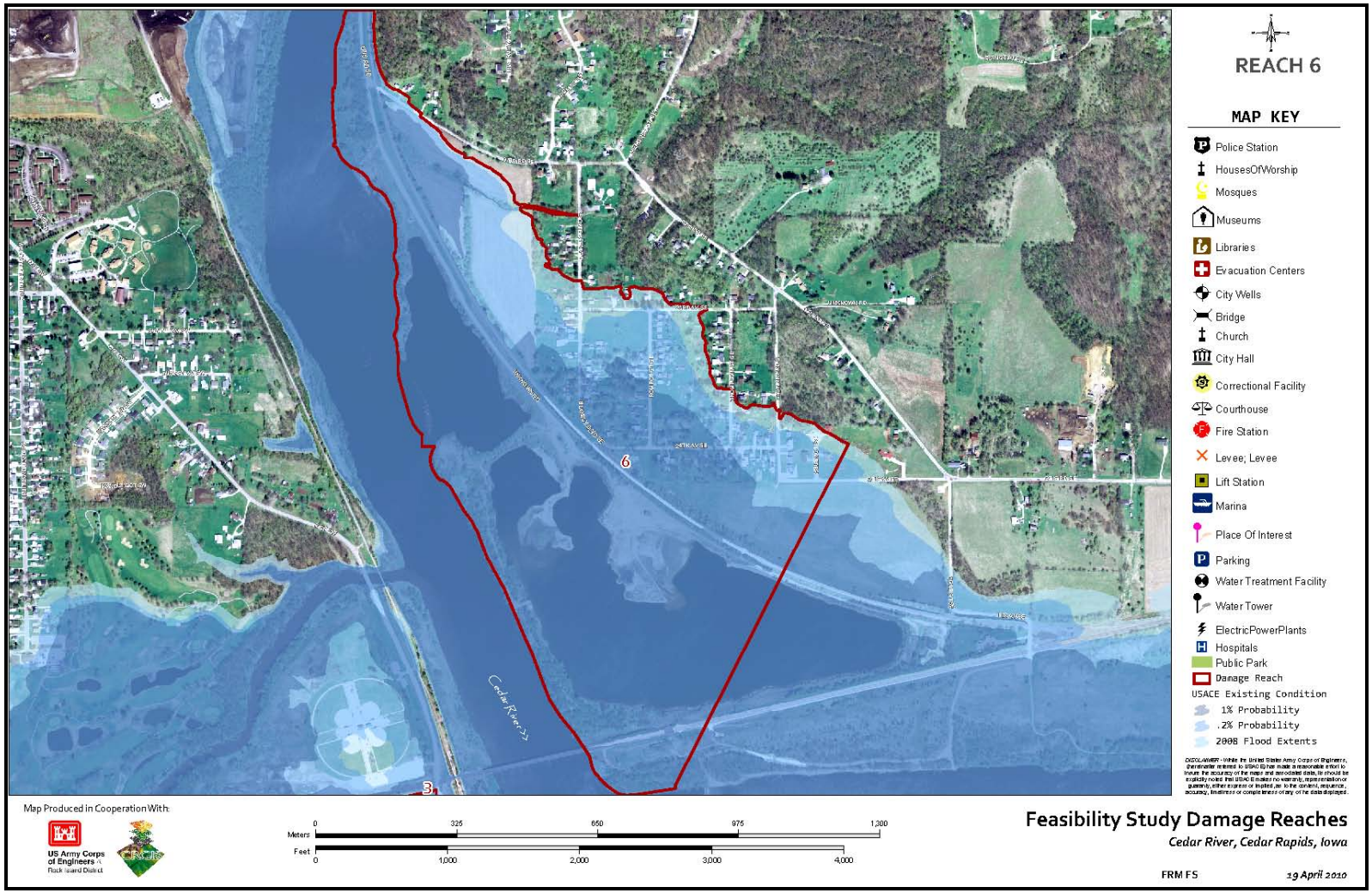


Figure 38. Damage Reach 6 – Cedar Valley (Rompot) Neighborhood

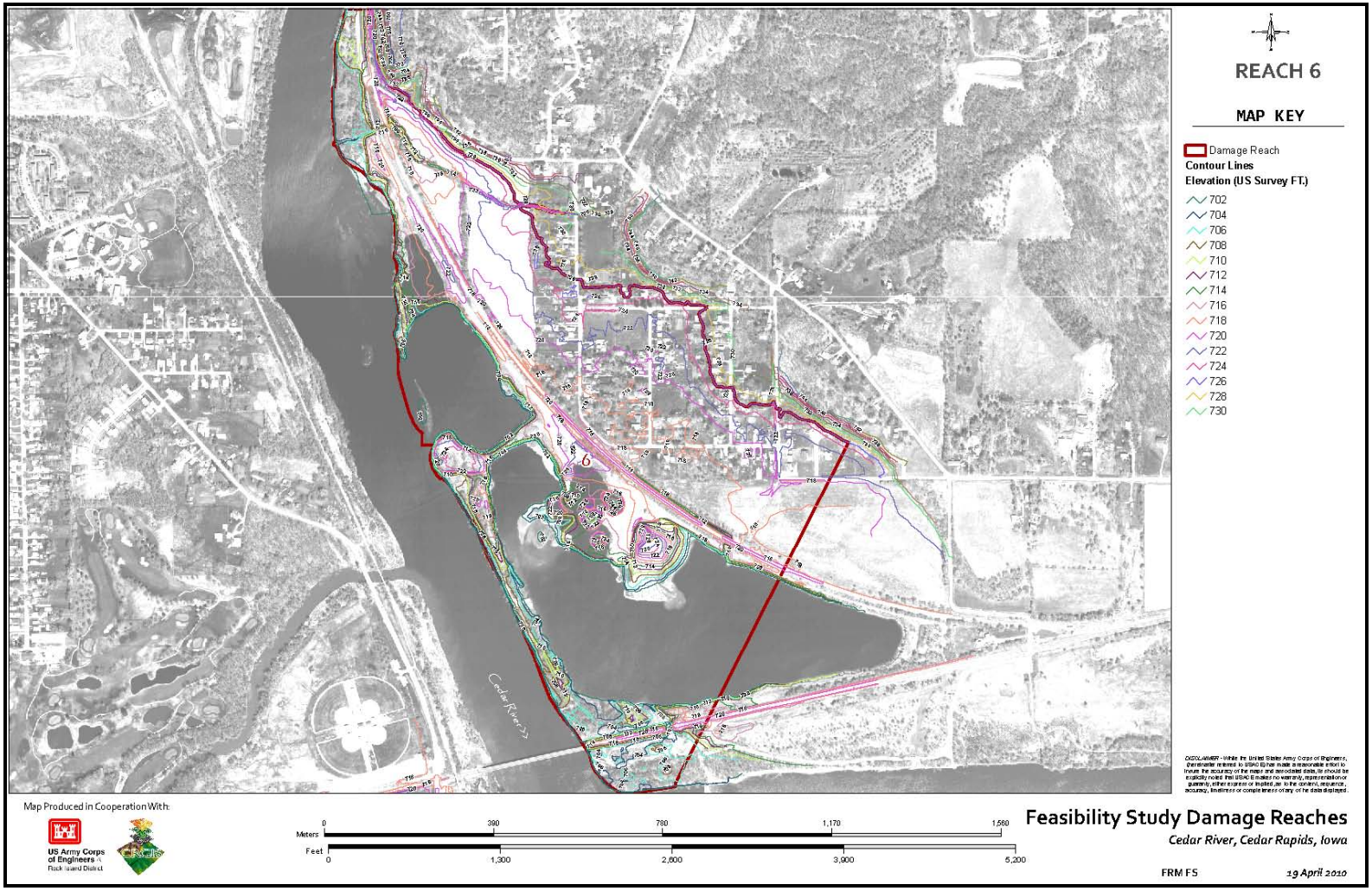


Figure 39. Topography, Reach 6

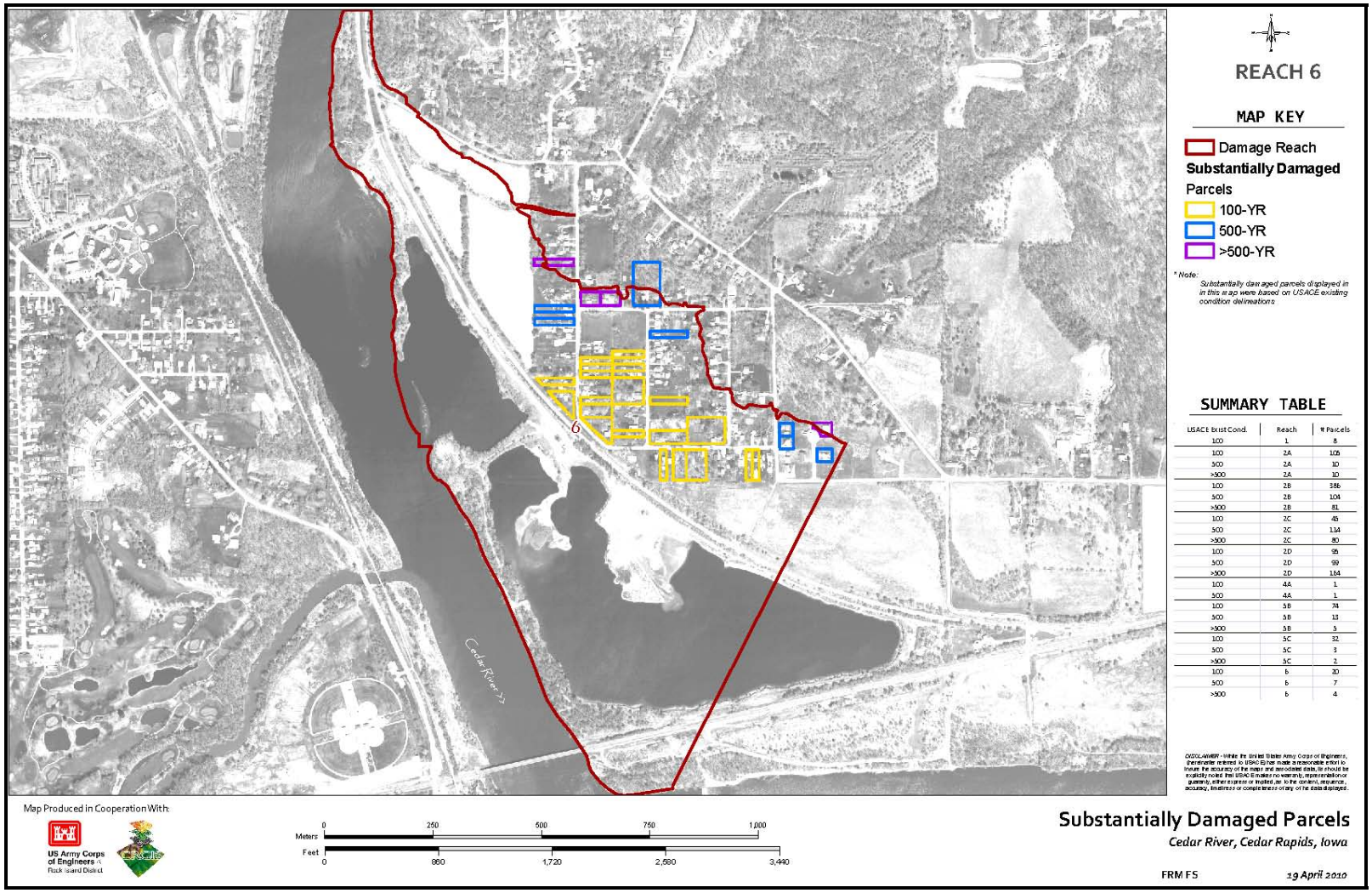


Figure 40. Substantially Damaged Parcels, Reach 6

3.1.4.14. Damage Reach 7 – Water Pollution Control Facilities (WPFC). The WPCF provides wastewater treatment for the City. The Cedar Rapids WPCF is located at 7525 Bertram Road, southeast of Cedar Rapids. The WPCF serves the populations of the cities Cedar Rapids, Marion, Hiawatha and Robins. While the total population of these communities is approximately 160,000, it must be understood that the WPCF treats wastewater of significant strength due to the industrial customer base of the region. The population equivalent served by the WPCF is on the order of 1,000,000. The WPCF was inundated to a water elevation of 720 feet (figure 41) in the June 2008 flood event.

The main lift facility was lost for about 10 days. 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 primary settlers (first physical treatment process) and the roughing filters (the first biological treatment) were out of service for about 1 month. The first stage of activated sludge treatment was out of service about 2 months. The second stage of activated sludge treatment was out of service about 3 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.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $30,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The WPCF is considered a critical facility.
- Reach 7 consists of public properties that are mainly impacted with the 0.5 and 0.2 percent chance events as shown in table 18.
- The topography of the Reach is shown in figure 42. The area starts receiving significant flood damage impacts at an elevation of approximately 711. The 2008 flood of record elevation for this Reach was 720. Elevations on the map range from 690 to 730. The WPCF was built above the FEMA base floodplain and it is outside of the USACE existing condition 1 percent probability flood inundation limit.

Table 18 Properties Impacted – Reach 7

Only Public

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50.0%**	**20.0%**	**10.0%**	**4.0%**	**2.0%**	**1.0%**	**0.5%**	**0.2%**
-0.5 to 0	0	0	0	0	0	1	3	2
>0 to 2	0	0	0	0	0	0	1	1
>2 to 4	0	0	0	0	0	0	0	4
>4 to 6	0	0	0	0	0	0	0	1
>6 to 8	0	0	0	0	0	0	0	0

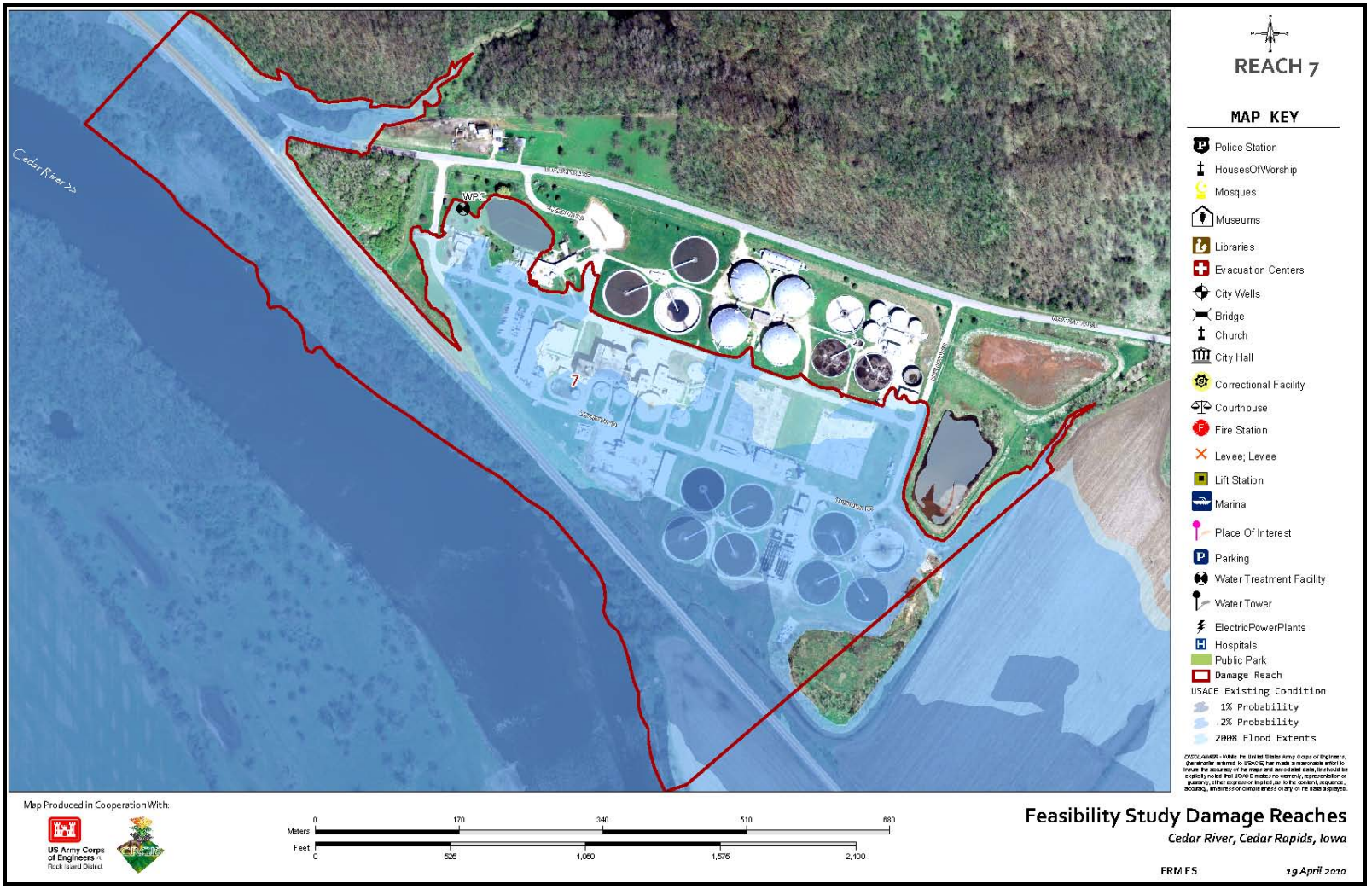


Figure 41. Damage Reach 7 – Water Pollution Control Facilities

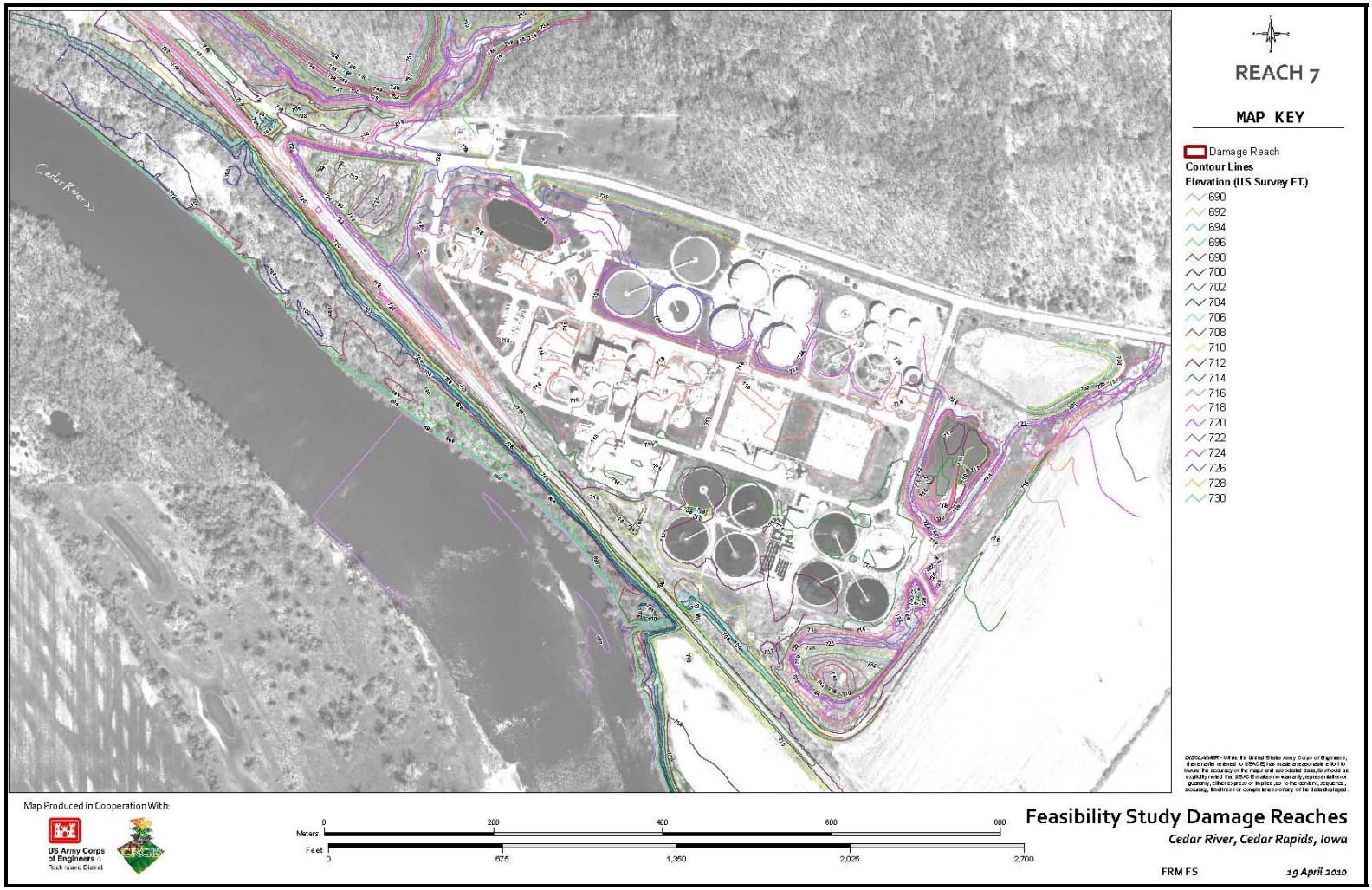


Figure 42. Topography, Reach 7

3.1.4.15. Damage Reach 8 – Fresh Water Intake Wells. This reach (figure 43) is defined by the fresh water well field which includes 46 vertical and 4 horizontal collector wells. The well field provides potable water to the City.

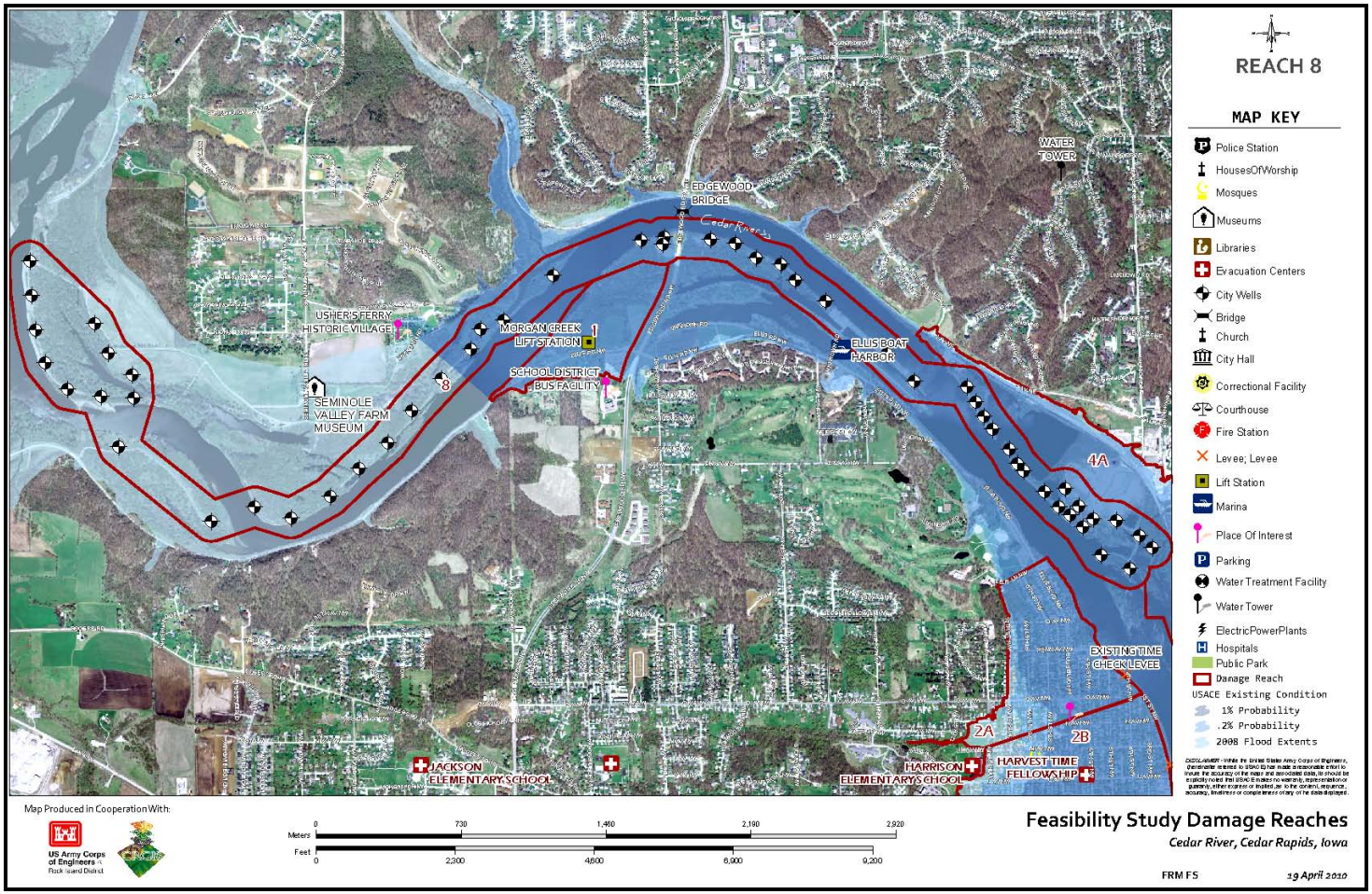


Figure 43. Damage Reach 8 – Fresh Water Intake Wells

3.1.4.16. Damage Reach 9 – Mays Island. Located in the center of downtown Cedar Rapids, Mays Island had four main facilities before the June 2008 flood. These facilities, from north to south, are the Veteran's Memorial Building (Cedar Rapids City Hall); a City-owned underground parking garage; the Linn County Courthouse; and the Linn County Corrections Facility (figure 44). Since the record flood, the Veteran's Memorial Building (Cedar Rapids City Hall) and City-owned underground parking garage have not re-opened. City Hall is operating from a temporary location outside of the floodplain. For purposes of the economic analysis the Veteran's Memorial Building was assumed to be repaired to be used as an office building in the Future Without Project Condition. The Linn County Courthouse and Linn County Corrections Facility have re-opened, and damage surveys were conducted for these properties.

Damage Reach Details

- The Estimated Annual Damages for this Reach are $23,000. For purposes of the economic analysis, these properties were assumed to be elevated above the base floodplain and repaired (according to the assumptions listed in section 3.2) in the Future Without Project Condition.
- The Veterans Memorial Building (City Hall), Linn County Courthouse, and the Linn County Corrections Facility are considered critical facilities.
- The public properties within this Reach are impacted with varying degrees of flood depths versus percent chance event as shown in table 19. The majority of the flood inundation occurs between 4.0 and 0.2 percent chance events.
- The area starts receiving significant flood damage impacts at an elevation of approximately 723. The 2008 flood of record elevation for this Reach was 731.5.

Table 19 Properties Impacted – Reach 9

Only Public

	Count of Structures for Percent Chance Event							
Feet over 1st Floor	**50.0%**	**20.0%**	**10.0%**	**4.0%**	**2.0%**	**1.0%**	**0.5%**	**0.2%**
-6 to 0	0	0	0	1	1	1	1	2
>0 to 2	0	0	0	0	0	0	1	0
>2 to 4	0	0	0	0	0	0	0	1
>4 to 6	0	0	0	0	0	0	0	0

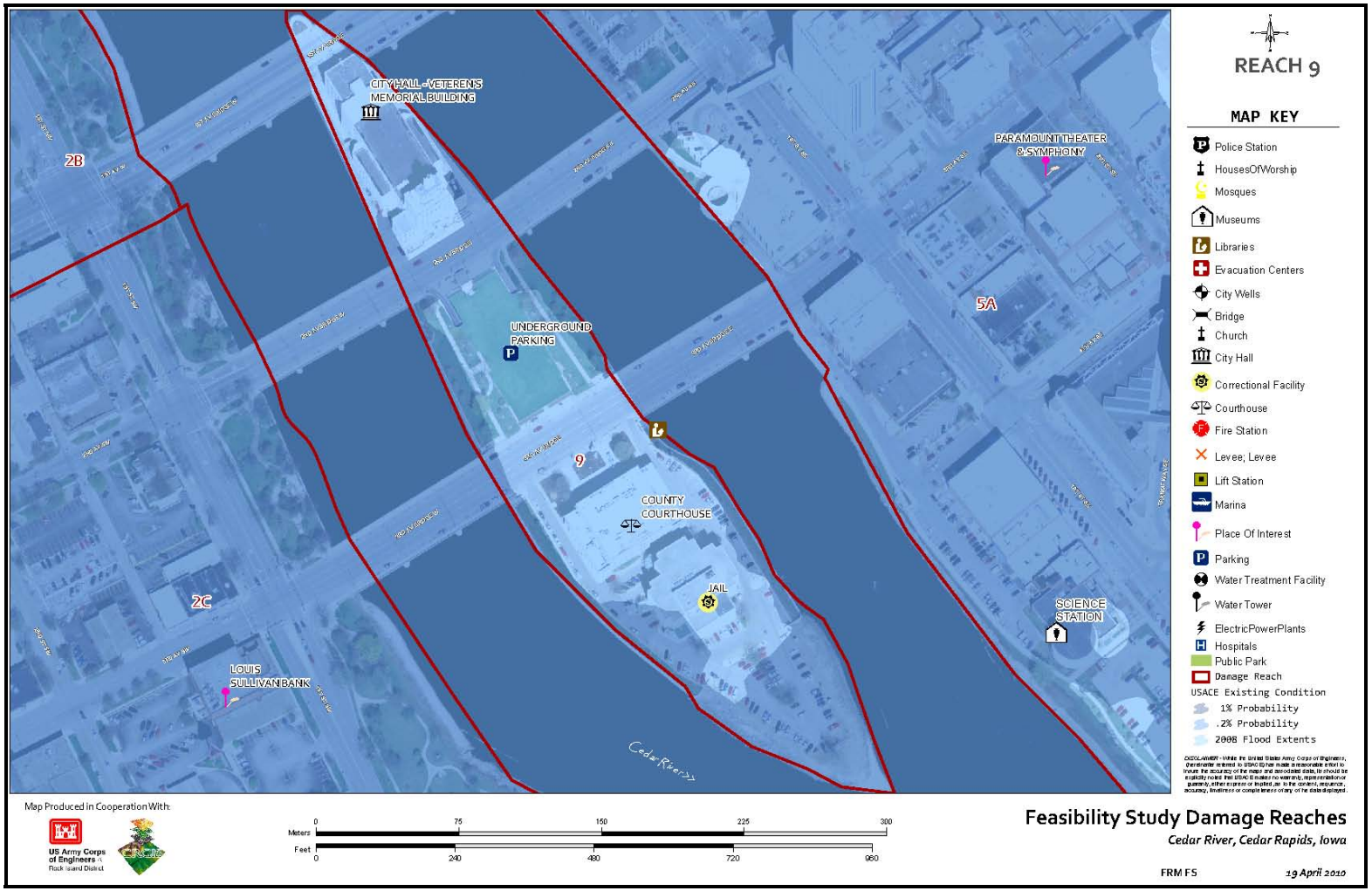


Figure 44. Damage Reach 9 – Mays Island

3.1.5. Relevant Resources. Resources that could be affected by the Study are:

- **Natural Resources**
- **June 2008 Flood Impacts**
- **Hydrology**
- **Created Resources**
- **Floodplain Management**
- **Recreation**
- **Hazardous, Toxic, Radioactive Waste (HTRW)**
- **Cultural Resources**
- **Socioeconomic Resources**

3.1.6. Natural Resources. The Study area (figure 3) supports an assortment of songbirds/neotropical migrants typical for any large Midwestern urban area. Two active eagle nests exist near the confluence of McLoud Run and the Cedar River. This same backwater complex serves as a resting area to migratory waterfowl.

McLoud Run is the only urban trout stream in Iowa. No lasting adverse impacts were realized as a result of the 2008 flood. The fishery in the Cedar River is diverse and is consistent with other Iowa river fish populations. Cedar Lake is currently listed as a Category 5a Impaired Water by the Iowa Department of Natural Resources (IADNR). This is based on a Fish Consumption Advisory issued by Region 7 U.S. Environmental Protection Agency (USEPA) for total PCBs 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 PCBs and chlordane.

3.1.6.1. Birds. Various groups of birds will be evaluated as to each alternatives probable impact on the group. Groups include song birds/neotropical migrants, bald eagles, migratory waterfowl, and wading birds.

Bald eagles breed along the Cedar River, and at least two nests are present on the island complex near the McLoud Run confluence. Suitable trees where eagles can loaf and perch are numerous. During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared.

3.1.6.2. Mussels/Fish. Freshwater mussels are the most imperiled group of animals in North America. This general area of the Cedar River has been the site of federally-endangered Higgins' Eye pearly mussel (*Lampsilis higginsi*).

The groups of fish relevant to this project are trout/McLoud Run, rough fish of the river and Cedar Lake. Cedar Lake does provide a sport fishery, dominated by common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*) freshwater drum (*Aplodinotus grunniens*) and buffalo (*Ictiobus*) species although 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 Five-in-One 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, or migratory, 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 critical spawning habitat for these species. Tagged shovelnose sturgeon have been recaptured as far downstream as Pools 17 and 18 of the Mississippi River. Additionally, in 2009 an adult lake sturgeon was also sampled near Palisades-Kepler State Park.

3.1.6.3. Wetlands. Few wetland areas exist in the highly urbanized Study area. One wetland area of concern is a riverine, forested wetland located between the railroad embankment adjacent to and upstream of Quaker Oats. This backwater forested wetland complex extends upstream and beyond the confluence with McLoud Run. This area supports migratory waterfowl, songbirds, and eagles and other raptors.

3.1.6.4. Endangered and Threatened Species. The species of federally-endangered or threatened species that may be present in Linn County are prairie bush clover (*Lespedeza leptostachya*) and western prairie fringed orchid (*Platanthera praeclara*), both threatened.

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.

There are no state-listed/protected species or their critical habitat in the Study area.

3.1.7. June 2008 Flood - Causes and Impacts. Several factors contributed to the antecedent hydrologic conditions leading up to the Flood of 2008. The previous year was the fourth wettest year on record for the State of Iowa, resulting in saturated soil conditions and higher-than-normal flows. In addition, portions of Iowa received above normal snowfall during the winter of 2008, resulting in significant snow-water equivalents. Much of northern Iowa had snow- water equivalents of 2 to 4 inches, with areas in Northeastern Iowa having snow-water equivalents in excess of 4 inches. Figure 45 shows snow-water equivalents in the Upper Mississippi River (UMR) Basin prior to the major snow melt.
Heavy rains beginning in April over Iowa caused area tributaries, as well as the Mississippi River to rise above flood stage. Widespread areas of Eastern Iowa recorded 6-plus inches of rainfall with 10-

plus inches reported locally, as shown in figure 46. This was the second wettest April on record for the State of Iowa. The resulting runoff caused the three flood control reservoirs located on the Iowa and Des Moines Rivers to rise significantly into early May.

Although river and reservoir levels had begun to recede during the second part of May, river levels remained higher than normal. Beginning in late May and into early June, the jet stream shifted resulting in a trough in the West and a ridge in the East. The low level jet allowed for a continuous moisture feed as storms tracked repeatedly over the same areas, much like what happened in 1993. The average precipitation for the State of Iowa over the 15-day period of May 29 through June 12, 2008 was 8.99 inches. In comparison, the maximum 15-day total in 1993 was 7.81 inches. Rainfall totals over the UMR for June 1 through June 15, 2008, are shown in figure 47.

The Iowa U.S. Geological Survey (USGS) reported 29 stations observing record stages. Record flooding (photograph 1) was observed along the entire length of the Cedar River. The River at Cedar Rapids crested at 31.2 feet on June 13, 2008, 11.12 feet over the previous record and above the 0.2 percent probability event (table 20). The stream hydrograph is shown in figure 48.

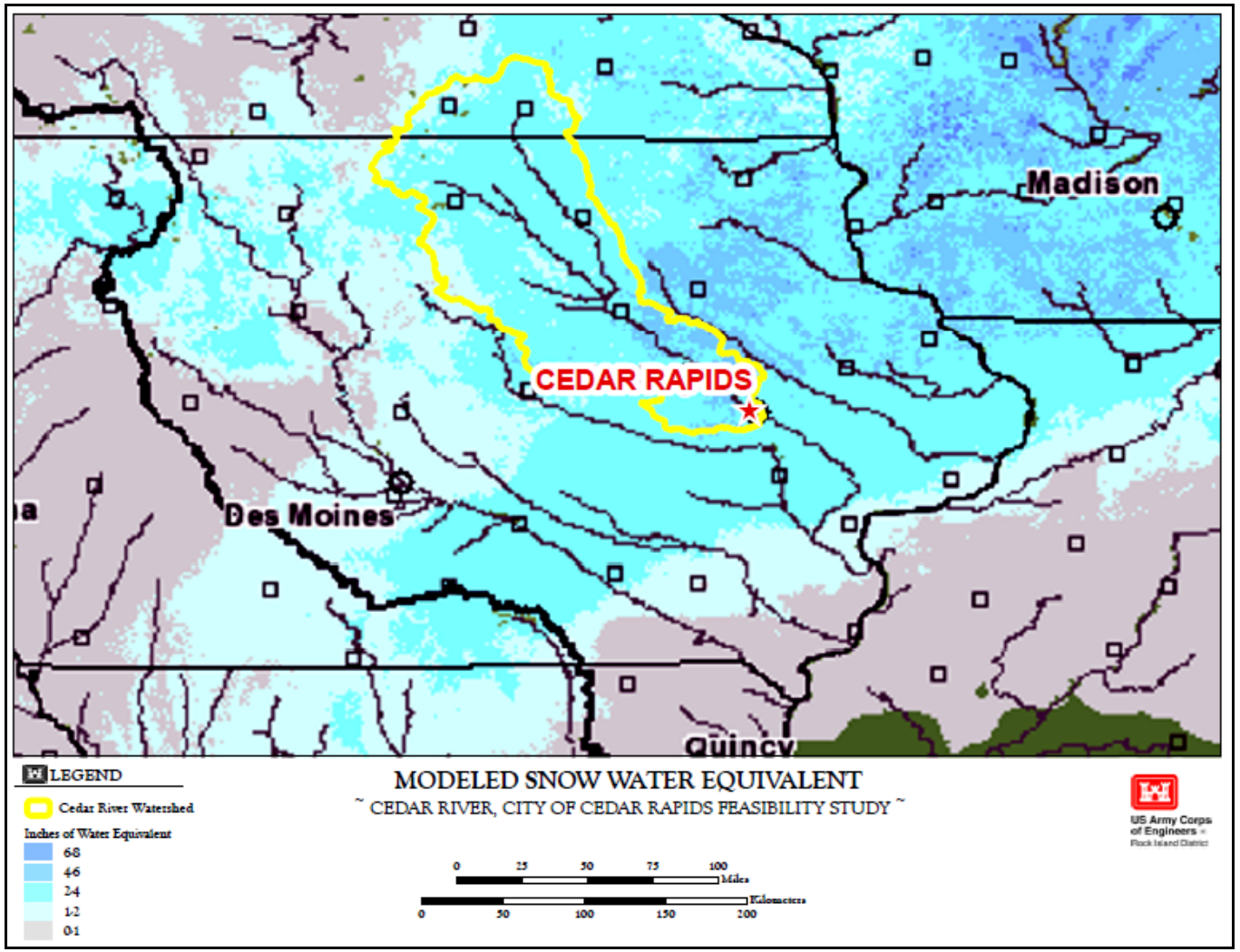


Figure 45. Modeled Snow Water Equivalent

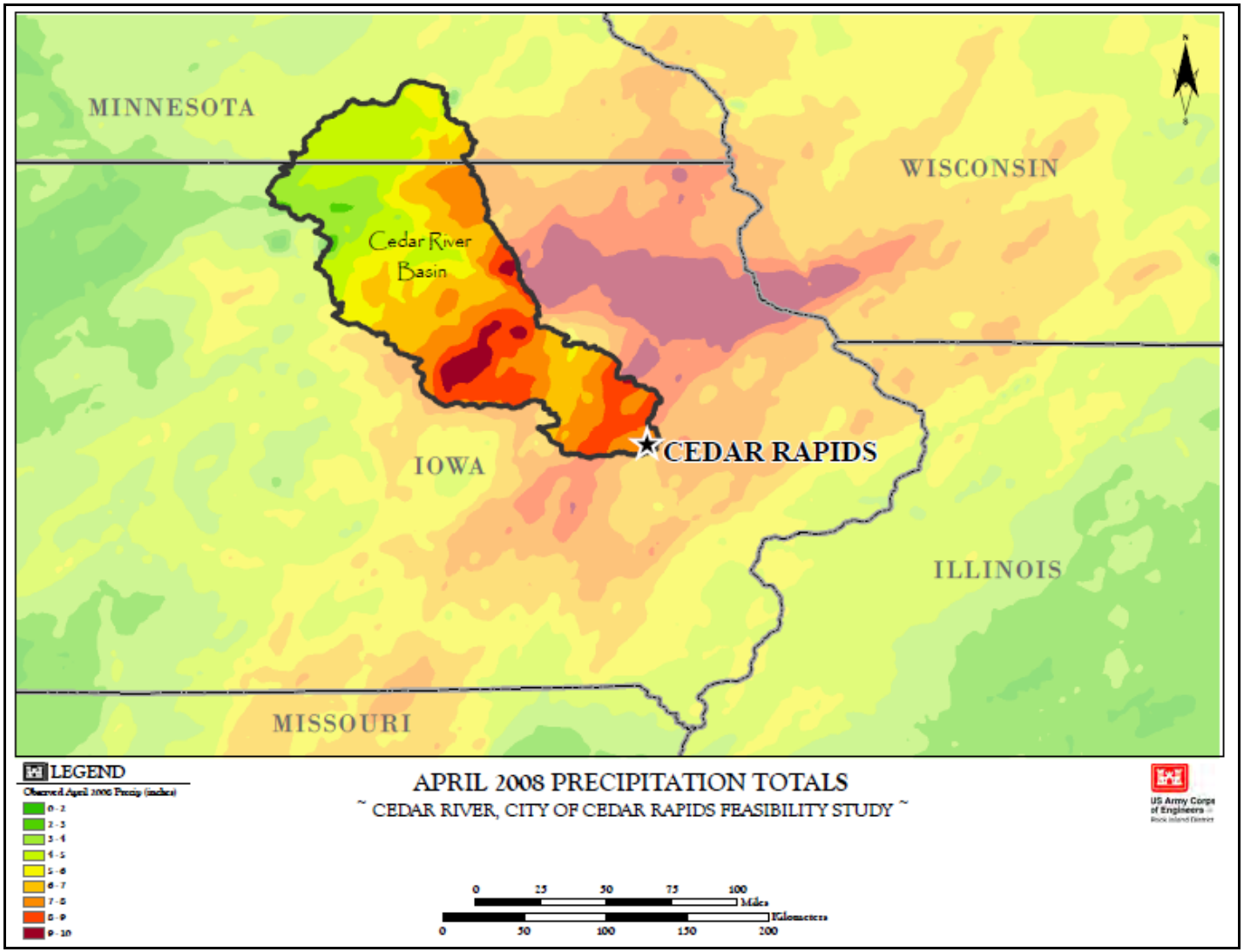


Figure 46. April 2008 Precipitation Totals

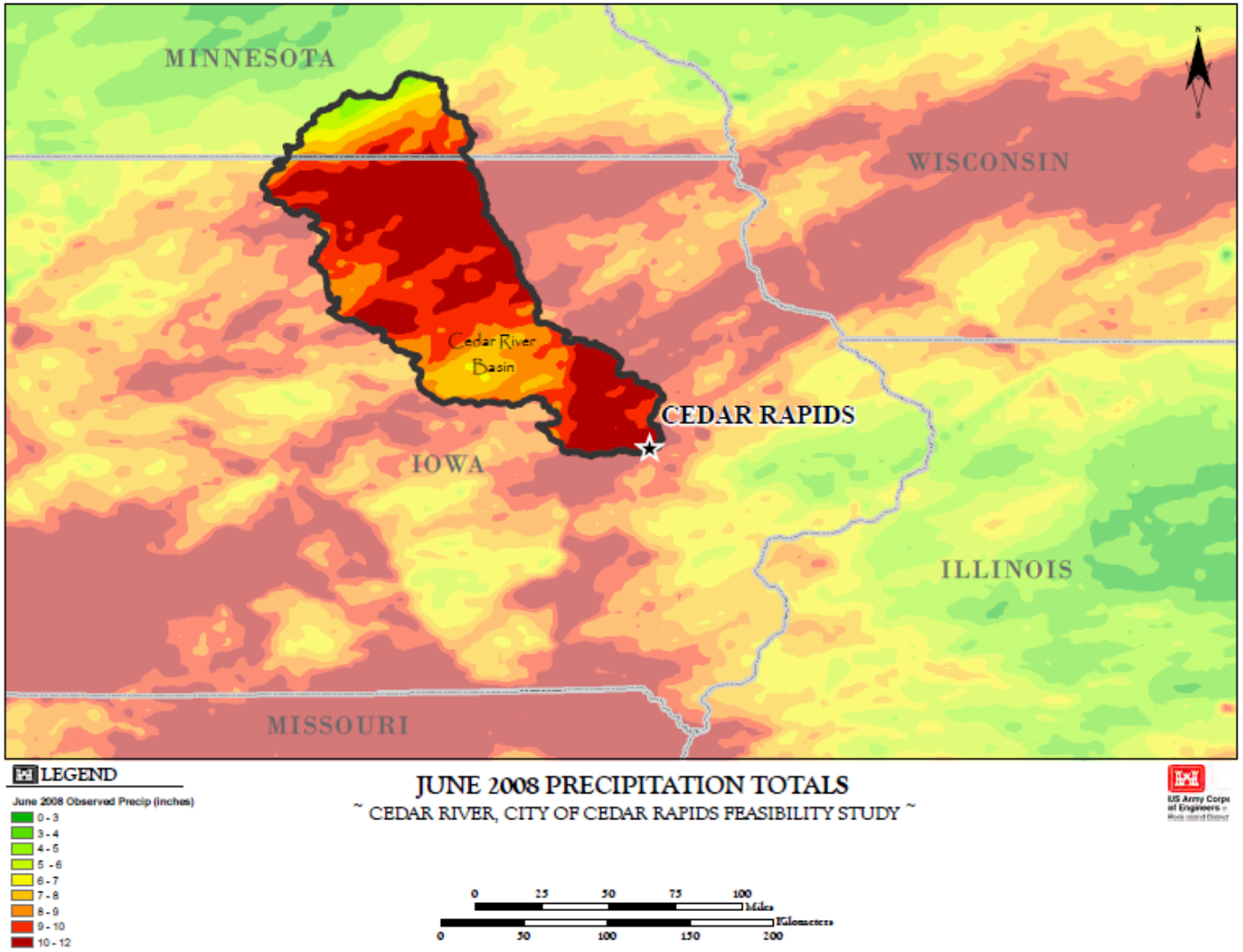


Figure 47. June 2008 Precipitation Totals

Photograph 1. June 13, 2008 - Cedar River at Downtown Cedar Rapids During Flood Crest

Table 20. Cedar River Crests Associated with the June 2008 Flood Event

Gage	Crest
Waterloo, Iowa	26.4 *
Cedar Rapids, Iowa	31.2 *

* Record Crest

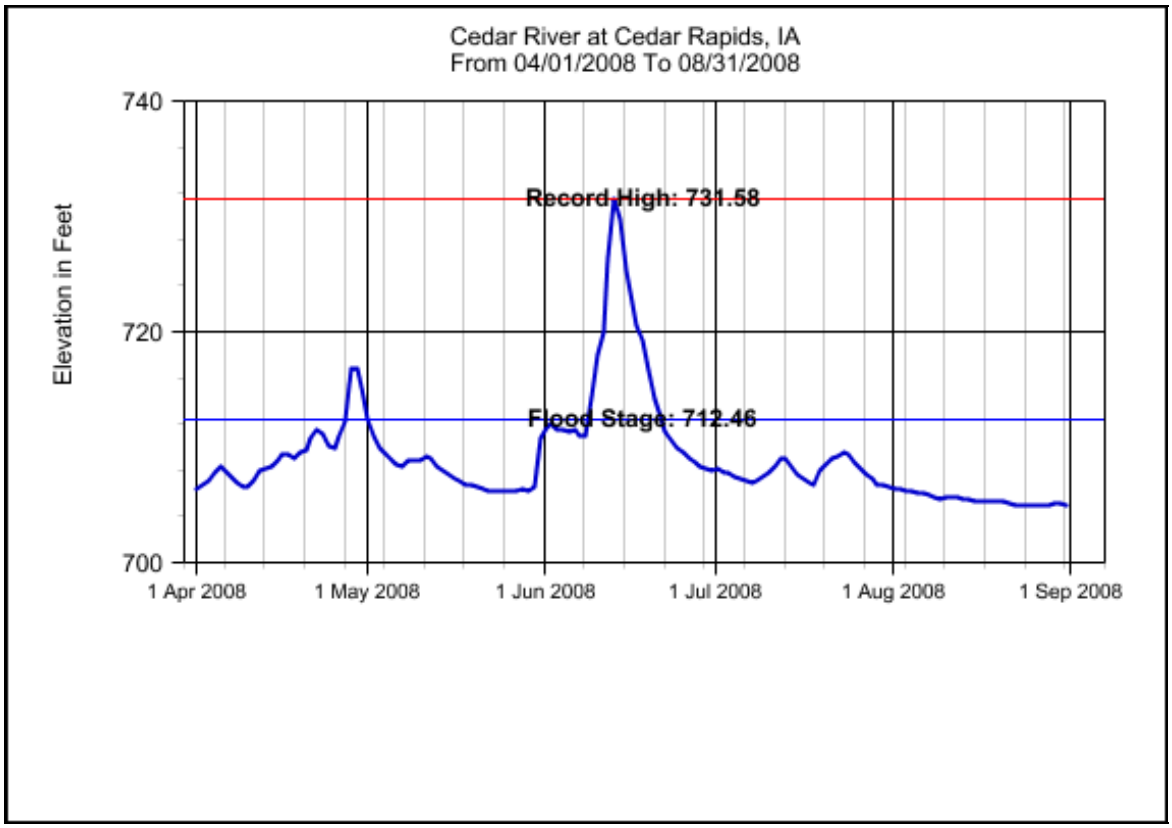


Figure 48. 2008 Flood Hydrograph

3.1.7.1. Transportation. In June of 2008, many of the City's transportation services were severely impacted or non-existent due to extreme flooding. As part of the River Corridor Redevelopment Plan (RCRP), transportation issues were addressed by analyzing transit, freight railroads, bridges, streets and parking, and pedestrian/bicycle pathways.

The Ground Transportation Center was inundated by approximately 8 feet of water. Consequently, downtown transfers now take place at a temporary facility located at 2nd Street SE and 12th Avenue SE. In addition, as a result of the flood, eight buses had to be taken out of service.

Cedar Rapids is served by five freight railroads. They include the Union Pacific (UP), the Cedar Rapids and Iowa City Railway (CRANDIC), the Canadian National (CN), the Iowa Northern Railway Company, and the Iowa Interstate. The CRANDIC Bridge serves the Penford Corporation and was completely washed out due to the flooding in June. The UP Bridge upstream of I-380 accumulated boathouses and other debris but sustained only minor damages. All other rail lines had minor damage.

During the June 2008 flood, only the Interstate 380 Bridge remained open out of seven Cedar River bridges. 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. Traffic connectivity between the north and south parts of town is crucial for future flood event planning.

Streets and parking were also impacted by the flooding event. The flooding of the downtown corridor and subsequent neighborhoods on both sides of the river inundated approximately 1,300 City blocks.

3.1.7.2. Infrastructure and Utilities. Due to the widespread reach of the flood waters, most of the infrastructure within the City was impacted. Schools, churches, businesses, industry, public and private services, and facilities were severely impacted (figure 49).

Utilities impacted from flooding include electric, gas, water, sewer, fiber-optic network, and other general services. The damages to the water and sewer systems for the City are the only main utilities investigated for this report.

The freshwater intake wells supply raw water to the two potable water treatment plants. All of the 46 vertical wells lost service when the flood waters inundated the motors, and 3 of the 4 horizontal collector wells lost service when the flood waters inundated the transformers—at Horizontal Collection Well (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 intake field was limited to about 12 million gallons per day to only the J Avenue plant during the flood. As average water demand in the City is around 38 million gallons per day, 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 return to service of HCW 4, 2 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 HCW 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 5 weeks of the flood. It took about 2 months to address repairs to all of the vertical well motors. Approximately $2 million has been expended on well field emergency repairs and the City has received funding from FEMA to elevate approximately 10 wells. There are also plans to elevate the remaining wells using additional funding sources.

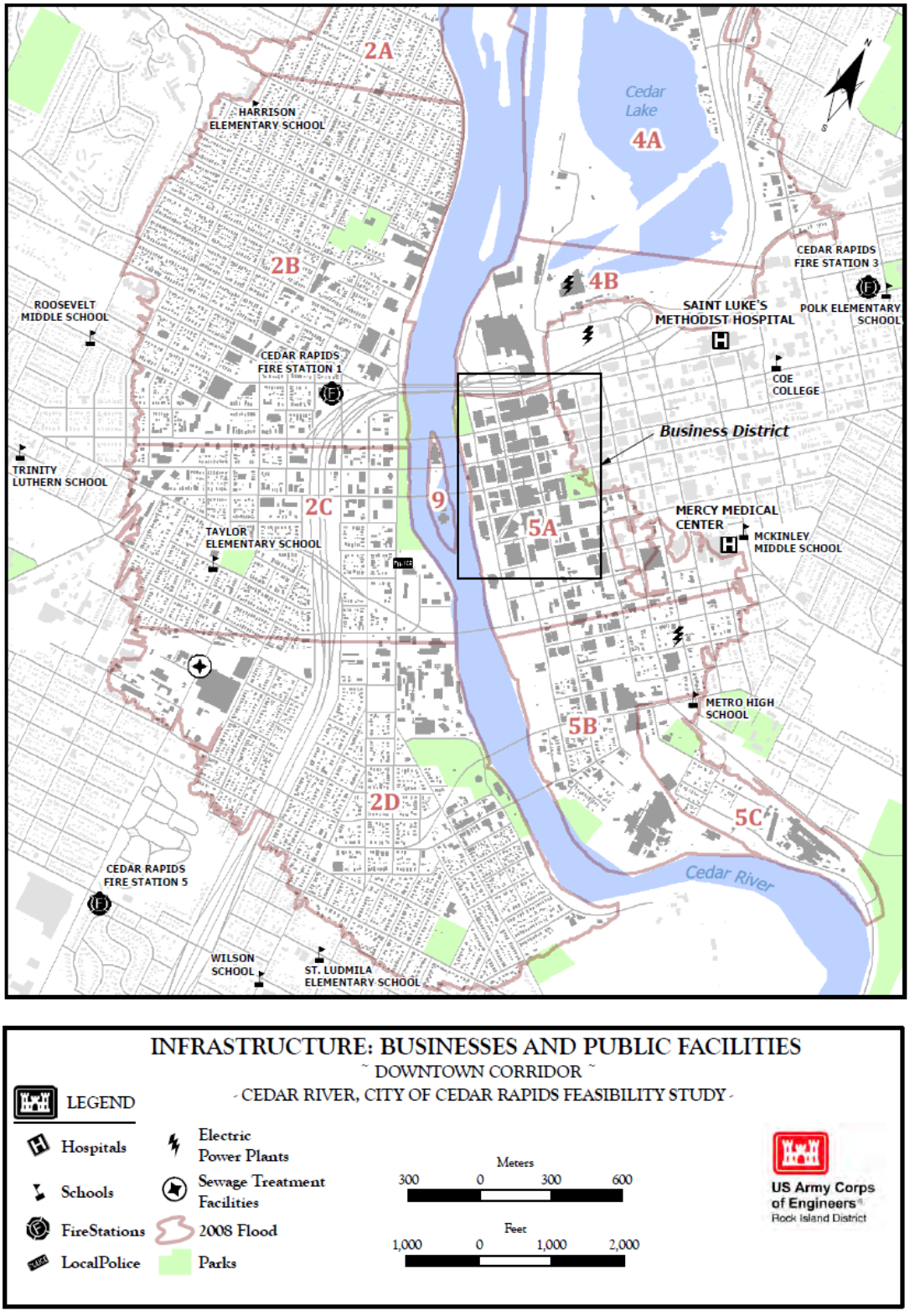


Figure 49. Infrastructure: Businesses and Public Facilities Located in the Downtown Corridor

The WPCF was inundated to a water elevation of 720 feet NAVD. 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 lost service 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 1 month. The first stage of activated sludge treatment was out of service about 2 months. The second stage of activated sludge treatment was out of service about 3 months. The incineration facility for destroying primary and biological treatment solids is still out of service. Currently, 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.

The Morgan Creek Lift Station, located in Edgewood, was also inundated by the flood. It lost service resulting in raw sewage from the northwest and northeast sections of the City bypassing treatment processes and draining directly into the flood flow upstream of downtown Cedar Rapids.

3.1.8. General Hydrology. The drainage area of the Cedar River at the City is 6,510 square miles. Historically, major floods have been caused by a combination of rainfall and snowmelt or by heavy rainfall alone. On the Cedar River, the flood of record is the June 2008 event. This flood was the result of severe rainfall events. The River crested in Cedar Rapids on June 13, 2008 at an elevation of 731.58 feet NGVD, roughly 4 to 5 feet above the 500-year flood insurance study (FIS) flood stage at the gage, and a discharge of 140,000 cfs.

Since 1903, the USGS has maintained a stream gaging station on the Cedar River at Cedar Rapids. The gaging station is located roughly 400 feet upstream of the 8th Avenue Bridge. The 10 major floods on the Cedar River are listed in table 21 in decreasing order of the magnitude of their discharge. For reference, the flood profiles for the Cedar River developed by FEMA (FIS 1991) are located in Appendix A, *Hydrology and Hydraulics.*

Table 21. Floods of Record, Cedar River, Cedar Rapids, Iowa

Year	Discharge (cfs)	Gage Height (ft)
2008	140,000	31.12
1961	73,000	19.66
1993	71,000	19.27
1965	66,800	18.51
1929	64,000	20.00
2004	62,500	18.30
1999	62,300	18.31
1933	58,400	18.60
1947	56,200	18.23
1906	55,700	17.60

[1] Estimated from high water marks. USGS, 2001, National Water Information System (NWISWeb) [http://waterdata.usgs.gov/nwisl]

The Cedar River at Cedar Rapids flow frequency analysis was reviewed and approved by the IADNR, November 30, 2008. The USGS and the Corps are in agreement regarding the use of the Bulletin 17B systematic analysis for the USGS Cedar River at Cedar Rapids gage record of 106 annual peak discharges. A summary of the results are shown in table 22. For reference purposes, FIS (March 18,

1991) published values at Cedar Rapids compared to the post-2008 flood event flow frequency analyses are also shown in the table 23.

Table 22. Cedar River at Cedar Rapids
Annual Frequency Curve Discharges

Exceedance Probability	Discharges (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

Table 23. Adjustment of Flow Frequency Discharges on Cedar River Below Cedar Rapids

Cedar River at Cedar Rapids Upstream of 8th Ave Bridge	10% Chance Event (cfs)	2% Chance Event (cfs)	1% Chance Event (cfs)	0.2% Chance Event (cfs)	2008 Flood Peak 13-Jun-08 (cfs)
FIS (1991)	53,000	77,000	87,000	112,000	
COE (2008)	54,500	82,200	94,100	122,000	140,000

3.1.9. Created Resources. Created resources include modifications to the landscape; in this Study, the created resources are directly related to urban development.

3.1.10. Floodplain Management. Contemporary land use in the Cedar Rapids floodplain is principally urbanized with very little open space. The floodplain is extensively developed by residential, commercial, and public infrastructure. The City has an existing levee system throughout its river corridor that has in the past provided marginal protection. The City updated its Flood Response Manual in March 2010 which includes stage related flood fighting efforts, updating flood fighting maps, and evacuation plans. Design standards for new development within the floodplain and adjacent watersheds are also being reviewed and revised. At this point the design standards are only dealing with requirements for water detention basins for all new developments over 1 acre.

Additional work on floodplain management has occurred through the City's planning efforts. The RCRP and the neighborhood planning initiatives have led the City to discuss plans for sustainable neighborhoods, businesses, and infrastructure. Additional work is required to develop a more comprehensive floodplain management plan.

3.1.11. Recreation. The Cedar River corridor has many recreational resources available to the public. The City has developed and maintained over 23 miles of multiuse trails and is developing more user friendly pedestrian access to the downtown areas. McLoud Run offers a unique fishery being the only urban trout stream in Iowa and is located just north of the downtown. The Cedar River also offers fishing and boating opportunities for the public.

The City is currently served by four trails in close proximity to the downtown core and one trail downstream on the left descending bank. These trails provide connectivity with the City's riverfront and afford the City's residents with recreational opportunities for walking, biking, running, jogging, in line skating and cycling. The four trails 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.

In addition to the trail system, the City's recreational inventory also includes the following four urban parks in the vicinity of the Alternative 4C alignment:

- Mays Island Plaza, located on Mays Island in the center of the Cedar River, is the governmental center for both the City and Linn County;
- Riverfront East Park, located along 1st Street East;
- Masaryk Park, located at 14th Avenue and 1st Street SE; and
- Osborn Park- This Park is located at 14th Avenue and 13th Street SE.

Figure 50 illustrates the trails and parks in the vicinity of the Alternative 4C alignment.

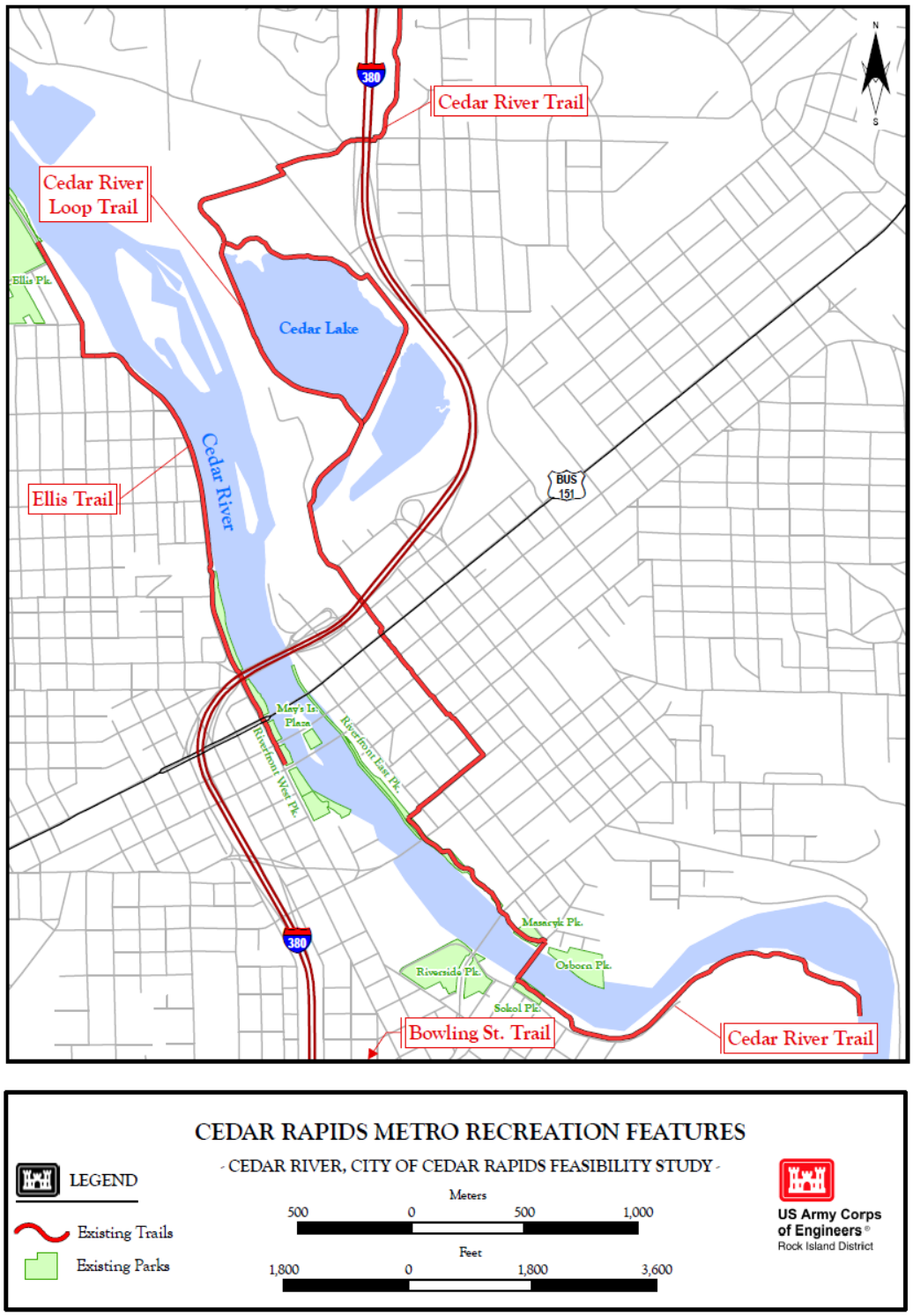


Figure 50. Cedar Rapids Trails and Parks in the Vicinity of Alternative

The Cedar River Trail experiences its peak usage period during June and July, and its off peak period occurs between September and December. The low trail usage rates for June and July 2008 and 2009 are attributed to the June 2008 flood. Table 24 shows the historical weekly usage for the Cedar River Trail expressed in user days.

Table 24. Historical Cedar River Trail Usage

Year	June to July	Sept to Dec
2005	3,608	1,215
2006	3,459	1,096
2007	3,629	1,820
2008	796	unknown
2009	1,696	unknown

For the period January 6 to December 7, 2008, the Cedar River trail experienced a total of 37,048 user days; for the period April 19 to July 26, 2009, there were 34,391 user days.

3.1.12. Hazardous, Toxic, and Radioactive Waste (HTRW). Phase I Environmental Site Assessments (ESAs) were completed throughout the Study area. Phase I ESAs included the entire selected plan and the preferred borrow site areas. Phase II ESA samples were obtained and analyzed for a portion of properties within the selected plan that allowed rights-of-entry for investigation. Phase II samples were obtained and analyzed for the preferred borrow site. There are additional properties identified within the selected plan corridor that merit Phase II sampling but these have not been obtained to date since rights-of-entry have not been granted. See Appendix F, *Hazardous, Toxic, and Radioactive Waste*, for details on findings and identification of several other items that need to be completed prior to the completion of the HTRW analysis.

Phase I ESA analysis includes a record search for ownership, land use, etc. and a walking site survey looking for evidence of soil or water contamination. Phase II ESA analysis involves taking soil and ground water samples in the areas that have the potential for contamination based on the findings determined during Phase I.

3.1.13. Cultural Resources The following information is from the Bear Creek Report.

3.1.13.1. Archeology. The prehistory of the Cedar Rapids area is not well known. A total of 31 archeological sites have been previously identified in Cedar Rapids. Twenty-three of the sites have been identified as prehistoric, five are from the historic period and three have no data with regard to period of occupation. Geomorphologic investigations documented in the Bear Creek Report identified buried landforms which may contain prehistoric deposits in the Study area. There is potential for Paleo-Indian, Early and Middle Archaic, Late Archaic, Woodland, and Proto-Historic deposits in the alluvial fans and natural levees found within the Cedar River Valley.

3.1.13.2. History. Located in east-central Iowa, the City of Cedar Rapids is Iowa's second largest city and its location within the state reflects its unique development in many ways. The Cedar River attracted the region's earliest settlers and thenceforward influenced urban development. Routes crossing the rapids during low water periods enabled and facilitated fording by prehistoric and historic settlers and transients. The time span of initial settlement and early municipal evolution of Cedar Rapids was between approximately 1837 and 1860. These dates correspond to the first Euroamerican

settlement ca. 1837 and the arrival of the first railroad in mid-1859, an event that would transform and shape the City in the coming decades. In the 1840s, the first water-powered mills were constructed, using dams to harness the river's power. The main focus of this hydro-industrial development was confined mainly to the rapids area, where the natural head provided the potential energy to turn the wheels of the milling and other industries. Another notable concentration of millworks in the Study area was along McLoud Run about 2.2 km (1.4 mi) upstream from downtown Cedar Rapids. McLoud Run is named for John McLeod, a settler who staked a claim to the stream and surrounding area.

The early rise of industry and commercialism in general was directly related to the development of navigation on the Cedar River upstream to Cedar Falls/Waterloo and downstream to its mouth and, eventually, ports along the Mississippi River. Highwater Rock, a large National Register of Historic Places (NRHP)-listed stone in the river near the 1st Avenue Bridge, was historically used to gage water levels. After dam construction began in the early 1840s, the river was essentially bifurcated in terms of boat traffic, creating an upper Cedar River to Cedar Falls/Waterloo and lower Cedar River to its mouth at the Mississippi River. This division is especially noteworthy when considering the history of steamboat navigation in the vicinity of Cedar Rapids. The era of early settlement ended with the construction of the railroad to Cedar Rapids, an event cumulating with the arrival of the first train in June 1859. In the first decade of the 20th century the four primary railroads and various satellite entities had consolidated their hold on lands north of 1st Avenue East and other parts of downtown.

Associated with the rise of industry and commerce was the rapid expansion of residential neighborhoods beginning in the late 19th century and increased ethnic diversity as immigrants moved to the City in search of work and a new life. Immigrants from Czechoslovakia (locally referred to as Bohemian heritage) formed the largest ethnic group, with the earliest immigrants arriving in the early 1850s and larger numbers after the Civil War. Other ethnic groups are present, albeit in smaller numbers, and include Irish, Germans, Scottish, Scandinavians, Arabs, Greeks, and African-Americans. It should be noted, however, that smaller ethnic enclaves, such as *Hogan's Alley*, an Irish neighborhood between 1st and 2nd Streets SE and 7th and 8th Avenues SE dating to the turn of the 20th century, were also present but not well documented or discernable in the historical record.

Many of the neighborhoods dating to the late 19th century within the Study area were associated with various "additions" and "replats" bearing names well known in Cedar Rapids history. During the Civil War, the platting of new subdivisions came to a halt, and building slowed dramatically.

Following the Civil War, an increase in population triggered a resumption of subdivision development. In 1874, a series of additions adjacent to the Original Town was added by court decree. This activity, along with the annexation of Kingston, set off a steady period of physical growth for Cedar Rapids during the 1870s, which continued into the 1880s. Throughout the 20th century, especially after WWII, Cedar Rapids continued to expand outward away from the river as industries not dependent on railroads evolved with the intrastate and interstate road systems. Concurrent with this expansion, inside the Study area a combination of stasis and demolition took place within historic neighborhoods.

An important event having widespread effects on the Study area was construction of I-380 through Cedar Rapids. This route adversely affected historic resources in the vicinity of McLoud Run and the northeastern quadrant proximal to the railroad yards, including residences along parts of A Avenue East and along the river (e.g., historic mills). Various cultural resources dating to the early part of Cedar Rapids history were in locations of long-term and repeated historic and modern construction

and were partially, if not completely, destroyed. Some may retain sufficient integrity to potentially provide important information on a poorly documented (archeologically and historically) time in the history of Cedar Rapids. Central Cedar Rapids witnessed considerable growth and reconstruction over the past 160+ years as the landscape was transformed from forested bottoms to well-developed urban and suburban settings.

3.1.13.3. Architectural. There are 453 structures in the 500-year floodplain on the east side of Cedar Rapids. Of these 453 structures, 122 structures have previously been determined eligible for listing or have been listed on the NRHP. Fifty of the NRHP eligible structures are included in three Historic Districts: 1) the Bohemian Commercial District, 30 NRHP eligible structures; 2) the St. Wenceslaus District, 14 NRHP eligible structures; and 3) Mays Island, 6 NRHP eligible structures.

The City completed two architectural and structural reconnaissance surveys to document NRHP-eligible/listed properties prior to the Flood of 2008. The FEMA conducted numerous architectural and structural reconnaissance surveys in the aftermath of the 2008 flooding episode prior to debris removal and demolition. The NRHP status was reviewed by FEMA, and FEMA received concurrence from the Iowa State Historic Preservation Office (SHPO).

Wells Fargo Bank (The Peoples Savings Bank or People's Bank and Trust Company**)**, located at 101 3rd Avenue, was listed on 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 feet, around which includes a single story of offices and other rooms, giving total dimensions of 50 x 90 feet. 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."

3.1.13.4. Multiple Properties Historic Districts. The Commercial and Industrial Development of Cedar Rapids, Iowa (circa 1865-1945), Multiple Property Documentation was listed on the NRHP 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.

Contributing structures and buildings to the Commercial and Industrial Development of Cedar Rapids, Iowa, are as follows:

1st Avenue
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 (Hac'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

Commercial and Industrial Development of Cedar Rapids, Iowa (circa 1865- 945), Multiple Property Historic District is noncontiguous and many buildings exhibit flood damage. "Noncontiguous" means that the buildings are not all in one location, but located throughout the downtown area, and often separated by other noncontributing buildings and roads, and open spaces. At present, this district does not overlap other districts with the City of Cedar Rapids.

The Mays 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 Mays 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: Mays Island, approximately 9.5 acres; Federal Building lot, approximately 2 acres. Mays Island was inundated during the 2008 flood.

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 the 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, Multiple Properties District (listed on the NRHP in 1997). In addition, two individual properties within the district are already listed on the NRHP: 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 potential historic district form an irregular L-shape comprising the collection of commercial, residential, and industrial properties that formed the heart of the City's 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. Numerous buildings were affected by flood waters.

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 near future. Numerous buildings were affected by flood waters and many have been razed or in the process of being removed. The NRHP eligible St. Wenceslaus Historic District evaluation was underway, but flood damage is extensive and the majority of the residential building sites have been removed. More information on the relationship of the Czech Village Historic District and the Bohemian Historic Commercial District, will be made when the NRHP nomination form has been completed or reassessed as to flood damage and razed buildings

3.1.14. Socioeconomic Resources. The City, located in Linn County, is the second largest city in Iowa. The estimated population in 2008 was 125,850. The Cedar Rapids/Iowa City corridor has an estimated population of 423,353. Linn County is one of the few Iowa counties that has been increasing in population over the past 10 years. In general, the existing condition floodplain in Cedar Rapids is densely developed. The City has extensive plans for substantial growth and redevelopment. Figure 51 (defined in the RCRP) displays the neighborhoods through the river corridor. Descriptions of the six neighborhoods are taken from the RCRP.

- The Northwest area, or Time Check area, is predominantly residential and houses a workforce community. A substantial percentage of its residents own their own homes. Mother Mosque serves as a significant heritage site for the neighborhood, while Ellis Park, Harrison Elementary School, and the Time Check Recreational Center function as important neighborhood amenities.

- Taylor Area Neighborhood Association is an active group which provides services to the Taylor Elementary School and Resource Center, such as Kids' Club, a vibrant before and after school program.

- The Czech Village is a small, compact area within the Southwest neighborhood. The area is known for a variety of unique and authentic Czech businesses. Czech Village houses residents of all ages and many families own their homes.

- The Downtown area functions as a center of business activity but lacks the vitality of a neighborhood with many residents. There are several pockets of high density housing that accommodate smaller households who move frequently.

- Oakhill Jackson is a historically industrial company town settled by Czech immigrants. It has undergone considerable changes as factories and plants have moved or closed over the years, yet its character remains predominantly single-family residential with a mix of small commercial uses. It is home to a diverse population.

- Cedar Valley, or Rompot, is an almost entirely residential area with scattered agricultural land and no commercial uses. Similar to other places adjacent to the river, it has lower residential densities. Its residents are diverse.

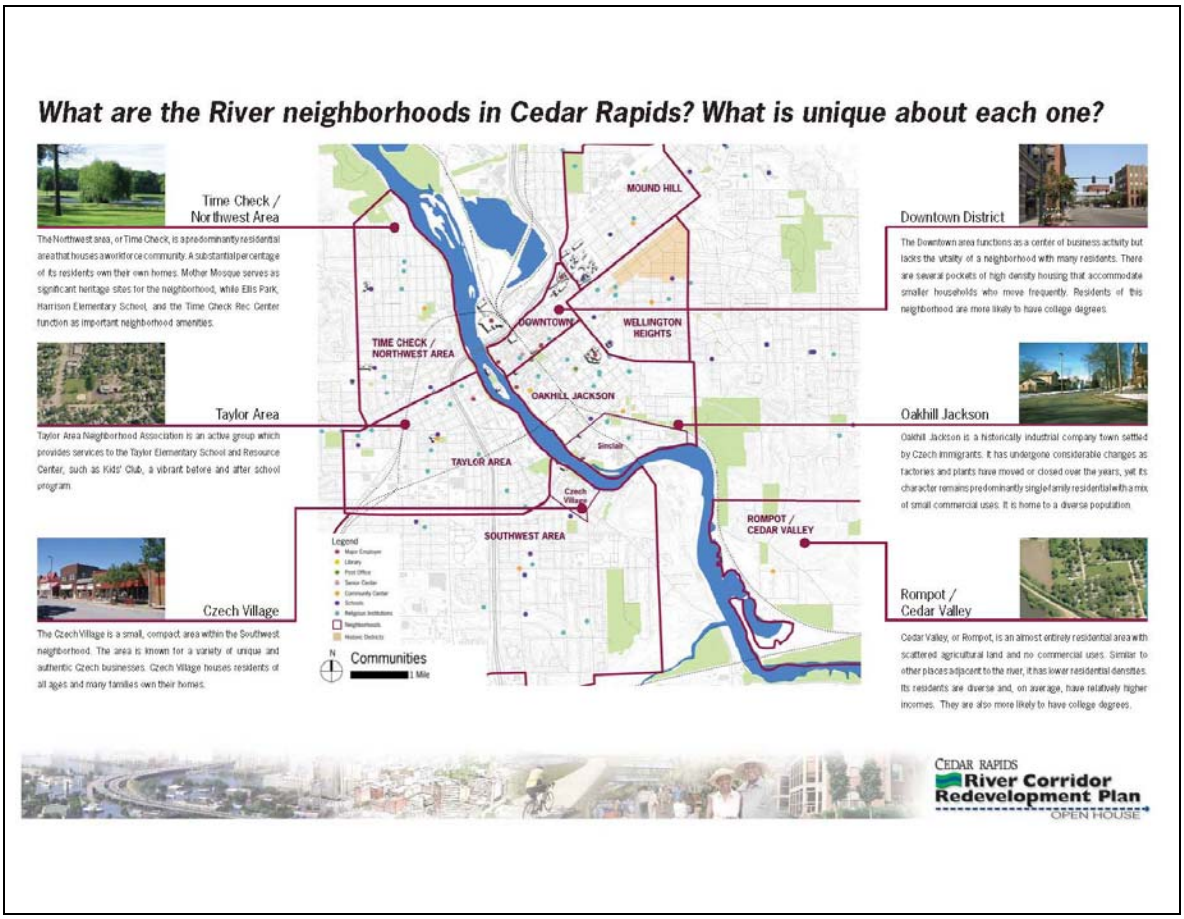


Figure 51. Neighborhoods in the Cedar River Corridor

3.1.15. Air Quality and Noise. The City of Cedar Rapids issues an air pollution alert, air pollution warning, or air pollution emergency whenever the Air Pollution Control Officer determines that the meteorological conditions are such that the accumulation of air contaminants in any place is reaching, or has reached, levels which could, if sustained or exceeded, lead to a substantial threat to the health of persons. The City also places restrictions on noise between the hours of 10:00 PM and 7:00 AM and on vehicles producing noise levels greater than 94 decibels.

3.1.16. Demographic Characteristics. 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.

3.1.16.1. 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 25 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 25. 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 of Cedar Rapids 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 26).

Table 26. 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

3.1.16.2. 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; 31 percent are renter-occupied
- 67 percent 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). Non-family 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 couples 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

3.1.16.3. 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 27 presents labor force data for Cedar Rapids and Linn County.

Table 27. 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 services	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
TOTAL	**66,459**	**100**	**108,901**	**100**

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

3.1.16.4. 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 and economic data (tables 28, 29, and 30) 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 28. 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. This represents an increase of 8.7 percent in the total number of employed in the Cedar Rapids MSA area by 2020. By 2030, the labor force is expected to grow again by about 8.5 percent (table 29). 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 30).

Table 29. 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 30. 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

The focus of the following section is on what life in Cedar Rapids is like for its residents, workers and institutions since the Flood of 2008. Discussion includes the City's plan for development or redevelopment, what has been lost since the flood, and the relative impacts.

Today, the City is still in the midst of recovering from the 2008 flood event that left $2.5 billion in damage to Cedar Rapids and Linn County, impacting 7,749 parcels, 310 public facilities, and more than 900 downtown businesses. Many residents are still struggling to rebuild, and businesses are fighting to survive, as they hope that their vision plan for flood recovery will become a reality.

Community Cohesion. The Flood of 2008 severely affected the community cohesion within the core neighborhoods of Cedar Rapids. As entire neighborhoods were forced to evacuate, multi-generational characteristics of the neighborhoods may have been lost forever. Those that were hit by the flood were also some of the most socially vulnerable within the City. The concept of "social vulnerability" holds that some groups suffer disproportionately from the effects of a natural disaster due to a lack of capacity to anticipate, cope with, resist, and recover from the impacts of a hazard[1]. Researchers have identified a variety of factors influencing social vulnerability, including socioeconomic status, age, race, gender, ethnicity, and physical or mental disability[2].

In their endeavors to recover from the flood the City engaged citizens in flood recovery planning efforts and worked to create a shared vision for flood reinvestment in the flood-impacted area. People from throughout the community came together, engaging in thousands of hours of planning time to invest in decisions about how their neighborhoods could survive. Community feedback specifically called for rebuilding high quality neighborhoods, improving flood management to better protect homes and businesses, and to help the community become more sustainable.

The social networks in the area connecting friends and family are obviously strong, and social sustainability is clearly a part of the recovery vision. Items of highest priority for those in the flood-impacted neighborhoods are to retain the ethnic and historical character of their pre-flood communities, to support sustainable neighborhoods where residents can walk to schools, parks and services, to establish new neighborhood centers that will bring residents together and foster a sense of place, and to enable a return to the quality of life they cherish. Within the Study area there are nine

[1] P. Blaikie et al., "At Risk: Natural Hazards, People's Vulnerability, and Disasters." Development in Practice 5, no. 2 (1994): 170–180.

[2] A thorough explanation of social vulnerability by Susan Cutter, plus a series of additional perspectives, can be found on the Social Science Research Council website: http://understandingkatrina.ssrc.org/Cutter/

distinct neighborhoods—Cedar Lake Area; Cedar Rapids Downtown-east; Oakhill Jackson; Sinclair-Cargill; Timecheck/Northwest; Cedar Rapids Downtown-west/Taylor; Czech neighborhood; Edgewood; and Cedar Valley (Rompot)—each with its own Neighborhood Association that serves as both advocate and organizer within that community.

The cultural sprit of the community also suffered greatly due to the loss of 80 percent of the historical and cultural landmarks and cultural institutions. Historic and cultural properties inundated include the National Czech and Slovak Museum and Library; the African American Museum and Cultural Center of Iowa and the Science Station; the Paramount Theatre; Theatre Cedar Rapids; and the Cedar Rapids Public Library. Even though the loss of these places and programs created a deep sense of loss of identity within the community, the City of Cedar Rapids and its citizens were not willing to relinquish these important pieces of their identity. The arts and cultural sector of the City has worked diligently to restore and reopen these cultural institutions thereby preserving their significance to the community.

Life, Health and Safety. Access to health care and medical facilities becomes extremely important during an emergency situation. In June 2008, all communication methods for the City were lost during the flood, including computer networks, telephone systems, and the 9-1-1 dispatch and radio system. Communications were quickly reinstated to provide uninterrupted services to the citizens so that the public was not in danger due to lack of emergency response systems.

Clearly, the flood events, flood fighting, and the ongoing threat of flooding represent key stressors in the Cedar Rapids community whose effect cannot be ignored. Research on the effects of stress on health has established the detrimental effects of stress, particularly chronic stress, on physical and mental health and substance abuse. Research has also shown that these health effects do not occur uniformly in populations. Certain groups, for example poorer individuals, minorities, and the elderly, evidence much greater effects. The mental health effects of surviving a major flood event and of dealing with any subsequent rises in river levels are stressors that are felt for many years. As a result of the 2008 flood, there was a significant increase to the need for a variety of social services in Cedar Rapids. The social services that were provided had an enormous financial impact on the City and its residents. Estimated costs of these services are between $10 million to $20 million. Without the guarantee of future flood risk management, flood-impacted residents could remain in a state of uncertainty and continue to struggle with the psychological impacts far into the future.

Flood-blighted properties have been abandoned and are in poor condition. These properties are not only an eyesore, but a public health nuisance as flood odors and grime radiated into the air surrounding the building and nearby community events. Those properties located within the heart of downtown Cedar Rapids' core business district 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 the downtown neighborhood. Impacts on neighboring properties, particularly when those are customer-oriented businesses, can be severe.

Business/Employment. There has been a significant social impact on employees of displaced businesses. The majority of downtown Cedar Rapids was impacted by the 2008 flood which heavily damaged both large and small businesses. A total of 131 businesses have closed, 568 have reopened in the same location, and 143 reopened outside the City or flooded area. While 671 businesses have remained open and jobs remain available to the employees, the resulting loss of employment in the area encompassed 1,324 permanent and 541 temporary jobs.

Among those businesses heavily damaged by flood were some of the City's largest employers including Quaker Oats, Alliant Energy, St. Luke's Hospital and Mercy Medical Center. Penford and Cargill were heavily impacted as freight connections were disrupted by damaged railroad connections. Unemployment rates rose in the weeks following the flood; however the City has thus far been successful at maintaining stability in the face of the disaster.

Downtown alone represents the largest concentration of jobs in the community and the City's largest business park. The loss of property in the Downtown District has significant impacts on the downtown property tax base that generates tax revenues for the City. The sales tax revenues lost following closure of businesses and industries not only affect revenues for the City, but also trickle down throughout the City's economy and have far reaching impacts.

Public Facilities and Services. Major City services including City Hall, the County Courthouse, the Central Fire Station, the Police Department, the animal control building, the public works building, the ground transportation center, and the main public library sustained billions of dollars in damages. Cedar Rapids Community School District central offices and Taylor Elementary School were flooded and displaced. Cultural icons, including museums, theaters and cultural centers, were destroyed.

All of the City's primary municipal buildings were evacuated and eventually flooded. In all, 310 municipal facilities were damaged. The wastewater treatment facility was submerged and lost power, and all but one raw potable water supply well were taken out of service, dropping water production to 25 percent of what was necessary to supply uninterrupted residential and industrial service to the community. However, by the heroic and tireless efforts of many, services that the citizens of Cedar Rapids rely upon continued.

Major east-west connectors across the river were closed, severely compromising traffic flow for citizens, emergency and City vehicles, and school buses. Freight connections were disrupted by damaged railroad connections, heavily impacting two major industries.

Displacements. Following the worst natural disaster in Iowa's history, 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 could return to their damaged property. 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.

All of the City's primary municipal buildings were evacuated and eventually flooded. Both the Central Fire Station and the Police Department were evacuated and moved to temporary locations. City Hall, located on a small island in the middle of the Cedar River, houses the City administrative departments. City Hall was evacuated 2 days before the river's crest and was reopened at a new site within 2 days of the flood's crest. Evacuations over those 2 days displaced more than 18,000 residents and 13,000 employees. District students displaced by the flood totaled 1,280 or approximately 8 percent of the enrollment, disrupting the learning environment. Mercy Medical Center was evacuated and patients were transported to other medical facilities.

The 2008 flood destroyed a vast majority of the affordable housing stock that was within some of the most core neighborhoods within the City of Cedar Rapids. The neighborhoods hit hardest by the flood were Time Check, Downtown, Oakhill Jackson, Taylor Area, and Czech Village. An estimated 10,000 residents were displaced by the flood and the majority of housing that was affected was 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.

Environmental Justice. The Flood of 2008 affected already disadvantaged residents, many elderly and lower-income. The City's desire for future flood risk management for all residents is to ensure that all people, regardless of their socioeconomic status, race or color, are afforded the same degree of protection from environmental and health hazards.

Environmental justice is the equal distribution of environmental risks and benefits without discrimination, and must be taken into account when developing and assessing an FRM strategy. The majority of those impacted by the 2008 flood in Cedar Rapids were the low-income and the elderly. An acceptable flood management strategy must equitably distribute negative impacts of future flooding to avoid disproportionately affecting already disadvantaged residents.

Without FRM, some of the more socially vulnerable populations in the City would remain at risk. These populations are those that have the fewest resources to prepare or recover from a flood, live in the highest-risk locations, have the least access to resources, and lack the political and social connectedness to aide in their recovery.

The City conducted a social vulnerability analysis to identify the vulnerable populations that resided within the flood-impacted area and how these populations were affected as a result of the 2008 flood. Characteristics considered to be associated with the most vulnerable included: minorities, poor, children, elderly, disabled, and female headed households.

Based on 2000 census demographic data for the 19 census block groups that comprise the designated Study area, there is a higher percentage of minorities, disabled, female-headed households, residents using public assistance, and renters within the flood-impacted area than within the City as a whole. The percentage of elderly people is the same for the City and the flood-impacted area.

The Social Vulnerability Profile Analysis was conducted using census data for the 19 flood-impacted block groups to determine if there were any statistically significant vulnerability measures. The results of the analysis showed the following characteristics for the 19 census block groups located within the area impacted by the Flood of 2008. Areas labeled as statistically significant are those that have higher levels of socially vulnerable residents. The percentages would suggest that the majority of the block groups demonstrate high social vulnerability with respect to the assessed characteristics. These populations would likely require different sorts of emergency preparedness and response strategies than low hazard-low vulnerability areas.

- 15 of the 19 Block Groups had a higher percent of residents in poverty compared to the City average, with 2 block groups being statistically significant.
- 14 of the 19 Block Groups had a higher percentage of renter occupied housing units compared to the City average, with 3 block groups being statistically significant.
- 14 of the 19 Block Groups had a higher percentage of elderly residents compared to the City average, with 5 being statistically significant.

- 9 of the 19 Block Groups had a higher percentage of minority residents compared to the City average, with 2 block groups being statistically significant.
- 10 of the 19 Block Groups had a higher percentage of children that are less than 5 years old compared to the City average, with 1 block group being statistically significant.
- 15 of the 19 Block Groups had a higher number of disabled persons compared to the City average, although no block groups were statistically significant.
- 13 of the 19 Block Groups had a higher number of female headed households compared to the City average, although no block groups were statistically significant.

Table 31 presents the social characteristics of the Study area, by reach, to assist with assessing the social equity of plan alternatives. Alternatives 1 and 1A provide flood risk reduction to both sides of the river, which includes all Study reaches. Alternative 4C provides flood risk reduction to the east side of the river only, which encompasses Study reaches 4A, 4B, 5A, 5B, and 5C. This data is taken from the 2000 census and may not reflect current conditions since some of the residents have moved out of these areas following the 2008 flood event.

Table 31. Social Characteristics of Study Area by Reach

Study Area Reach	Total Population	Black Population	Hispanic Population	Asian Population	% of Reach Population Below Poverty Level	Children <16 yrs
2A	405	7	8	0	9	70
2B	3362	93	77	74	11	776
2C	1705	96	51	54	13	392
2D	2434	49	53	12	11	537
4A & 4B	20	0	1	0	10	4
5A	823	63	15	128	24	171
5B	425	102	15	2	37	90
5C	76	5	1	0	24	23

3.2. Future Without Project Condition. * Forecasts of the Future Without Project Condition consider reasonably knowledgeable 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 Condition. Hydrologic, demographic, and economics forecasts are not predicting major changes in the Study area. The floodplain is fully developed and land use is not predicted to change significantly in the Study area. There is developable land within 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 that would lead to changes in hydrologic relationships are expected. Therefore, damage-elevation and elevation-frequency relationships were not altered for the Future Without Project Condition.

The June 2008 flood of record occurred during the initial start of the Study. The City has been recovering since 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 voluntary acquisitions 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 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) plus 1 foot elevation. For Study purposes, "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 means that the homes listed in the City assessor database as substantially damaged by the 2008 flood and located in the FEMA 100 year floodplain were raised to 1 foot above the USACE 100 year floodplain and repaired to pre-flood value and condition in the without project Estimated Annual Damages (EAD) analysis.

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

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.

3.2.1. City's Planning Efforts

3.2.1.1 River Corridor Redevelopment Plan (RCRP). The City has engaged community residents in the creation of the RCRP to provide the framework for recovery and reinvestment in the entire flood impacted area of Cedar Rapids. Residents have participated through a series of public meetings, focus groups, and open houses. The development of the RCRP has been broken down into two phases. Phase One of the plan focuses on flood management strategies to maximize flood damage reduction 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.

Phase Two of the RCRP focuses on neighborhood planning to directly involve the community in planning for reinvestment in the flood-damaged neighborhoods of Cedar Rapids. This 5-month planning process included a community kick-off meeting held in January of 2009, three interactive workshops, and four area meetings to culminate in the presentation of an Action Plan to the Cedar Rapids City Council. The process allowed residents to envision what their neighborhoods would look like in the future. The resulting Area Plan will guide decision-making, establish reinvestment priorities, and provide clear roles and responsibilities for community by addressing six key themes; housing and neighborhood character, transportation and connectivity, recreation and open space, arts and cultural opportunities, business reinvestment, and community services.

The end step in the process of developing the Area Plan is the creation of an Action Plan. While an Area Plan provides the overall vision for the future of the neighborhoods, an Action Plan contains the elements necessary to implement the Area Plan such as specific actions, a timeline for those actions, responsibility for actions, and tools to assist in progress monitoring.

3.2.1.2. Parks and Recreation Master Plan. Residents of Cedar Rapids have also been engaged in the development of a Parks and Recreation Master Plan which will address issues such as parks and open space needs for the community, development and recreational uses for the greenway and riverfront, trails and connectivity between parks, and indoor recreation. The City began the process of developing its first Parks and Recreation Master Plan in 2008 prior to the flooding that occurred in June. In August of 2008, the 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 Parks and Recreation Master Plan was held in June of 2009.

All four major elements of the Parks and Recreation Master Plan—parks and open space, trails, riverfront, and indoor recreation—must work together as entire system. 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, ensuring 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.

There are currently 3,091 acres of named park area, excluding golf courses at 57 sites. The riverfront encompasses approximately 1,700 acres. Of the City's open space and natural areas, 48 percent are within FEMA designated floodplains.

The next steps in the process of creating a Parks and Recreation Master Plan include the development of master plan options utilizing the feedback gathered at the first open house, hosting the second open house on facility and programming options, and presentation of the final Parks and Recreation Master Plan at the third open house.

3.2.1.3. City Plan. In forming the initial Study Team, the City tasked the group with developing and formulating FRM options that would provide the City with FRM measures against the record 2008 event. In doing so, the City Workgroup developed options that would address the FRM issues. The initial planning process led the City to approve a Greenway Acquisition and Construction Area (figure 52) for implementing a City-preferred FRM Plan. The City Plan is outlined in great detail as Strategy 2B in the Flood Mitigation Options Report, March 2009.

The development of the City FRM plan was based on the following assumptions:

- The floodplain would be widened as much as possible through the City corridor taking into account areas such as the downtown site for the new Federal Courthouse on the east bank of the Cedar River, the Police Station on the west bank, bridge approaches, and others as areas where the floodplain cannot be expanded. This assumption also attempts to reconnect parts of the Cedar River floodplain to over bank flows, thus relieving hydraulic pressure on bridges and other areas of the floodplain.

- 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).
- FEMA Hazard Mitigation Grant Program (HMGP) funding will be used to create a greenspace in the Time Check neighborhood (solid block lines in figure 52).
- Housing and Urban Development (HUD) Community Development Block Grant (CDBG) City Funding will be used to acquire properties in construction zone (yellow areas in figure 52.)
- Local-Option Sales Tax (LOST): On March 3, 2009 voters in Cedar Rapids approved a 1 percent sales tax increase which will be used for acquisition and rehabilitation of the flood-damage and tax relief for those properties. The tax will be split with 90 percent for the acquisition and rehabilitation and 10 percent for tax relief. The tax will expire on June 30, 2014, after a total of 5 years and 3 months. Total revenue from LOST is anticipated to be approximately $78.1 million.
- A watershed plan needs to be incorporated at the state and Regional level to help mitigate future watershed hydrology issues. This idea was developed as supplementary to any permanent FRM project in Cedar Rapids, i.e. any future work in the watershed would decrease the risk of the FRM project failing by accounting for more watershed management issues upstream.

The City estimates that a total of 7,198 properties throughout the City were impacted by flooding during the June 2008 event. Approximately 1,200 of these properties were substantially damaged (repair damages of greater than 50 percent of pre-flood market value). The City's cost estimate to acquire these properties is $200 million. The City's recovery efforts include a voluntary property acquisition program funded by two Federal sources and a potential local source (city/state). To date, the City has applied for Federal funds from HUD and FEMA. The City's voluntary acquisition programs activity as of July 30, 2010 include:

HUD (CDBG)
1,211 properties
110 refused to participate
Currently in Duplication of Benefits process with the State of Iowa

FEMA (HMGP)
117 properties
20 refused to participate
96 Purchase Agreement signed
87 closing held

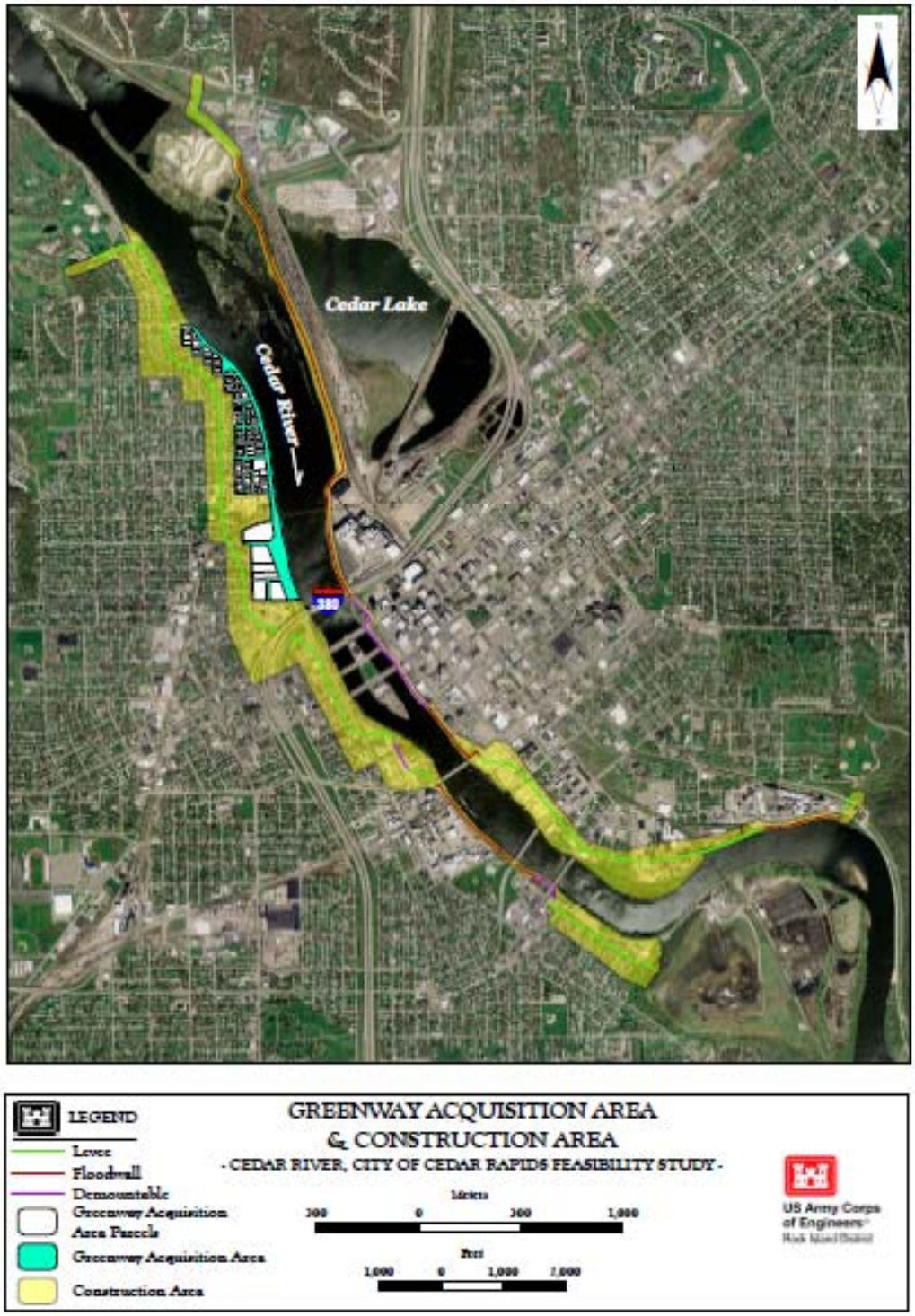


Figure 52. Greenway Acquisition Area and Construction Area (City's Preferred FRM Plan)

3.2.2. Study Area: Damage Reaches

3.2.2.1. Damage Reaches 1 & 6: The City as part of the RCRP developed plans using Federal and local funding to reduce future flood damages in Edgewood and Cedar Valley neighborhoods (figure 53). The plan for both Reaches is to acquire 55 parcels as part of the greenway acquisition and 2 parcels as part of the neighborhood revitalization plans.

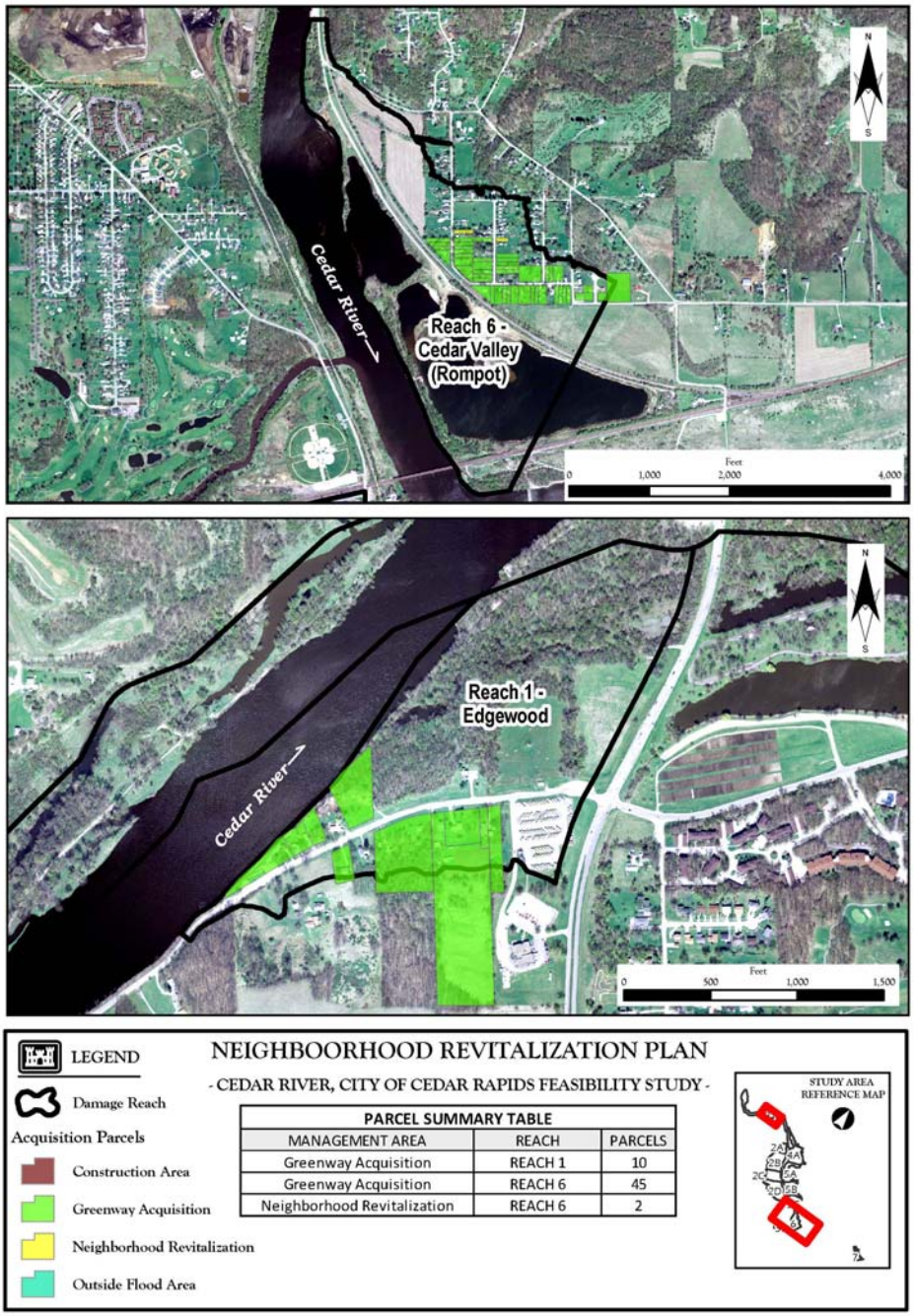


Figure 53. Neighborhood Revitalization Plan – Reaches 1 and 6

Damage Reaches Details: The City has concentrated HMGP funding in the Greenway Acquisition areas for both Reaches. To date, voluntary property acquisitions have occurred in the Reaches.

- **Cedar Rapids Community School District Bus Facility:** 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. There are no further details on the construction timeframe for this project.

- **Morgan Creek Lift Station:** The Morgan Creek Lift Station is located north of Ellis Road NW and west of Edgewood Road. The lift station pumps wastewater from the northwest region and part of northern Cedar Rapids beyond a ridge of high ground and into the collection system south of Ellis Park. It currently serves a population of 12,000 in a service area of 21,700 Acres. It is anticipated that this area will ultimately contain a population of 88,000. In the flood of June 2008, the facility was out of service for 6 days from June 12 to 18, 2008. One pump was restored to service on June 18, 2008. The second pump was restored to service August 12, 2008.

  The Iowa Department of Economic Development awarded a Community Development Block Grant (CDBG) Disaster Recovery Infrastructure contract to the City on November 4, 2009. The City Council approved a measure on December 9, 2009 authorizing execution of the CDBG agreement for funding to restore flood damage and capital improvements at the Morgan Creek Lift Station.

  Proposed work on the lift station includes:

  - Construct a new building adjacent to the existing building to house electrical equipment, restroom, work bench, compressors, and storage area. The size of the building expansion will be approximately 30 by 30 feet.
  - Replace existing pumps with three new 125 hp units.
  - Remove existing transformers and install one new transformer.
  - Install an emergency generator with an aboveground storage tank (1,600 gallons of diesel fuel). The tank would be double-walled and self contained. The emergency generator and tank would be located approximately 700 feet south of the lift station on a parcel of land owned by the Cedar Rapids school district. An underground electric line will connect the generator to the lift station.
  - Replace gravel in the east parking lot with a concrete surface. The surface of the parking lot will be raised to an average elevation of 730 feet (from the existing elevation of 729 feet).
  - Modify the existing berm east of the lift station (raised in some areas and lowered in others) to an elevation of 731.5 feet to provide access to the lift station from the northwest corner of Edgewood Road and Ellis Road NW during a 100-year flood. A 12-foot wide access road with 3.5:1 side slopes is proposed along the path of the existing berm.
  - Expand the security fence to enclose the lift station and parking lot.

- Construct a driveway and turn around area to allow access the lift station building from the west.
- The floor of the new building will be at the same elevation as the existing floor, 732.5 which is 1 foot above the 100-yr flood elevation. The generator will be located across Ellis Road at an elevation of ~ 745, which is ~ 6 feet above the crest elevation of the 2008 flood. The doors on the building addition will be water-tight just like the existing doors. Sump pumps will be replaced with higher capacity pumps and sump pump controls will be replaced to improve reliability. The air compressors used to power the ball valves and operate the pneumatic level control system will be replaced and relocated to the upper floor so they will not be prone to flooding. The new pump motors will be submersible improving the reliability of the system in the event of a flood. The project funding is through a CDBG grant.

- **The Edgewood Bridge Approach:** The City has investigated options to raise the southern flood impacted bridge approach roadway and to completely reconstruct the bridge. The project has been submitted for state funding.

3.2.2.2. Damage Reaches 2A & 2B. The City as part of the RCRP developed plans using Federal and local funding to reduce future flood damages in Ellis Park-North Time Check and the Time Check neighborhoods (figure 54). The plan for both Reaches is to acquire 312 parcels as part of the construction area, 117 greenway acquisition, and 401 parcels as part of the neighborhood revitalization plans.

Damage Reaches Details

- **Time Check Levee:** The Time Check levee as stated previously in Section 3.1 meets no Corps criteria for providing FRM benefits. The levee will continue to be used by the City to flood fight with an unknown level of risk of failure.
- **Cedar Rapids Transit Administration Office:** The office is back in operation since the flooding and is located on the fringe of the new USACE 1 percent chance event.
- **Central Fire Station:** The station services the entire west side of downtown Cedar Rapids and has not been reoccupied since the June 2008 flood. Fire Department services have been temporarily moved to 1010 - 1st Street NW and to a storage shed located at 1825 Edgewood Road SW. The City has determined that the building will not be reused as a fire station. At this time no decisions have been made on a new location.

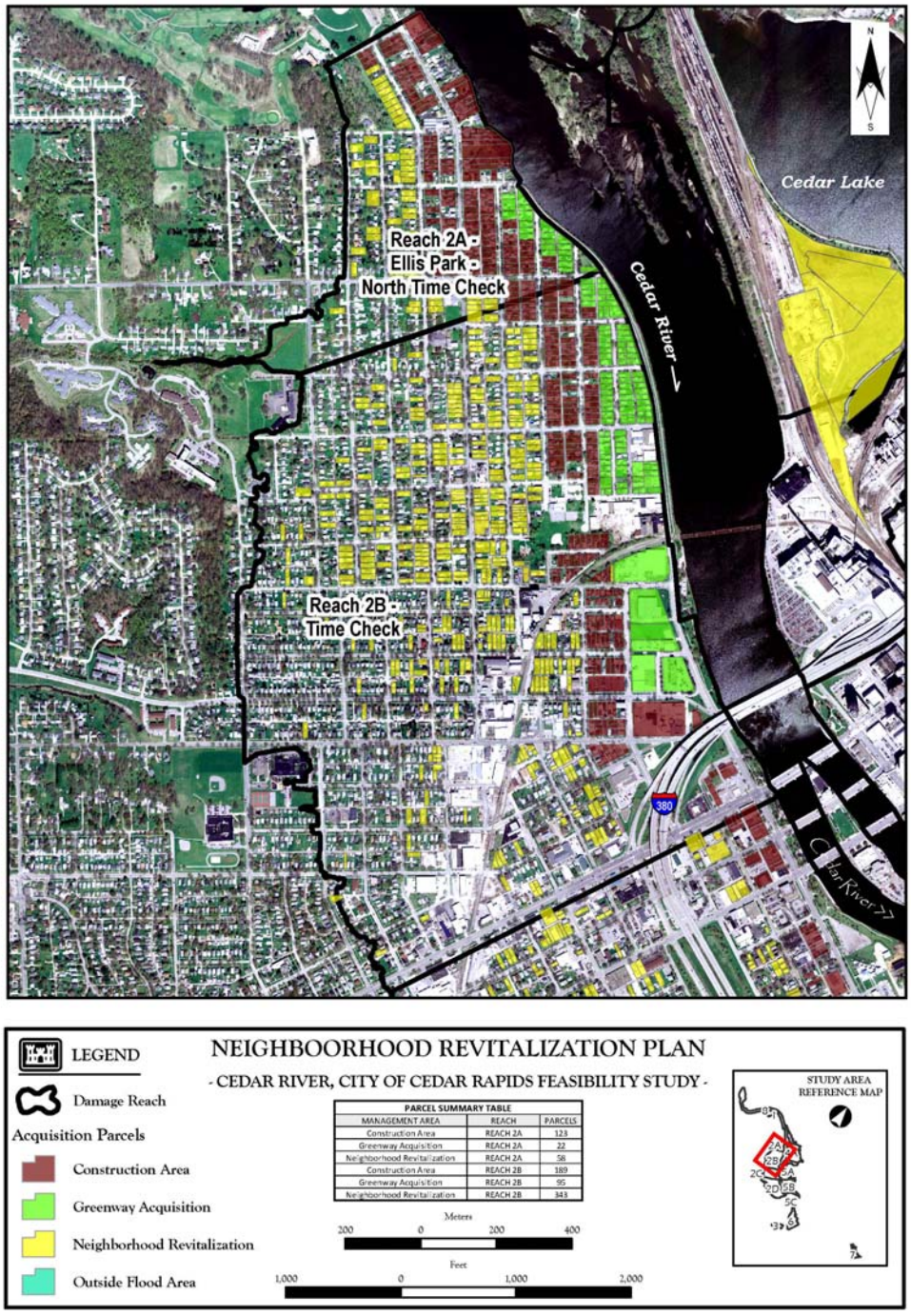


Figure 54. Neighborhood Revitalization Plan – Reaches 2A and 2B

3.2.2.3. Damage Reaches 2C & 2D: The City as part of the RCRP developed plans on using Federal and local funding to reduce future flood damages in Edgewood and Cedar Valley neighborhoods (figure 55). The plan for both Reaches is to acquire 98 parcels as part of the construction area and 358 parcels as part of the neighborhood revitalization plans.

Damage Reaches Details

- **Penford and Czech Village Levees:** The levees as stated previously in Section 3.1 meet no Corps design guidelines or criteria for providing flood risk management. The levees will continue to be used by the City to flood fight with an unknown level of risk of failure.
- **Cedar Rapids Police Department Headquarters:** The departments basement and storage buildings were damaged in the 2008 flood. The plans are to remove any important equipment from the basement and these building to decrease future flood damages.
- **Taylor School:** The school has been reopened after nearly a year of closure.
- **Cedar Rapids Public Works Department:** The building has been reoccupied and all previous services have been re-established.
- **Lynn County Administration Building:** The building is going through a public input planning to determine where the facility will be relocated.
- **Czech & Slovak Museum & Library:** The library is investigating options to relocate the building on adjacent land. The new location for the library could potentially be elevated above the flood level of 2008 and incorporate visitor parking on the ground floor.
- **Czech Village (adjacent to Museum):** Some buildings within this area are listed on the NRHP.

3.2.2.4. Damage Reach 3. The majority of structures in the Prairie Creek Reach are located in the 0.2 percent chance event or greater. Since the flood in 2008, the main facilities have been completing upgrades to the facilities within the Reach. The upgrades include flood proofing the installation of new and existing equipment and raising important utility supplies.

3.2.2.5. Damage Reaches 4A & 4B. The City, as part of the RCRP, developed plans using Federal and local funding to reduce future flood damages in Cedar Lake neighborhoods (figure 56). The plan for both Reaches is to acquire 16 parcels as part of the neighborhood revitalization plans.

Damage Reaches Details

- **Cedar Rapids Potable Water Facilities:** The facilities are located on the edge of the record flooding event of June 2008 and were not significantly impacted. The facilities were not investigated further but have been considered for potential impacts from alternative formulation.
- **Alliant Energy Power Plant:** The facilities will continue to provide steam power to the downtown area.

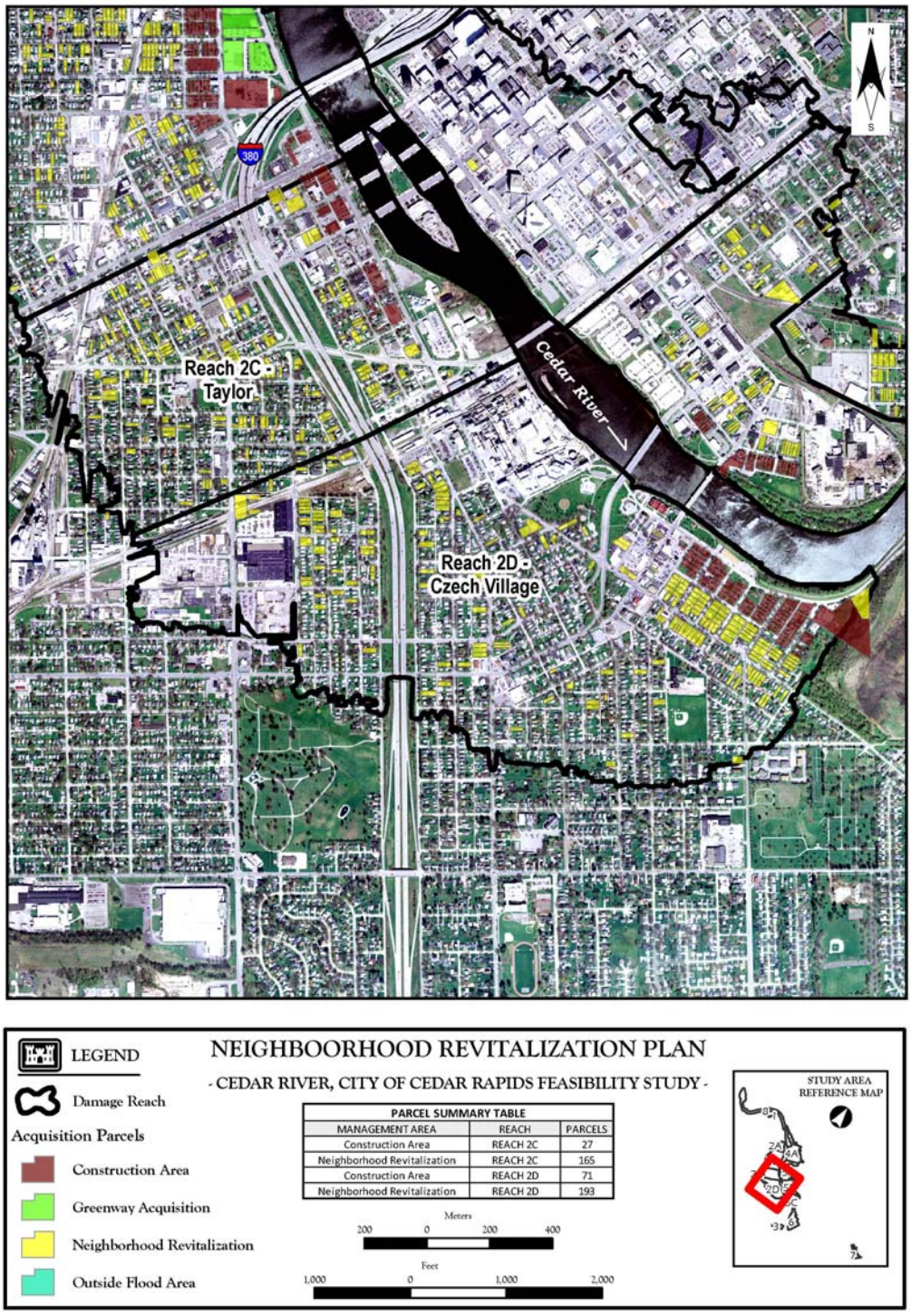


Figure 55. Neighborhood Revitalization Plan – Reaches 2C and 2D

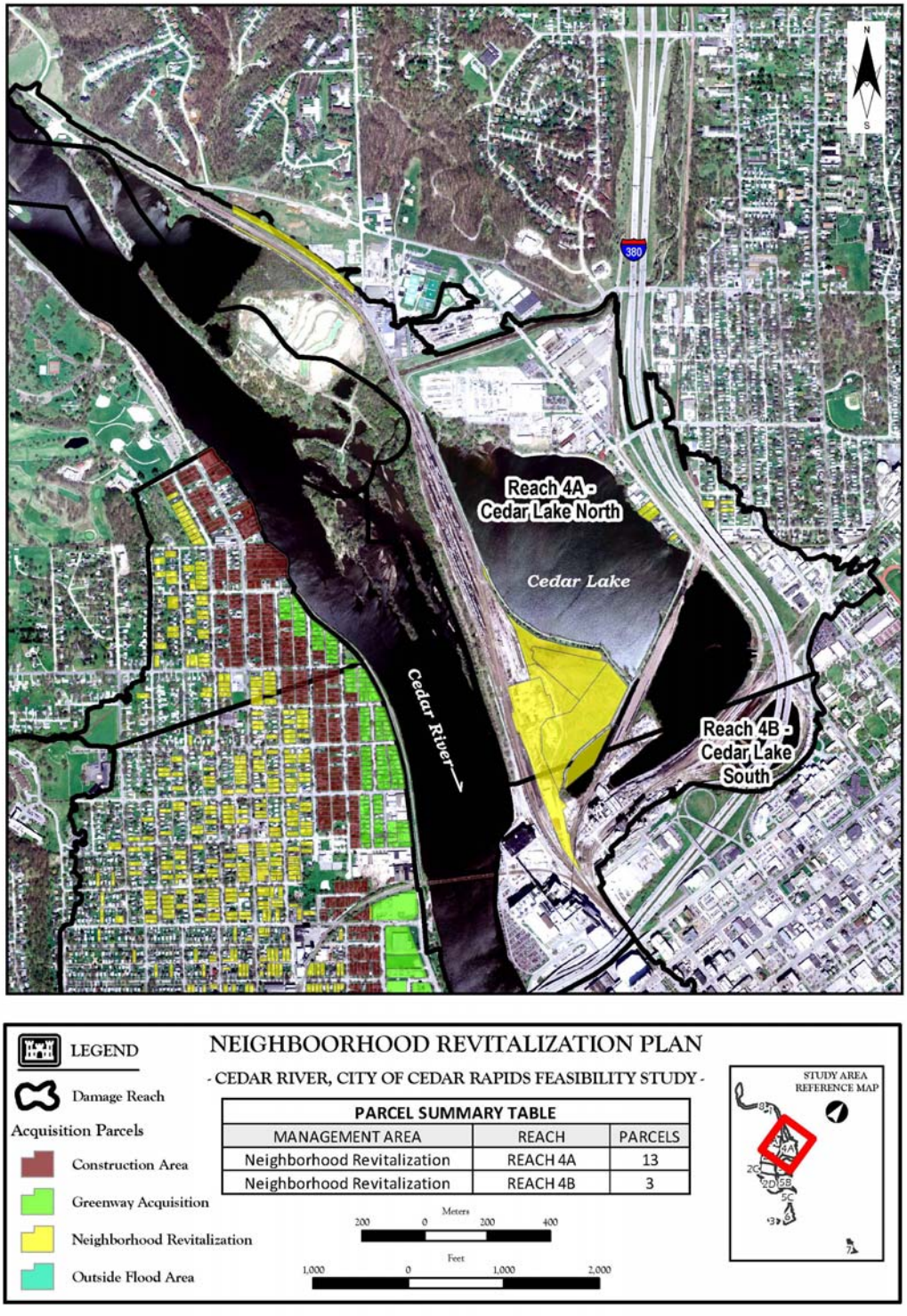


Figure 56. Neighborhood Revitalization Plan – Reaches 4A and 4B

3.2.2.6. Damage Reaches 5A, 5B, & 5C. The City as part of the RCRP developed plans on using Federal and local funding to reduce future flood damages in these Reaches (figure 57). The plan is to acquire 24 parcels in the construction area and 77 parcels as part of the neighborhood revitalization plans

Figure 57. Neighborhood Revitalization Plan - Reaches 5A, 5B, & 5C

Damage Reaches Details

- **Existing Federal Courthouse:** The building was determined to have insufficient space and security. The future use will be to function as part of the City's administration facilities that were formerly located in Veterans Memorial Building on Mays Island.
- **Future Federal Courthouse:** The building will take over all functions from the previous facility. It is being constructed six blocks southwest of the old facilities between 1st Street SE and 8th Avenue. The US General Services Administration has been coordinated with on Study details and timelines. The construction completion date is scheduled for the late summer of 2012. The building should open in the fall of 2012.
- **U.S. Cellular Center:** The center functions as a "the premier entertainment and convention facility in Eastern Iowa." The center is owned by the City of Cedar Rapids and managed by Venuworks.
- **Cedar Rapids Ground Transport Center:** The center has been functioning from a different location south of the main facility. At this time, there have been no determinations on where the transport services will be located.
- **US Post Office:** This facility has resumed pre-flood functions with no plans to relocate.
- **Mercy Medical Hospital:** The hospital is fully operational with no plans for moving services.

3.2.2.7. Damage Reach 7. This Reach includes the WPCF, which provide waste water treatment service to Cedar Rapids and the surrounding communities.

Damage Reach Details. The WPCF provide waste water treatment services to approximately 160,000 people (includes regional contributing communities, City of Cedar Rapids is approximately 125,000). Prior to the June 2008 flood, the WPCF treated an average of 34.5 million gallons per day (mgd) and plant design treatment capacity is 56 mgd.

Pre-flood average flow of 34.5 mgd is approximately three times the total flow expected for a more typical residential wastewater treatment facility. Post-flood comparable average flow per day with minimal changes in population is 52.7 mgd. This significant increase in average daily flow represents modest industrial growth and significant inflow and infiltration due to sanitary sewer damage suffered in the flood.

Industrial flows to WPCF have increased from a pre-flood average per day of 16.3 mgd to a post flood average of 17.5 mgd. Current organic loading levels to the WPCF are 10 times the rate expected from the City[Carbonaceous biochemical oxygen demand (CBOD) lbs/day population equivalent – 23,000 lbs/day, current industrial loading – 243,000+ lb/day]. Average current WPCF CBOD loading is approximately 280,000 lbs/day, representing a population equivalent of 1.6 million people with an actual service area population of approximately 160,000.

This scale of flow and organic loading multipliers is unique in the municipal wastewater treatment industry and further illustrates the commitment the City has made to serve an extensive network of food processing, biotech, and related industries. Some of the products produced by these are facilities are: ready-to-eat cereals; corrugated medium; ethanol; high-fructose corn syrup; industrial enzymes; bakers yeast; starches; oat or soy fiber; ready-to-spread frostings; and pancake syrup. The WPCF

provides an advanced level of treatment through a variety of processes that are necessary for responding to the constantly changing and expanding needs of our industrial and commercial customers. Control and removal of biological solids created during treatment is a key factor for success at this scale of wastewater treatment operations.

3.2.2.8. Damage Reach 8. This Reach includes the City Well Field that provides potable water for the City.

Damage Reach Details

- **Well Fields:** The Seminole well field was initially constructed in 1971, commonly referred to as Lower Seminole [(Vertical Collector Wells (VCW) 1 thru 16]. The well field was expanded in 1991 with the construction of Upper Seminole (VCW 17 thru 23). In June of 2008, all of the operational VCWs were submerged in the flood waters. National Guard helicopters were used immediately following the flood to get a few of these VCWs operational to shore up the water supply. To mitigate the possibility of future flood damage, 10 of the VCWs—1 , 2, 4, 11, 17, 18, 19, 20, 21 and 22—have been raised by 10 feet. The work consisted of extending the casings of each VCW along with the pump columns and shafts, and platform and ladder modifications and electrical work. The other 36 VCWs will be raised in a series of projects.
- **2008 Flood Impacts:** The well fields supply 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 (HCW) were lost from service when the flood waters inundated the transformers 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 mgd to only the J Avenue plant during the flood. As average water demand in the City is around 38 mgd, 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 return to service of HCW 4, 2 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 HCW 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 HCWs had replacement motor control gear installed within 5 weeks of the flood. It took about 2 months to address repairs to all of the vertical well motors. One of the three damaged collector wells is still awaiting repairs.

3.2.2.9. Damage Reach 9. Located in the center of downtown Cedar Rapids, the island has four main facilities from north to south – Cedar Rapids City Hall; a City-owned underground parking garage; the Linn County Courthouse; and the Linn County Corrections Facility.

Damage Reach Details

- **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:** The underground parking facilities are being repaired and will be in service in the future.
- **Linn County Courthouse:** The County has plans and funding in place to provide nonstructural flood proofing measures to the building (utilities to a level above the 2008 flood event). 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.

3.2.3. Relevant Resources. This section will describe the Future Without Project Condition for the Study area. Issues identified through the scoping process or resources that potentially could be affected by the Study are:

- **Natural Resources**
- **June 2008 Flood Recovery**
- **Hydrology**
- **Created Resources**
- **Floodplain Management**
- **Recreation**
- **Hazardous, Toxic, Radioactive Waste (HTRW)**
- **Cultural Resources**
- **Socioeconomic Resources**

3.2.3.1. Natural Resources. The Study area supports an assortment of songbirds/neotropical migrants typical for any large Midwestern urban area. Two active eagle nests exist near the confluence of McLoud Run and the Cedar River. This same backwater complex serves as a resting area to migratory waterfowl. These avian resources are not expected to change significantly without this FRM project.

McLoud Run is the only urban trout stream in Iowa. No lasting adverse impacts were realized as a result of the 2008 flood. The fishery in the Cedar River is diverse and is consistent with other Iowa river fish populations. Cedar Lake is currently listed as a Category 5a Impaired Water by the IADNR. This is based on a Fish Consumption Advisory issued by Region 7 US EPA for Total PCB's 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. The river also supports a freshwater mussel community and has been the site of Higgins' Eye pearly mussel (*Lampsilis higginsi*) releases (federally-endangered). The fishery resources of McLoud Run, the Cedar River, and Cedar Lake are not expected to change significantly without the implementation of this FRM project.

3.2.3.2. June 2008 Flood Recovery. There is a high degree of uncertainty in defining the Future Without Project Condition. Project schedule necessitates the use of assumptions (example: starting Phase 1 HTRW /other data collection before final measure screening) to define these conditions for the project Study area. In June 2008, 10 square miles of the City, including the entire downtown and

nearby neighborhoods, were inundated due to a record breaking river stage of 31.6 feet (4 to 5 feet above the 500-year event). Flooding caused the evacuation of 20 percent of the City's population. Although the City is fully committed to the Study, it could not defer all recovery decisions until the Study is completed. This pro-active approach creates uncertainties in information available for the Corps' planning process.

3.2.3.3. Hydrology. Development along the Cedar River and the watersheds above Cedar Rapids 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 the future condition (year 2059).

3.2.3.4. Created Resources. Created resources include man-made modification to the landscape; in this Study, the created resources are directly related to urban development.

3.2.3.4.1. Transportation. Since the flood event in June of 2008, the City has spent a great deal of time and resources in developing new and innovative plans for changing and upgrading the transportation services. As part of the RCRP, transportation issues were addressed by analyzing transit, freight railroads, bridges, streets and parking, and pedestrian/bicycle pathways. New recommendations were made for future planning purposes and incorporated in this section.

Transit. A benchmarking analysis for Cedar Rapids Transit (CRT) and 15 peer transit properties was performed based on Federal National Transit Database (NTD) reporting. Based on the information derived from NTD, CRT must be credited for providing its services as effectively as it does. The following transit improvements were recommended:

- **Renew Bus Fleet.** With the average age of CRT's bus fleet over 18 years, compared to the 12-year useful service life of a transit bus, the CRT bus fleet must be renewed. The acquisition of five or six new buses per year is recommended.
- **Renew Bus Garage or Consolidated Fleet Facility.** The CRT bus garage is well beyond its useful service life, so a new replacement facility will be needed.
- **New Intermodal Transfer Facility Site.** The Corridor MPO is evaluating potential ITF sites located between 4th and 7th Streets SE and 4th and 7th Avenues SE. Progressive Service Improvements - incremental improvement of fixed-route bus service including greater frequencies, service spans, weekend service, express bus service, and bus rapid transit is recommended.
- **Downtown Circulator.** The potential exists for a new downtown circulator bus route linking the Cedar Rapids Medical Center area to the central business district and possibly to the west side or the river.
- **Intercity Commuter Bus.** The feasibility of intercity commuter bus service between Cedar Rapids and Coralville/Iowa City is recommended to be evaluated.

Freight Railroads. A major recommendation of the Vision Cedar Rapids Downtown Framework Plan (May 2007) was to reduce or eliminate the impacts of freight railroad operations

along the 4th Street Corridor in downtown Cedar Rapids. As part of the RCRP effort, potential options for reducing and removing freight railroad traffic from the 4th Street Corridor were identified.

Based on previous work by the City, potential freight railroad improvements were developed to address the 4th Street Corridor issues. These potential improvements are shown in figure 58 and are discussed as follows:

Potential Freight Railroad Improvement Projects

Quiet Zones. Crossings that are closely-spaced, such as the avenues crossing the 4th Street Corridor, can be addressed as a group in considering them for quiet zone status. Given the typical traffic volumes, it is unlikely that gates and flashers would be sufficient to reduce the risk at some of these crossings. Supplemental safety measures (SSMs), such as four-quadrant gates or medians, are more likely to be required in this case.

New UP-CRANDIC Connection North of Wilson Avenue SW. The new connection between the UP and CRANDIC railroads has a conceptual capital cost of $2 million. The Wilson Avenue SW connection and crossover are anticipated to be located on railroad-owned land, so no land acquisition costs are included.

New UP-CRANDIC Connection at 3rd Street SE and 10th Avenue SE. A new connection between the UP and CRANDIC has a conceptual capital cost of $6.4 million. The UP tracks would have to be acquired. In addition, trackage rights agreements between the UP and CRANDIC railroads would be necessary.

Realign Connections at UP, CN, and Industries Using Existing UP Bridge. Realigned track connections at the east end of the Cedar River bridge between the UP-Cedar Rapids Industrial Lead (CRIL) tracks and the UP North Yard, CN Yard, Alliant, and Quaker Oats facilities would realign the connections between the rail lines and the local industries, so that cars to/from ADM could be interchanged via a route that no longer requires the use of the UP-CRIL via the 4th Street SE right-of-way. A conceptual cost of $6.4 million was estimated for these improvements. This cost estimate does not include any earthwork or track construction or other costs associated with relocating the UP North Yard further to the north to replace capacity lost by the new connections or the CN yard further to the east.

New Realigned UP Bridge over Cedar River. A new, ballasted-deck, double-track bridge realigned on an angle to the northeast of the Quaker Oats elevator building would replace the existing UP truss bridge over the Cedar River that was constructed in 1898. In order for this concept to be successful, it would be necessary to reestablish connections to UP North Yard, CN Yard, Alliant, and Quaker Oats facilities. Removal of the existing bridge is anticipated to cost approximately $4 million, while construction of the new bridge would cost approximately $31 million. New track across the bridge would add over $910,000 to the project cost. This cost estimate does not include the cost of the approach work on either end of the bridge or the reconfigured connections to North Yard, the CN or any of the industries in that general area.

New UP Third Main Track. A new third running track (136# rail) along UP Boone Subdivision for a distance of 4.8 miles from the east end of Beverly Yard (approximately Edgewood Road SW) to Otis Road SE would be constructed. This improvement provides an alternative means for delivery of cars to/from Cargill's SE side facility so as to not tie up one of the existing main line tracks. Holding tracks of an approximate 24-car capacity would also be constructed near Otis to allow for staging of cars destined for Cargill. Conceptual cost is estimated to be $105 million.

Discussions are currently underway with the freight railroads to identify a set of freight railroad improvements for which to seek funding assistance. Additional improvements such as upgrading and double tracking of the UP-CRIL from west of the UP downtown bridge to the UP Beverly Yard have been identified.

Bridges. Due to the limitations on transportation that the closures to the Edgewood Road, 1st, 2nd, 3rd, 8th, 12th, and 16th Avenue Bridges (figure 58), the City would like to investigate ways to provide continued access across the Cedar River in times of flooding. The bridge closures severely impacted ambulance, police, fire services, and others. More detailed hydraulic modeling with the recommended Cedar Rapids flood management strategy is required to determine the flood mitigation benefits of removing, consolidating, or raising the elevation of these bridges. At the same time, detailed traffic and engineering studies will be needed to determine the traffic operations impacts of these options and how high these bridges could be raised, recognizing the impact to the bridge approaches and adjacent land uses.

Edgewood Road Bridge. The Public Works Department is exploring potential concepts for addressing the flooding of the Edgewood Road Bridge over the Cedar River. In particular, the need exists to raise the elevation of the south approach to the bridge from south of Ellis Road NW. The Public Works Department has alternative concept plans for the Edgewood Road Bridge and south approach improvements.

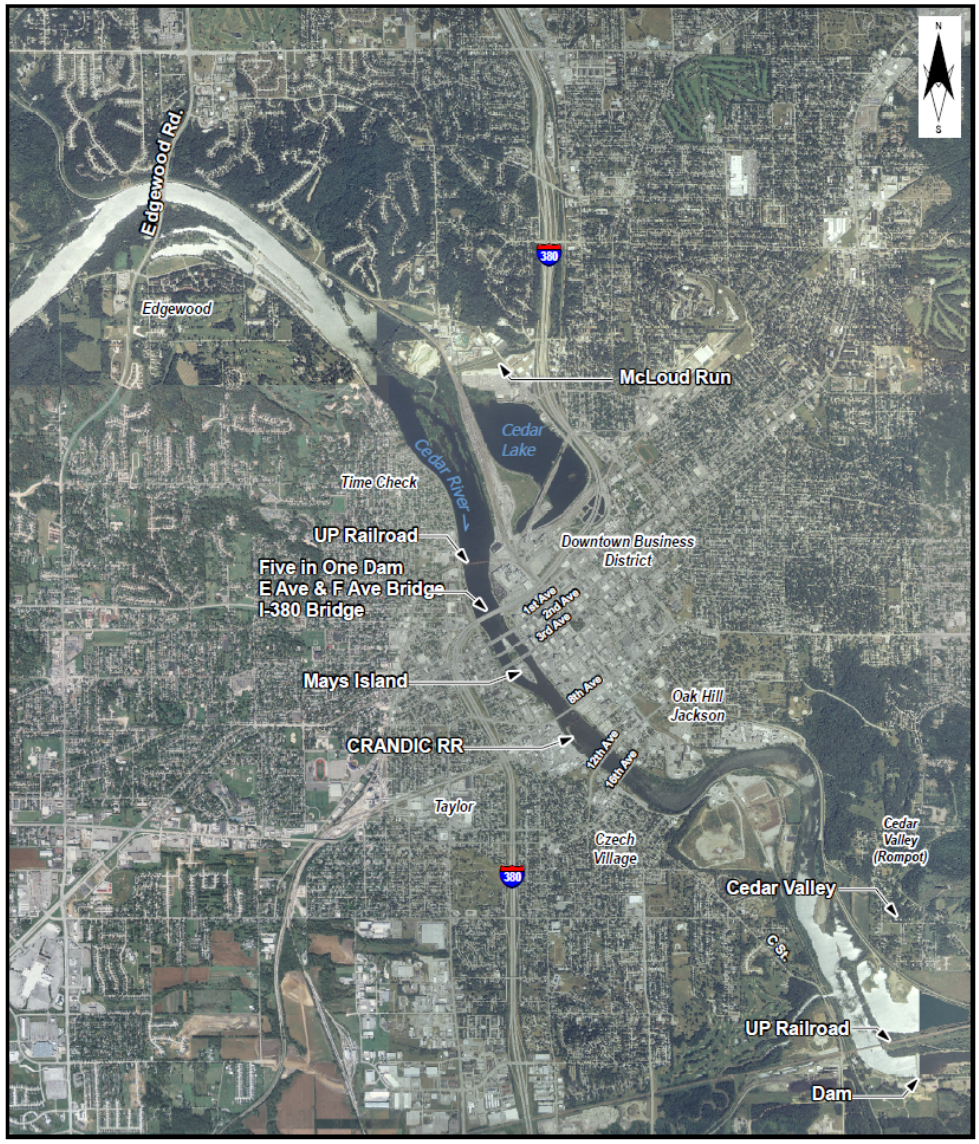
Southwest Arterial Bridge. The Public Works Department is exploring potential concepts for a new Cedar River bridge crossing. This proposed new bridge crossing, referred to as the Southwest Arterial is located approximately half way between downtown Cedar Rapids and US-30/US-151, and would connect C Street SW and Otis Road SE just south of the UP mainline. An additional advantage of the proposed Southwest Arterial Bridge is the elimination of two at grade railroad crossing of the UP. The Public Works Department has alternative concept plans for the proposed Southwest Arterial Bridge.

I-380 Realignment. The section of I-380 through the downtown area was examined for potential realignment. Concerns have been raised about the safety of the I-380 section through downtown because of the tight turning radii and the crashes that have occurred in the vicinity of the reverse-curve section. A concept involving the realignment of the I-380 Bridge over the Cedar River to the north and improving the curvature of the section to 4 degrees was developed. The estimated conceptual cost for this realignment of I-380 exceeds $215 million. This cost estimate excludes land acquisition, residential/commercial acquisition, demolition, environmental mitigation, enhancements, removal of existing I-380, and existing roadway relocation. The City has recommended that as part of the an upcoming Iowa Department of Transportation (IDOT) study, the alignment of I-380 through Cedar Rapids be reassessed.

Highway 100 Bridge. The Iowa DOT is studying the extension of Highway 100. The proposed Highway 100 Extension is included in the 2040 Transportation Plan for the Cedar Rapids Metropolitan Area. The Iowa DOT has recently completed the Final Environmental Impact Statement for the project.

Sinclair Bridge. The Public Works Department has explored a proposed new bridge crossing, referred to as the Sinclair Bridge. This concept is generally located at the south tip of downtown and would connect the Sinclair site area (former meat packing plant) at 3rd Street SE to generally follow the former UP freight line to the southeast, crossing the Cedar River, and eventually

connecting with C Street SW. This potential new bridge concept must be reviewed for compatibility with the recommended flood mitigation strategy and in concert with decisions on the 2nd and 3rd Avenue Bridges.



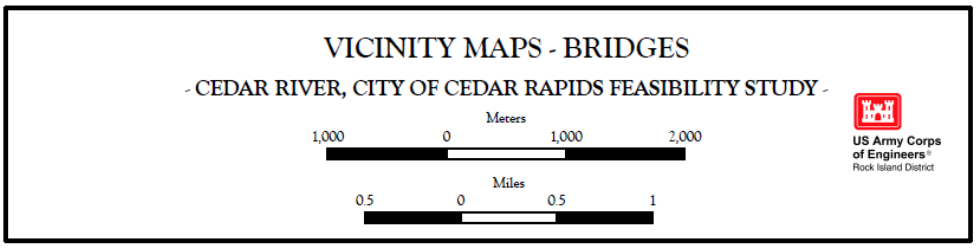


Figure 58. Vicinity Maps – Bridges

Streets and Parking. As stated in the Vision Cedar Rapids Downtown Framework Plan (May 2007), the current street network in Downtown Cedar Rapids was designed mainly to handle large volumes of traffic generated by the retail activity in the 1980s. Improvements are desired in visual character, comfort, and convenience so as to create an economically healthy, vibrant, aesthetically-enhanced, and pedestrian-friendly downtown area. Potential improvements include:

- converting one-way streets to two-way operations;
- improving aesthetics by developing signature streets and boulevards;
- providing on-street parking;
- providing street continuity; and
- providing greater access to the riverfront.

The City's Consultant Group recommends that 1st Avenue be converted to a Grand Boulevard. A street comprises the entire three-dimensional visual corridor, including the public realm and how it relates to the adjacent land uses. Special emphasis is placed on streets that service and take into account all users, not just motor vehicles. The following are recommended characteristics of a 1st Avenue Grand Boulevard:

- accommodating multiple users and connect to the broader street network
- accommodating social interaction, encourage pedestrian activity, or serve as a social network
- using hardscaping, landscaping, street furniture, or other physical elements to create a unique personality and capture a sense of public space
- capitalizing on building design, scale, architecture, and proportionality
- benefitting from community involvement and participation (festivals, parades, open-air markets, etc.)
- reflecting the local culture or history
- providing interesting visual experiences, vistas, natural features, or other qualities
- utilizing green infrastructure or other sustainable strategies

The Cedar Rapids metropolitan area is investigating the concept of "Complete Streets." Complete Streets are designed and operated to enable safe access for all users. Complete Streets policies are intended to make a community's streets work for drivers, transit riders, pedestrians, and bicyclists, as well as for older people, children, and people with disabilities. In addition, to help implement Complete Streets in local neighborhoods where traffic issues exist, it is recommended that Cedar Rapids consider the use of traffic calming techniques. Traffic calming techniques are typically used to increase pedestrian safety and to better integrate pedestrian and bicycles in to the roadway system.

Provision of adequate parking amenities is essential for the economic health and vitality of downtown Cedar Rapids. The 1st Street Parkade is unlikely to re-open, resulting in a loss of 369 off-street parking spaces or 8 percent of public off-street parking spaces. The City should continue to monitor public and private parking supply and usage as the Downtown area redevelops to ensure sufficient capacity exists for downtown area land uses, including cultural, business, retail, and residential activities.

3.2.3.4.2. Infrastructure and Utilities. The impacts and damages to the City's infrastructure are still being analyzed and descriptions are still being made. Presented in this section is the documentation of the City's facilities planning process that was completed under guidance from the City and outlined in the RCRP (December 2008).

Plans to floodproof utilities impacted from the recent flooding should be paramount in the City's short and long range FRM planning. The utilities at risk include electric, gas, water, sewer, fiber-optic network and other general services. Further information will be included as more data becomes available.

3.2.3.5. Floodplain. Recent projections show that Linn County is one of four counties in Iowa that show an upward trend in population. The population increase may result in further development in the floodplain areas. In addition to placing more people in and damageable property at risk of flooding, such urbanization affects the potential flood management system by increasing impermeable surfaces, increasing flood peak flows and volumes, reducing floodplain storage, reducing groundwater recharge, and increasing non-point pollution from runoff. Continued urban development within the floodplain could make future changes to the "footprint" of the potential flood management system.

A comprehensive watershed plan is also being proposed by multiple Federal, state, and local agencies to combat FRM, ecosystem restoration, and land use issues. This plan would incorporate watershed wide restoration measures that reduce runoff, increase infiltration, reduce sediment delivery, and restore the natural hydrology to the system. Ultimately, comprehensive Floodplain and Watershed Management plans need to be implemented on a local and regional scale.

3.2.3.5.1. Management. The Study will evaluate existing and potential floodplain management programs and measures that could be implemented in Cedar River Corridor. The potential modifications considered include those that could be implemented locally, such as floodproofing structures, and programs that could be implemented basin-wide, such as educational programs or flood risk mapping to encourage more appropriate land use in the floodplain.

The NFIP, administered by FEMA, and other programs have significantly contributing to reducing flood damages through regulation of the floodplain. However, flood risk will rise as population in the regulatory floodplain grows and land adjacent to regulated areas is developed. Some of the causes of continued flood risk include:

- encroachment of urban development in the floodplains, sometimes aggravated by limitations of and non-compliance with NFIP and state floodplain management guidelines;
- the lack of updated floodplain and floodway maps that reflect changes in flood hydrology and channel geometry;
- approval of projects that do not address negative impacts or effects outside the immediate project area;
- deferred channel and levee maintenance;
- the lack of funding for FRM projects and voluntary acquisition programs for repeatedly flooded structures; and

- the lack of understanding or awareness of the actual risk of flooding, both within and outside of the regulated floodplain.

3.2.3.5.2. Residual Risk. With the City's current system of levees, risk of flooding from unexpected problems, larger floods, or uncertainty associated with the stability of the existing levees will always remain. Information about the threat of flooding needs to be communicated throughout the Study area in a manner that will broaden the current level of understanding.

3.2.3.6. Emergency Preparedness. The potential flood management system could include flood warning and response features that provide information to emergency response personnel throughout the river basin. Additional data collection and dissemination features, along with improvements in current weather forecasting capabilities, could lengthen warning time and increase opportunities to implement flood fighting capabilities.

3.2.3.7. Watershed Management/Urbanization. Increased agricultural practices and urbanization can increase impervious areas, reducing percolation and increasing rainfall runoff. Studies have shown that increased land development is accompanied by an increase in both peak flow and runoff volume, with the greatest increases observed in runoff volume. Urbanization has the greatest effect on more frequent storm events (more frequent than the 4 percent event), and the location of the urbanization within the watershed influenced its effect on runoff flows and volumes. Development within the basin over the next 50 years is not expected to alter the discharge-frequency curve at Cedar Rapids. For these reasons, the discharge-frequency curve for the existing condition is applicable for all levee alternatives and for the future condition (year 2059).

3.2.3.8. Iowa-Cedar Rivers Comprehensive Plan. On March 10, 2010 a multi-agency watershed team conducted their second official meeting to discuss a framework for collaboration and development of a watershed based plan that will coordinate on-going watershed planning efforts in the Iowa-Cedar Rivers Basin through multiple avenues. The purpose of this Study is to formulate a comprehensive watershed plan and process for interagency collaboration to address water resource and related land resource problems and opportunities in the Iowa-Cedar Rivers Basin in the interests of increasing social and economic value, increasing ecological integrity, and managing risk. The Study objectives are to:

- develop a definitive vision for the watershed that addresses sustainable management of water and natural resources of the Iowa-Cedar Rivers Basin for multiple purposes; balances economic, environmental, and social values; and manages risk;
- formulate a watershed plan exemplifying the vision;
- develop a process for managing the Iowa-Cedar Rivers Basin through coordination, collaboration, and partnership toward achievement of the vision;
- develop a system for managing data and information;
- develop a process for ongoing public outreach and involvement; and
- develop strategies for implementing the watershed plan.

The Study will focus on the following assessment areas:

1. Floodplain Management
2. Water Quantity and Allocation

3. Water Quality
4. Fisheries, Wildlife, and Native Vegetation
5. Water-Based Recreation
6. Urbanization
7. Agriculture
8. Energy Production
9. Cultural Resource Preservation

This planning effort will focus on creating a collaborative process that will identify resource problems and identify which entity is best suited to address this concern through their authority or charter. Within this collaborative framework entities may study a single aspect of a larger watershed plan without being dependant on other entities funding mechanisms.

A Project Management Plan (PMP) has been developed by the Corps of Engineers with interagency input that outlines the roles and responsibilities for each of the group members as well as any interested stakeholders. A draft PMP was presented to the interagency team in early July and was well received. The revised PMP is not a final version yet but provides adequate guidance and structure to begin the watershed plan. Two public involvement sessions are scheduled in December 2010, one each for the Dry Creek and Dry Run Creek watersheds.

3.2.4. Recreation. The City has identified plans to enhance and further develop recreational opportunities along the Cedar River corridor as outlined in the Cedar Rapids - Framework Plan for the Reinvestment and Revitalization. The City is currently refining and further developing recreational plans.

3.2.4.1. Pedestrian Paths. Creating a walkable and pedestrian-friendly environment is critical for the vitality of downtown Cedar Rapids. Walkability has been identified as one of downtown Cedar Rapid's greatest need in the Vision Cedar Rapids Downtown Framework Plan (May 2007). Bicycling as a mode of transportation can reduce the number of short trips that are too long to be walked yet too short for efficient use of a car. National travel analysis suggests that 40 percent of trips are less than 5 miles, which is a distance well-suited for bicycle use.

Potential improvements to be considered include the following:

Sidewalks. To facilitate pedestrian activity, Cedar Rapids should add new sidewalks where links are missing, and widen existing sidewalks, as appropriate. Other important issues to consider when reviewing and planning for new sidewalks include:

- pavement quality, which is a factor for encouraging use as well as limiting potential liability from injury;
- providing wider sidewalks in commercial districts or town centers, because they are more inviting than narrow, crowded sidewalks;
- protection from moving traffic, including shoulders, a slightly higher elevation, a row of parking, or trees and planters; and
- signage or striping to make motorists aware of the pedestrian space, especially at conflict points such as when sidewalks cross curb cuts.

Median Islands and Curb Extensions. Median islands create a safe waiting place for pedestrians when crossing a major street. At corners, curb extensions shorten the street crossing distance for pedestrians. Both median islands and curb extensions help increase pedestrian safety when crossing streets.

Mid-block Crossings. Mid-block crossings are best for locations with very heavy pedestrian and vehicular traffic and long block lengths. Mid-block pedestrian crossings provide additional safe access for pedestrians by creating a designated crossing point.

Traffic Speed Reduction. Fast moving traffic acts as a deterrent to pedestrian activity and makes walking more dangerous and less enjoyable. To slow down vehicles, Cedar Rapids can implement a number of tactics, including:

- converting driving lanes to parallel parking;
- planting trees and other landscaping along the roadside;
- encouraging buildings to be constructed closer to the street rather than behind a parking lot;
- altering the road surface approaching pedestrian crossings; and
- adding additional speed bumps and speed tables in the roadways.

Provide Pedestrian Amenities. Pedestrian amenities can make the experience of walking more interesting and enjoyable. Benches or ledges give people a place to rest, talk and people-watch, and should be distributed widely. Attractive, human scale lighting helps provide a pleasant aesthetic and a sense of security. Trees, planters, hanging flower baskets, City banners, and brick pavement all make a pedestrian environment more attractive.

3.2.4.2. Bike Paths. The City is in the process of identifying potential locations to modify current roadway design to accommodate and encourage the use of bicycles as a viable option for commuters. Important issues to increase bicycling as a mode of transportation is to ensure that there are accessible destinations, reachable on safe facilities with secure parking at the destination. Potential improvements to be considered are:

Multiple-Use Paths/Trails. The Cedar Rapids metropolitan area has an extensive existing and planned trail network that is documented in the 2040 Transportation Plan. Many of these trails consist of converted unused rail corridors for pedestrian and bicycle use.

Bicycle Lanes. On-street bicycle lanes are the most common and convenient facility for bicyclists to use. These designated bicycle lanes should be at least 5 feet wide. Appropriate amounts of right-of-way are needed to create bicycle lanes and striping and signage designate the lane. For streets that are unable to support a separately striped bicycle lane, the use of “sharrows” is an acceptable form of indicating that bicyclists and motorists should share the lane.

Signing and Striping. On the road, striping and marking a bicycle lane clearly delineates a cyclist lane from vehicle lanes, or a “sharrow” indicates that bicyclists

and motorists should share the traffic lane. Similarly, traffic signs are necessary for increasing bicyclists and driver's awareness of each other's presence.

Bicycle Parking. Bicycle parking is a key component of encouraging bicycling. Parking should be secure, with designated areas and sufficient bicycle racks or lockers. Sheltered bicycle parking is preferable. Bicycle racks in high traffic areas should be visible, designed to store many bicycles without damage and enable bikes to be locked using a variety of lock types. Lockers are secure, protect bikes from weather and vandalism or theft, and can be placed in underutilized space.

Bicycles on Transit. Many transit agencies have purchased and installed bicycle racks on their bus vehicles. The most common practice is to mount a bicycle rack on the front of the bus. Front mounted racks typically carry two bicycles.

3.2.5. Hazardous, Toxic, and Radioactive Waste (HTRW). It is not anticipated that any HTRW concerns would be addressed in the Future Without Project Condition.

3.2.6. Cultural Resources. If no project is feasible, recommended, or supported, there would be no undertaking and no Federal interest in the Study area. To date, 122 historic structures have been identified in Study area. Fifty of these are located within the boundaries of three historic districts. If no Federal project is completed, these structures will be subjected to future inundation by flood waters. The likely result may be the eventual loss of structural integrity leading to the demolition of the structures. In addition to the loss of individual structures, if too many structures are demolished within the identified historic districts, it could result in the delisting of districts.

With regards to archaeological historic properties within the Study area, in a Future Without Project Condition, the impacts would not be as severe. Currently, since the majority of archeological sites are buried and protected by the built environment, archeological historic properties are fairly well protected from inundation and erosion.

3.2.7. Socioeconomic Conditions. Under Future Without Project Condition, the City would remain much as it is today, and no plans to alleviate flooding problems or concerns would be explored. The City will likely explore planning efforts to keep the status quo. Furthermore, the Future Without Project Condition would not meet the City's objective for sustainable development that ensures environmental, economic and social well-being of its citizens.

Cedar Rapids sits in a more vulnerable economic position today than before the flood. Without flood risk management, future recovery and progress remains uncertain. Residents and business owners would be forced to make decisions on relocating or rebuilding before the future of the area is fully determined. Many of the flood-impacted neighborhoods and areas would redevelop at a much slower pace than desired. The quality of life would be adversely impacted by the loss of multi-generational neighborhoods, the arts and cultural community, the historical heritage districts, business and employment opportunities, and the continued stress of not knowing if another major flood will occur.

Sustaining another flood without an FRM alternative would leave lasting scars on the City, its residents and businesses, and would decrease the possibility of a full recovery in the future.

As the City 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.

As a large Midwest economic center, the City's ability to retain and attract a capable qualified workforce for major employers is critical to remaining competitive. If another flood occurs, maintaining the assets needed to retain and attract this workforce could be an issue.

Although some businesses have returned, or are in the process of returning, to the Downtown District, many owners and investors are cautious about making such commitments until FRM issues are resolved. One of the significant factors that would determine success for business recovery is the ability to rebuild investor and developer confidence by providing flood risk from another flood. However, if another flood occurs, experience indicates many of these businesses and industries would simply go out of business or relocate, significantly damaging the City's economic viability. Without complete flood risk management, future flooding would continue to haunt the downtown as is creates a cycle of more blighted properties, discouraging growth and the ability to meet the City's full potential.

Without proper flood risk management, and without permanent flood support, the cultural community would have to overcome substantial barriers to the recovery and return of historic buildings, the visual and performing arts, and the cultural spirit of the community. Losses in these areas adversely affect the quality of life that is important to the community and important for attracting and retaining a strong work force.

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. Without the commitment of flood risk management, some of these very core neighborhoods could remain a blighted area for a very long time and possibly never able to rebound.

Flooding destroyed a vast majority of the affordable housing stock that was within some of the most core neighborhoods within the City of Cedar Rapids. Over 1,200 units were damaged in these areas, leaving a major void in the affordable housing market. Without the certainty of a future FRM system, it is reasonable to assume that perhaps half of all residential development impacted by the flood would not return to the flood-impacted area, and instead might relocate to the City's greenfield areas.

Over 1,400 housing units are being voluntarily acquired and demolished as part of the overall flood management strategy. The issue at hand is where redevelopment would occur. Without reliable FRM 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 more sustainable solution for the City, and rebuilding long-standing neighborhoods promotes community cohesion, the efficient provision of governmental services, and utilizes existing infrastructure. 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.

The City strives to recover from the 2008 flood but remains in a precarious position while waiting for a determination on the future of flood risk management. 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. Without an FRM alternative, plans for reinvestment in the flood-impacted area would be forced to undergo a complete renovation, and their vision may never fully be realized as development, both commercial and residential, would be unwilling to move into an area that remains at risk of future flooding. Reinvestment and redevelopment in the flood-impacted area might be overlooked in favor of greenfield development.

The ability to provide medical services for residents along both sides of the river is of the utmost importance. Closure of major east-west connector routes became a serious concern during the 2008 flood event. Both of the City's main medical facilities are located on the east side of the river and residents along the west side of the river were unable to gain access to these facilities. Without future flood risk management, this is a scenario that is in danger of being repeated. Emergency response times and access for emergency vehicles are serious concerns that demand a flood management strategy be in place.

Mental health and stress related issues from a traumatic event such as the Flood of 2008 create a huge impact on those who work and live in Cedar Rapids. City records show that family finances and resources have declined due to the flood and economy, family stress is up as many families are still in limbo about their homes, and some students have not yet been able to return to their homes and neighborhoods. Loss of housing, relocations, additional costs of living and emotional stress are, unfortunately, effects that could be felt throughout the community again if a flood management strategy cannot be put in place.

Without flood risk management, future recovery and progress remains uncertain. Residents and business owners would be forced to make decisions on relocating or rebuilding before the future of the area is fully determined. Many of the flood-impacted neighborhoods and areas would redevelop at a much slower pace than desired.

A good example of a future With Project scenario for Cedar Rapids is the City's preferred flood management strategy that was created as a result of the post-flood public participation process. Alternatives 1 and 1A most closely reflect their preferred flood management strategy. This strategy promotes a framework for providing a comprehensive approach to flood management that includes structural measures to protect the downtown and residential neighborhoods and promote revitalization and redevelopment while complimenting the City's property acquisition initiative to remove people from the impact of future flooding. A combination of floodplain greenway with levees and floodwalls would offer flood risk management on both sides of the river through the City and the conversion of low-lying properties to greenway park would provide public recreational space.

The strategy also identified nonstructural measures including improvements to evacuation planning, interim flood risk management, flood proofing, and flood warning systems. The preferred strategy creates an environmentally just community by protecting both sides of the river and taking into account the low-income, working class neighborhoods that were the most impacted by the Flood of 2008 and are at the most risk from future flooding.

Redevelopment to meet community expectations requires implementation of an FRM project. Cedar Rapids has taken a comprehensive approach to flood management and has developed a multi-pronged FRM strategy and a strong vision for the future of the City. Strategic recovery goals for future flood risk management and recovery planning include: improving FRM measures to better protect homes and businesses; rebuilding high-quality and affordable workforce neighborhoods; restoring full business vitality; preserving arts and cultural assets; maintaining historic heritage; retaining and attracting the next generation workforce.

City officials and residents feel that the key to their future is environmental, economic and social sustainability. Protecting the City core on both sides of the river would help reduce sprawl, enable more sustainable redevelopment, contribute towards attracting a next-generation workforce, and improve community cohesion by using the river to join the City. Rebuilding within the City core also promotes social sustainability as families are encouraged to move back to the multi-generational neighborhoods where they have built personal relationships with fellow citizens.

Following the devastating flood event the community quickly united to embark on a flood recovery process to determine future flood risk management and recovery planning. Community leaders and citizens realized that minimizing future flood risk was an essential piece of reinvestment and recovery in Cedar Rapids. The River Corridor Redevelopment Plan, a product of a City-wide public participation process, outlines the City's flood management strategy to minimize future risk and improve the City's relationship to the Cedar River. Another significant community involvement effort was the Neighborhood Planning Process. 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.

All future planning by the City involves having FRM measures in place to protect both sides of the river. Providing adequate flood damage reduction along both the eastern and western banks of the Cedar River would enable residents to return, rebuild, and reestablish. It is only with this sort of security and long-term commitment that community cohesion can be expected to grow.

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, 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. Social sustainability is the concept that future generations should have the same or greater access to social resources as the current generation

The Greenway contributes to a sustainable flood damage reduction strategy by contributing to flood management and by improving the ecological health of Cedar Rapids. The Greenway can help to create economic value for the City and contribute positively to economic development. By helping to retain current residents and attracting a next-generation workforce, the Greenway would be efficient and cost-effective to maintain rather than being a burden to the City. However, the Greenway would simply not exist without the implementation of the preferred flood management strategy. Without this multi-purpose buffer between river and City, Cedar Rapids would miss the opportunity to develop a much-needed component of their sustainable, multi-pronged strategy for flood management.

The City's desire for future flood risk management for all residents is to ensure that all people are afforded the same degree of protection from environmental and health hazards. The City's preferred flood management strategy provides flood damage reduction for residents and businesses located along both sides of the river within the flood-impacted area. This strategy ensures that no group is disproportionately affected by future flood events.

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 events that may cause bridge and road closures and affect response times. The health and safety of its citizens is always a foremost concern of any City administration. A FRM plan would reduce health risks and improve safety, and would be expected to result in an improvement to the quality of life in Cedar Rapids.

It is evident that the City is actively employing multiple strategies for FRM through collaboration with entities at the local, state and Federal level. The City is dedicated to a full recovery aligned with a preferred FRM strategy and will continue to work towards this shared vision of flood recovery.

4.0. PLAN FORMULATION/ALTERNATIVES *

This section describes the development of alternative plans that address the planning objectives and the evaluation and comparison of those plans. It also describes the Recommended Plan and its implementation requirements.

4.1. Plan Formulation Rationale. * A wide array of FRM features, measures, and alternatives plans were developed to address one or more of the planning objectives. The Study followed the Corps of Engineers' six-step planning process specified in Engineering Regulation (ER) 1105-2-100. The process identifies and responds to problems and opportunities associated with the Federal objective and specified State and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step. This allows the interested public and decision makers to be fully aware of the basic assumptions employed; the data and information analyzed; the areas of risk and uncertainty; and the significant implications of each alternative plan. The steps used in the plan formulation process are outlined as follows:

1. Identify Problems and Opportunities. The specific problems and opportunities are identified, and the causes of the problems discussed and documented.

2. Inventory and Forecast Resource Conditions. This step characterizes and assesses existing conditions in the project area and forecasts the most probable Future Without Project Condition—hereinafter referred to as the "No Action Alternative"—over the period of analysis. The No Action Alternative is what the area and its uses are anticipated to be like over a 50-year period of analysis without any implemented project as a result of this Study. The With Project Condition is what the area and its uses are anticipated to be if FRM measures are implemented. This assessment gives the basis by which to compare various alternative plans and their impacts.

3. Formulate Alternative Plans. Potential features are proposed to meet the identified objectives. Specific design measures are developed for these features. These measures are combined into alternative plans in a systematic manner to ensure that reasonable alternatives are evaluated.

4. Evaluate Alternative Plans. The evaluation of effects is a comparison of the Future With Project Condition and Future Without Project Condition of each alternative. The evaluation is conducted by assessing and measuring the differences between each Future With Project Condition and Future Without Project Condition by appraising those differences.

5. Compare Alternative Plans. Alternative plans, including the No Action Alternative plan, are compared against each other with emphasis on the outputs and effects that will have the most influence in the decision making process. The comparison step can be defined as a reiteration of the evaluation step, with the exception that in this step each plan is compared against each other and not against the Future Without Project Condition.

6. Select Alternative Plan. A single alternative plan is selected for recommendation from among all those plans that have been considered. The culmination of the planning process is either a Recommended Plan or the decision to take no action. The alternative plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment, the NED Plan, shall be selected. 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.

4.2. Plan Formulation Results. The Study's plan formulation is best described in terms of iterations of the planning process. Multiple iterations of the process were needed to evaluate the large array of possible solutions proposed to solve the water resource problem. Figure 59 summarizes the iterations, the criteria used to evaluate and compare alternatives, the results of evaluation and comparison steps, and ultimately, the identification of the Recommended Plan.

4.2.1. Planning Process Iteration One. Based on the identified problems and opportunities, project goals, objectives, and potential features were formulated. From July 2008 through March 2009, the City Workgroup (City's consultant group and Corps representatives) developed goals and objectives (table 28) and gathered existing information to determine what management features would address the goals and objectives. The primary goal of the Iteration One was to reduce the array of potential features through evaluation and comparison of the features. This section describes this process. The product of this process was a smaller array of features to take through another iteration of the process.

4.2.1.1. Inventory and Forecasting. Periodically throughout the Study, the team held In Progress Reviews (IPRs) to exchange and vet information with the City, the Project Delivery Team (PDT), and Corps Headquarters. The Future Without Project assumptions are essential to the analysis and were detailed during IPR meetings. The key assumptions for this iteration were:

- The Study areas used are as defined in Section 3.1.
- The Future Without Project and Existing Conditions are dynamic as the City recovers from the 2008 record flood event but the Study team must use a static set of criteria in order to proceed with the analysis.
- The use of an existing HEC-RAS (1991 FEMA-FI) model, modified to account for updated flow frequency data, is acceptable for analysis purposes.
- Use of Flood Mitigation Options-March 2009 as the basis for screening is acceptable.
- The FEMA actions (HMGP) will effect alignments in the Study area.

4.2.1.2. Formulation of Features. In general, features are types of actions that accomplish the objectives when implemented. Features are broad categories of measures that form the basis for formulating specific and detailed measures. They are considered over arching themes that highlight the types of actions that would solve the problem. Table 32 shows the array of features that were formulated in Iteration One.

4.2.1.2.1. No Action. The District is required to consider the option of "No Action" as one of the alternatives in order to comply with the requirements of the NEPA. With the No Action Alternative, it is assumed that no project would be implemented by the District to achieve the planning objectives. The No Action Alternative forms the basis against which all other alternatives are measured.

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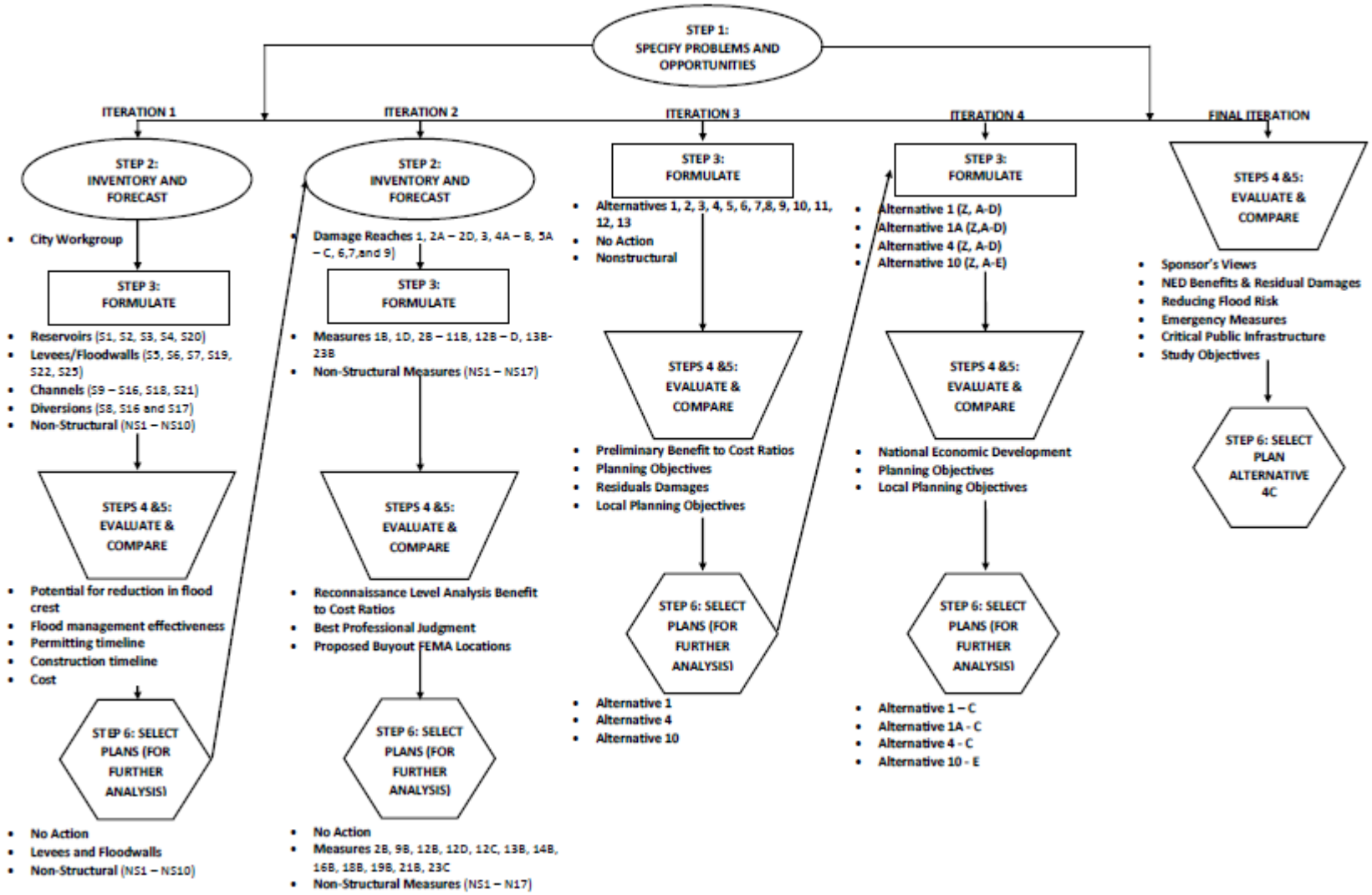

Figure 59. Study Planning Process

Table 32. Project Goals, Objectives, and Potential Features

Goal	Objectives	Potential Features
1. Reduce the existing and future flood risk and damages to public and private infrastructure and facilities in the City.	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	**No Action** **Structural:** Reservoirs; Floodwalls/Levees; Diversions; Dredging; Channel Modification; Island Removal; Canals; Bridge and Dam Modifications; Diversions; Tunnels **Nonstructural:** Floodproofing Structures (wet & dry); Agricultural Land Policies; Voluntary Acquisition; Flood Warning; Land Use Regulations & Zoning; Building Codes; Evacuation Plans; Elevate/Relocate Structures; Ring Levees; Flood Response Plan; Community Rating System; Flood Insurance; Relocation of Displaced Persons; Purchase Land Development Rights; Floodplains Management Plan; Community Flood Response Education
2. Provide recreational opportunities (ancillary to FRM project)	4. Increase recreational opportunities in the City along the Cedar River that are compatible with an implementable FRM plan.	Bike/Pedestrian Trails, Amphitheater, Interpretive Center, Parking Lots, Scenic Vistas

4.2.1.2.2. Structural Features. Structural features reduce flood risk by modifying the characteristics of the flood. They are often employed to reduce peak flows (flood storage); direct floodwaters away from flood prone property (flood barriers); or facilitate the flow of water through or around an area (channel modifications or diversions). All of these features have the potential to reduce flood damages; however, not all are likely to be economically justified. Following is a list of structural features that were considered:

Reservoirs. This features involves storing runoff to reduce flows in the river
single or multiple structures

Levees and Floodwalls. These features involve construction of physical barriers to direct floodwaters away from property and structures such as:
Short levee segments
Continuous levee
Floodwalls
Invisible floodwalls
Gate closures
Pump stations

Channels. This feature involves modification of existing channel capacity such as:
Dredging the river channel
Channel Modification
Remove Islands
Build Canals
Bridge Modification
Dam Modification

Diversions. This feature involves increasing conveyance of floodwaters by creating such structures as:
Diversion channels around the Study area
Tunnels

4.2.1.2.3. Nonstructural Features. Nonstructural features reduce flood risk by modifying the characteristics of the buildings and structures that are subject to floods or modifying the behavior of people living in or near floodplains. In general, nonstructural features do not modify the characteristics of floods nor do they induce development in a floodplain that is inconsistent with reducing flood risk. Some nonstructural features that can be formulated into nonstructural measures include removing buildings from floodplains by relocation or acquisition; flood proofing buildings; placing small levees, berms or walls around buildings; implementing flood warning and preparedness activities; and implementing floodplain regulation. The NFIP is considered among nonstructural features since it contains programs to provide minimum standards for floodplain regulation, to provide flood insurance, and to provide flood hazard mitigation. One nonstructural feature that is being implemented by the City, is utilizing funds provided by FEMA, HUD, and LOST for voluntary acquisition of flood prone properties closest to the Cedar River. In addition, public and private entities are concentrating efforts floodproofing buildings and associated utilities. The District is required to develop and present at least one action that is primarily nonstructural in nature. Nonstructural features will also be considered for integration with structural features to maximize effectiveness of all

alternatives. Following is a list of features that were considered (detailed descriptions are included in Appendix P, *Nonstructural Measures*):

- Flood proof Structures by Dry Floodproofing Methods
- Flood proof Structures by Wet Floodproofing Methods
- Incorporate Agricultural Lands Policy (Watershed Management)
- Voluntary Acquisition of Structures
- Develop Flood Warning System
- Land Use Regulation and Zoning
- Develop New Building Codes
- Develop Evacuation Plans
- Elevate Structures
- Relocate Structures
- Single Structure Levee/Floodwall
- Flood Response Plan
- Community Rating System
- Flood Insurance
- Relocation of Displaced Persons
- Purchase Land Development Rights
- Floodplain Management Plan
- Community Flood Response Education

4.2.1.3. Evaluation and Comparison of Features. Each feature that was evaluated and compared was given an alphanumeric label for ease of tracking. The letter "S" designates a structural feature. The letters "NS" designate "Nonstructural" features. The following features were formulated, evaluated and compared in this iteration:

- Reservoirs (S1, S2, S3, S4, S20)
- Levees/Floodwalls (S5, S6, S7, S19, S22, S25)
- Channels (S9 – S16, S18, S21
- Diversions (S8, S16 and S17)
- Nonstructural (NS1 – NS10)

Each feature may accomplish more than one objective. Table 33 shows the proposed features and associated objectives that each feature addresses.

Table 33. Objectives Accomplished by Feature

	Study Objectives (see table 32)			
Iteration One: Features	**1**	**2**	**3**	**4**
Reservoirs (S1, S2)	x	x		x
Flood Retention/Detention Basins (S3, S4, S20, Mini Basins)	x	x		x
Levee/Floodwalls (S5, S6, S7, S19, S22, S25)	x	x		x
Channels (S9A, S9B, S10, S11A, S11B, S12A, S12B, S13, S14, S15, S16, S18A, S18B, S21)	x	x		x
Diversions (S8A, S8B, S17, S16)	x	x		
Nonstructural (NS1-NS10)	x		x	

The City Workgroup, including the Corps, formulated criteria to be used to evaluate and compare the features:

- **Potential for Reduction in Flood Crest:** The 100-year, 500-year and 2008 flood results are from the existing HEC-RAS model. The change in water surface elevation varies along the entire reach of the Cedar River, so a range is provided for the potential reduction. Negative numbers indicate the measure causes an increase in the water surface elevation.
- **Flood Management Effectiveness (versus 2008 event):** The percentage is calculated by dividing the 2008 potential reduction by 12 feet. The depth of floodwater experienced downtown at 2nd Avenue was approximately 12 feet. This was used as a rough estimate to quickly compare options. The floodwalls / levees of Measures S5, S6 and S7 prevent flooding on the dry side; the assumption is that flood management effectiveness is set to 98 percent. The percentages are for individual measures and are not meant to be added together for cumulative effects.
- **Construction Timeline:** An estimate of the total time required for design, permitting, acquisition of property, utility relocations, demolition and construction.
- **Permitting Timeline:** Estimate of the total time required to obtain permits based on the complexity of the measure and type of studies required for the permits.
- **Cost:** Cost estimates are based on conceptual level of design. Quantity take-offs were completed on each measure and unit costs used to find the cost of each item. Land acquisition and right-of-way cost to build and maintain the measure are included along with an estimate of permitting costs.

The results of the evaluation and comparison of the features are shown below in table 34. The table shows the quantification of each criteria and which features were dropped from further consideration. In addition, the following information explains the screening of the features presented:

- **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.

- **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.

- **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.

- **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.

- **Screening of Bridge and Approaches - S10, S11A, S11B.** Elevating either 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 I-380).** 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 Study.

- **Screening of Construct Lift Bridge Spans - S13.** Bridges include 1st, 2nd, 3rd and Railroad near 16th Avenue. 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. Similar to 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 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 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. T he 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 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.

- **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 Study.

- **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.

Table 34. Iteration One – Results of Evaluation and Comparison of Features [1]

Feature	Description	Potential Reduction in Flood Crests: 100-yr, 500-yr, 2008 (Range in ft)	Flood Mgmt Effectiveness Compared to 2008 Flood	Construction Timeline	Permitting Timeline	ROM Cost Estimate (2008 Level of Protection)	Comments	Removed from Further Consideration
S1	Locate Large Reservoir Upstream	3.4 to 5.7 6.4 to 9.3 8.7 to 11.8	98%	Nearly 50 yrs	3-5 yrs	$600,000,000		X
S2	Locate Multiple Reservoirs Upstream	7.0 to 10.7 5.7 to 8.2 4.8 to 5.7	47%	40 - 50 yrs	3-5 yrs	$920,000,000		X
S3	Use Cedar Lake for Flood Storage	0 to 0.2 0 to 0.1 0 to 0.1	1%	10 - 20 yrs	1-3 yrs	$41,000,000		X
S4	Use Jones Golf Course as Retention / Detention Basin	0 to 0 0 to 0 0 to 0	0%	10 - 15 yrs	1-3 yrs	Not Effective for Flood risk management		X
S5	Construct FRM Measures (Floodwalls / Levees) at River's Edge	0 to -0.8 0 to -2.4 0.0 to -3.8	98%	10 - 15 yrs	1-3 yrs	$260,000,000	Floodwalls/Levees increase the water surface elevations throughout the City and	X
S6	Construct FRM Measures (Floodwalls / Levees) Offset from River at 100-yr Elevation	0 to -0.1 0 to -0.9 0 to -1.5	98%	10 - 15 yrs	1-3 yrs	$186,000,000	Floodwalls/Levees increase the water surface elevations throughout the City and upstream.	
S7	Construct FRM Measures (Floodwalls / Levees) Offset from River at 500-yr Elevation	0 to 0 0 to -0.2 0 to -0.3	98%	10 - 15 yrs	1-3 yrs	$188,000,000	Floodwalls/Levees increase the water surface elevations throughout the City and upstream.	
S8A	Build Diversion Channel Around Cedar Rapids (East Route)	3.4 to 5.7 6.4 to 9.3 8.7 to 11.8	98%	20 - 30 yrs	3-5 yrs	$5,600,000,000	Option is based on a concrete lined channel with a 330 ft top width, 1:1 side slopes, and 20 ft of water depth.	X
S8B	Build Diversion Channel Around Cedar Rapids (West Route)	1.2 to 5.7 2.0 to 9.3 2.5 to 11.8	98%	20 - 30 yrs	3-5 yrs	$2,800,000,000	Option is based on a concrete lined channel with a 350 ft top width, 1:1 side slopes, and 20 ft of water depth.	X

Feature	Description	Potential Reduction in Flood Crests: 100-yr, 500-yr, 2008 (Range in ft)	Flood Mgmt Effectiveness Compared to 2008 Flood	Construction Timeline	Permitting Timeline	ROM Cost Estimate (2008 Level of Protection)	Comments	Removed from Further Consideration
S9A	Increase Cedar River Channel Cross Section by Dredging	0 to 0.4 0 to 0.3 0 to 0.2	2%	10 - 20 yrs	1-3 yrs	$26,000,000	Option is based on dredging the bottom of the river from the Five in One dam to south side of landfill.	X
S9B	Increase Cedar River Channel Cross Section by Widening Channel	0 to 3.8 0 to 3.3 0 to 3.2	27%	10 - 20 yrs	3-5 yrs	$333,000,000	Option is based on widening the river channel to a bottom width of 700 ft from the Five in One dam to south side of the landfill.	X
S10	Elevate CRANDIC Railroad Bridge Above 2008 Flood Crest	0 to 0.2 0 to -0.1 0 to -0.2	0%	10 - 20 yrs	Less than 1 yr	$7,300,000	CRANDIC railroad bridge is located downstream of 8th Avenue. Elevate bridge superstructure above 2008 flood crest.	X
S11A	Elevate all Bridges and Approaches Above 2008 Flood Crest	0 to 1.6 0 to 1.2 0 to 0.6	5%	10 - 20 yrs	Less than 1 yr	$105,000,000	Bridges included: UP railroad upstream of I-380, 1st, 2nd, 3rd, 8th, CRANDIC RR, 12th, 16th & CRANDIC railroad downstream of 16th.	X
S11B	Elevate Select Bridges Above 2008 Flood Crest	0 to 1.2 0 to 1.0 0 to 0.4	3%	5 - 10 yrs	Less than 1 yr	$63,000,000	Bridges included: 1st, 2nd, 3rd, & railroad downstream of 16th.	X
S12A	Demolish Buildings and Remove Mays Island	0 to 0.7 0 to 0.5 0 to 0.3	2%	10 - 15 yrs	1-3 yrs	$182,000,000	Flood crest reduction occurs upstream of Mays Island.	X
S12B	Remove Island Upstream of I-380	0 to 0.8 0 to 0.7 0 to 0.6	5%	10 - 15 yrs	3-5 yrs	$44,000,000	Flood crest reduction occurs upstream of island.	X
S13	Construct Lift Bridge Spans	0 to 1.7 0 to 1.6 0 to 1.3	10%	10 - 20 yrs	Less than 1 yr	$109,000,000	Bridges included: 1st, 2nd, 3rd, & railroad downstream of 16th.	X
S14	Replace Five in One Dam Gates With Rubber Dams	0 to 0.2 0 to 0.3 0 to 0.4	3%	5 - 10 yrs	1-3 yrs	$14,000,000	Flood crest reduction occurs upstream of dam. Additional reduction may be possible if dam operation is considered.	X

Feature	Description	Potential Reduction in Flood Crests: 100-yr, 500-yr, 2008 (Range in ft)	Flood Mgmt Effectiveness Compared to 2008 Flood	Construction Timeline	Permitting Timeline	ROM Cost Estimate (2008 Level of Protection)	Comments	Removed from Further Consideration
S15	Provide Rubber Dam at South to Maintain Water Elevation During Low Flow	Negligible	0%	5 - 10 yrs	1-3 yrs	$12,000,000	Operation can lower dam in advance of a flood for a negligible effect on the crest.	X
S16	Construct a Tunnel Parallel to Cedar River Through Cedar Rapids Corridor	0 to 1.3 0 to 0.8 0 to 0.7	5%	10 - 15 yrs	1-3 yrs	$300,000,000	Option is based on four tunnels with 20- ft. diameter	X
S17	Build Diversion Channel Through Downtown Cedar Rapids	0 to 2.8 0 to 2.6 0 to 2.2	18%	10 - 15 yrs	1-3 yrs	$140,000,000	Option is based on a concrete lined channel 100 ft wide, vertical walls, and 20 ft of water depth.	X
S18A	Elevate Edgewood Road With Increase in Opening	0.2 to -0.1 0.2 to -0.2 0.2 to -0.3	0%	2 - 5 yrs	Less than 1 yr	$29,400,000	Minor increases anticipated in water surface elevations upstream of the bridge.	X
S18B	Elevate Edgewood Road With Same Opening	0 to -0.3 0 to -0.5 0 to -0.7	0%	2 - 5 yrs	Less than 1 yr	$25,000,000	Increases in water surface elevations anticipated upstream with no additional openings.	X
S19	Introduce FRM Measures Around Mays Island	0 to 0.0 0 to 0.1 0 to 0.1	0%	2 - 5 yrs	Less than 1 yr	$26,500,000	Protects only facilities on Mays Island.	X
S20	Use Chain Lake Wildlife Area for Flood Storage	0 to 0 0 to 0 0 to 0	0%	10 - 15 yrs	1-3 yrs	Not Effective for FRM		X
S21	Increase Channel Capacity by Removing "Pinch Points" on Either Side of Corridor	0 to 0.7 0 to 0.7 0 to 0.7	5%	10 - 15 yrs	1-3 yrs	$37,000,000	Channel improvements at two locations.	X
S22	Construct FRM Measures (Floodwalls / Levees) at Cedar Valley Neighborhood	Negligible	0%	10 - 15 yrs	Less than 1 yr	$22,000,000	Flood management effectiveness includes reduction only on the Cedar River, not on local reduction on the dry side of the FRM measure	X
S23	Construct Additional CMP Culverts in UPRR at C Street	0 to 0.0 0 to 0.1 0 to 0.1	0%	5 - 10 yrs	Less than 1 yr	Not Effective for FRM	Add 5 114-inch CMP culverts to the existing three 114-inch CMP culverts in the railroad embankment.	X

Feature	Description	Potential Reduction in Flood Crests: 100-yr, 500-yr, 2008 (Range in ft)	Flood Mgmt Effectiveness Compared to 2008 Flood	Construction Timeline	Permitting Timeline	ROM Cost Estimate (2008 Level of Protection)	Comments	Removed from Further Consideration
S24	Build Canal Through West Side of Cedar Rapids	0 to 3.6 0 to 3.2 0 to 2.9	30%	10 - 15 yrs	1-3 yrs	$232,000,000	Option based on a concrete lined canal with 240 ft top width, vertical sides, and an average depth of 20 ft.	X
S25	Construct FRM Measures (Floodwalls/Levees) at Ellis Rd West of Edgewood Rd	Negligible	0%	10 - 15 yrs	Less than 1 yr	$22,000,000	Flood management effectiveness includes reduction only on the Cedar River, not on local reduction on the dry side of the FRM measure	X
----	Remove All Bridges - Sensitivity Analysis	0 to 2.9 0 to 2.8 0 to 2.4	20%	----	----	----	Remove all bridges from Edgewood Road - the Union Pacific Railroad at C Street. This shows maximum possible FRM for removing bridges.	X
----	Remove Dams - Sensitivity Analysis	0 to 0.3 0 to 0.4 0 to 0.5	4%	----	----	----	Remove the Five in One Dam and dam south of UPRR at C Street. Shows maximum possible FRM for removing dams.	
NS1	Floodproof Structures by Dry Floodproofing Methods	None	0%	1 - 2 yrs	Minimal- (City permit)	Cost per residence: Option 1 - $32K Option 2 - $24K	Method effective only if floodwaters rise/fall rapidly. Effective for homes w/out basements. Cost assumption for 4000 sf residence. **Option 1 -** Replace interior/exterior building materials with water resistant materials. **Option 2 -** Place earthen berm around house perimeter of against HDPE house wrap.	

Feature	Description	Potential Reduction in Flood Crests: 100-yr, 500-yr, 2008 (Range in ft)	Flood Mgmt Effectiveness Compared to 2008 Flood	Construction Timeline	Permitting Timeline	ROM Cost Estimate (2008 Level of Protection)	Comments	Removed from Further Consideration
NS2	Floodproof Structures by Wet Floodproofing Methods	None	0%	1 - 2 yrs	Minimal- (City permit)	Cost per Residence $30 K	Based on relocating appliances / utilities from basement. Cost includes addition of a utility room on the house.	
NS3	Incorporate Agricultural Lands Policy (Watershed Management)	Varies depending on extent of implementation of new programs and expansion of existing programs	Varies	Varies	Varies	Varies	Size of watershed upstream of Cedar Rapids is 6,510 sq miles. Effectiveness, construction, permitting and cost vary depending upon implementation of new programs and expansion of existing programs.	
NS4	Acquire Heavily Damaged Structures	Negligible	1%	1 - 2 yrs	Iowa DNR Asbestos Removal Notification for Demolition	Varies - dependent upon assessed values. Estimated to be approximately $22/sf of property	Cost assumption that a structure is on the property	
NS5	Develop Flood Warning System Along Cedar Rapids Corridor	None	0%	2 - 5 yrs	None	$50K/gage station	Assume new gage station. Cost does not include annual O&M cost.	
NS6	Develop Zoning and Planning Along Cedar Rapids Corridor (Stormwater Management)	Varies depending on extent of implementation	Varies	1 - 2 yrs	None	Varies	Reduction will be local and not likely to affect Cedar Rapids crest.	
NS7	Develop New Building Codes Along Cedar Rapids Corridor	None	0%	1 - 2 yrs	None	----	Reduction will be local and not likely to affect Cedar Rapids crest.	
NS8	Develop Evacuation Plans Along Cedar Rapids Corridor	None	0%	----	None	----	See City's Flood Response Plan for Evacuation Map	

Feature	Description	Potential Reduction in Flood Crests: 100-yr, 500-yr, 2008 (Range in ft)	Flood Mgmt Effectiveness Compared to 2008 Flood	Construction Timeline	Permitting Timeline	ROM Cost Estimate (2008 Level of Protection)	Comments	Removed from Further Consideration
NS9	Elevate Structures	None	0%	2 - 5 yrs	Minimal- (City permit)	**Approx. Cost per Residence** Raise 4' - $19.4K Raise 6' - $26.8K Raise 8' - $34.1K Raise 10' - $41.5K	**Advantage:** No displacement of residents. **Disadvantages:** Outbuildings may still be subject to flood damage; possible loss of access during flooding.	
NS10	Relocate Structures	Negligible	1%	2 - 5 yrs	Minimal- (City permit)	**Approx. Cost per Residence** - $40K	Cost assumption that relocation is within the immediate area. Cost does not include destination site preparation/foundation construction	

[1] Source: *Cedar Rapids River Corridor Redevelopment Flood Mitigation Option*, Final March 29, Stanley Consultants, Inc., Muscatine, IA

4.2.1.4. Selection of Plans for Further Analysis. As a result of the comparison, no action, levees/floodwalls, and nonstructural features were identified as the best options to further reduce flood damages beyond the reductions resulting from the City's complementary nonstructural measures.

4.2.2. Planning Process Iteration Two. From April 2009 through November 2009, the Study team (PDT with input from City Workgroup) performed additional technical analysis of all proposed features from Iteration One. The team also developed screening criteria to be used in alternative selection. Using detailed technical information, the team applied professional judgment in order to assess the measures against the screening criteria. At this point in the Study a structure inventory was conducted focusing on public, residential, and commercial/industrial structures within the Study area. Those measures that appeared to be the most viable were refined and further developed so that accurate costs and economic benefits could be determined. The team compared the measures to screen out inferior plans and identify the optimal plans. Initial screening results were presented at a public meeting in April 2009. Subsequent discussions with the City narrowed the measures to levee/floodwall alignments for the downtown Cedar River Corridor.

4.2.2.1. Inventory and Forecasting. The inventory and forecasting efforts in this iteration concentrated on damage reach formulation, floodplain analysis as it pertains to the City's plans and how the Study addresses those plans, analysis of existing levees, and Hydrology and Hydraulic modeling.

Damage reaches were formulated in Iteration Two based on economic, hydrology/hydraulics, and when possible geographic reference points. Damage reaches are specific geographical areas within a floodplain that are used to define consistent data for plan evaluations and to aggregate structure and other potential flood inundation damage information by stage of flooding. Study reaches changed as the plan formulation process has evolved; that is as more information was gathered and developed Study reaches were added, split, and lines redrawn. At the time only the 1991 flood insurance study profile was available. The team used the 1 percent chance event profile to divide the downtown area into damage reaches with a difference in water level from the downstream limit to upstream limit of about 2 feet. These boundaries were then moved slightly so that the structures within each reach would be easy to identify and organize. The damage potential for individual structures in a floodplain was aggregated within spatially defined areas along the damage reaches. Within each damage reach, an index location is identified at which exceedance probability are stage measured. Then flooding stage at the site of each structure is also related to stage at this index. Thus, an aggregated function was developed to relate all damage in the reach to stage at the single index station. Reaches outside the downtown area were chosen such that the reach limits incorporated the region of interest.

While a certain level of uncertainty is expected when documenting the Existing and Future Without Project Conditions, this Study presents a unique situation. The Existing Conditions of the Study area are not static because recovery efforts as a result of the devastating record flood event in June 2008 were still on-going. Given the dynamic nature of the Study area, the final number of properties that will be removed through voluntary buy-out and building restrictions from the 1 percent and 0.2 percent floodplain would not be finalized in time for use in the analysis. In order for the Study to proceed on schedule, the team used the following assumptions with the acknowledgement that there may be updated information available after the Benefit Cost Analysis is completed.

The Study team has proposed and utilized the following assumptions regarding the Existing and Future Without Project Conditions. The key assumptions for this iteration are:

- The Existing and Future Without Project Conditions dictate that existing levees in the Study area (i.e., Time Check Levee) will not be included as providing flood risk reduction against any flooding events. This condition has been verified through field visits to the Study area. The existing levees do not meet Federal regulations for providing FRM and are not capable of reliably reducing flood risk. See Appendix G, *Geotechnical*, for more details.

- The City applied for and is receiving Federal funds for acquiring properties within the current FEMA Flood Insurance Rate Map (1991)100-year (1 percent chance event) floodplain for their designated greenway (117 properties were targeted for FEMA and 53 properties for HUD voluntary property acquisition) in accordance with the City's redevelopment planning efforts. The following assumptions were made using this information:

  In the City-designated greenway and existing FEMA [FIRM 100-year (1 percent chance event)] floodplain, it was assumed that residential properties identified in the City database as "substantially damaged" would be above the 1 percent floodplain. This follows City and FEMA 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) plus 1 foot elevation.

  In the additional sections of the existing FEMA [FIRM 100-year (1 percent chance event)] floodplain it was assumed the remaining residential properties (those not designated as substantially damaged) would be repaired to pre-flood values and that these properties would be raised 1 foot above the new Corps established 100-year (1 percent chance event) floodplain. The new Corps 100-year floodplain ranges from approximately 0.5 to 2.5 feet greater than the existing FEMA 100-year floodplain. The Study team measured structure value based on replacement costs less depreciation to the existing 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.

  It was assumed that commercial and public properties are governed with same criteria as residential in the FEMA (FIRM 100-year (1 percent chance event)) floodplain.

- The City is using local and Federal funds in acquiring properties for the Construction Zone/Neighborhood Revitalization (1,012 for HUD voluntary property acquisition) in accordance with their development planning efforts. It was assumed that in the City-designated Construction Zone/Neighborhood Revitalization area, vacant residential, commercial, and public properties would be repaired to pre-flood value and type of use, when information is not available from the property owner or the City.

- In addition to the Greenway, Construction Zone, and Neighborhood Revitalization designations; for all other areas in the floodplain it was assumed that all residential, commercial, and public infrastructure properties would be restored to pre-flood values and type of use, when information is not available from the City, business, utility company, etc.

Hydrology & Hydraulic Modeling: Several HEC-RAS models were created for the Cedar River at Cedar Rapids. The Existing Condition model simulates the conditions along the river for year 2009. All models were developed using HEC-RAS Version 4.0.0. 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.

4.2.2.2. Formulation of Measures. The Iteration Two focused on further refinement of the features carried forward from Iteration One and formulation of measures. A measure is a feature or activity at a site which addresses one or more of the planning objectives. Several different measures were identified for consideration in evaluating future possible actions in the Study area. Formulation of measures consisted of expanding and refining the levees and floodwall protection alignments proposed in Iteration One. A new array of measures (table 35) was formulated including the No Action Plan, an expanded list of nonstructural measures (NS1-NS17) and 26 structural measures (1B, 1D, 2B-11B, 12B-D, 13B-23B). Illustrations of the measures may be found in Appendix O, *Planning Formulation.*

Table 35. Flood Risk Management Measures Considered

Measure	Damage Reaches in Measure	Description of Measure
No Action	All	Future Without Project Condition
Nonstructural	All	Various Measures-See Appendix P
1B	1	Levee/Floodwall Alignment
1D	1	Edgewood Bridge Approach
2B	2A-2B-2C-2D	West Side Alignment-setback
3B	2A-2B-2C-2D	West Side River's Edge Alignment
4B	2A-2B	Northwest Alignment-River's Edge
5B	2A-2B-2C-2D	West Side Alignment-setback
6B	2A-2B	Northwest Alignment-setback
7B	2C-2D	Southwest Alignment-River's Edge
8B	2C-2D	Southwest Alignment-Setback
9B	2D	Southwest Alignment
10B	2B-2C-2D	West Side Alignment-River's Edge
11B	2B-2C-2D	West Side Alignment-setback
12B,12C,12D	3	Structural Protection-various alignments
13B	4A-4B	Northeast Alignment-Cedar Lake
14B	4B	Northeast Alignment-Cedar Lake South
15B	4A-4B-5A-5B-5C	East Side Alignment-setback
16B	4A-4B-5A-5B-5C	East Side Alignment-River's Edge
17B	5A-5B-5C	Southeast Alignment-River's Edge
18B	4B-5A-5B-5C	East Side Alignment-River's Edge
19B	5C	Otis Road East Alignment
20B	6	Cedar Valley (Rompot) Alignment
21B	7	Water Pollution Control Facilities
22B	8	City's Well Field
23B	9	Mays Island

4.2.2.3. Evaluation and Comparison of Measures. The evaluation and comparison criteria were developed using information gathered from the City and Corps planning efforts, as well as real estate, cultural resources, environmental, and engineering considerations. The City provided direct input from its public workshops and neighborhood meetings on effectiveness, implementability, and socially acceptable measures. The following criteria were used to evaluate and compare measures during this iteration:

- Reconnaissance Level Analysis BCRs (for nonstructural analysis):: A reconnaissance level analysis was conducted using existing economic information and GIS inputs to determine if nonstructural measures such as voluntary property acquisition and flood-proofing would have a Federal interest. Although the analysis yielded low BCRs, nonstructural measures were retained for further consideration. Details of this analysis can be found in Appendix P, *Nonstructural Measures*
- Best Professional Judgment
- Proposed Voluntary Acquisition of FEMA Locations

4.2.2.4. Selection of Measures for Further Analysis. As a result of the evaluation and comparison of the measures, many measures were dropped from further consideration. Results are as follows:

Measures recommended for further evaluation:

- All Reaches (No Action)
- Reach 2 (2B, 9B)
- Reach 3 (12B,12D)
- Reaches 4-5 (13B, 16B, 18B, 19B)
- Reach 7 (21B)
- Reach 9 (23C)

Measures not recommended for further evaluation:

- All Reaches (1C, 2C,…., 25C) (12E)
- Reach 1 (1B, 1C, 1D)
- Reach 2 (3B, 4B, 5B, 6B, 7B, 8B, 10B, 11B)
- Reaches 4-5 (14B, 15B, 17B)
- Reach 6 (20B)
- Reach 8 (22B)
- Reach 9 (23B)

4.2.3 Planning Process Iteration Three. From December 2009 through February 2010, the Study team reworked and refined the measures from Iteration Two to develop alternatives. The levee/floodwall alternatives were analyzed using the updated hydrology and hydraulics (steady-state hydraulic modeling) modeling as well as the economic structural inventory.

4.2.3.1 Formulation of Alternatives. The measures recommended for further study were re-evaluated, re-organized and refinements were made as more information became available. An additional screening was done. A total of 13 measures were refined and combined to form the initial

alternatives. During formulation, optimization of measures was performed as described in Section 4.2.3.2.

Structural Alignments (Damage Reaches 2, 4, and 5)

- Alternative 1: Measures 2B (West) and 16B (East)
- Alternative 2: Measure 2B (West)
- Alternative 3: Measure 16B (East)
- Alternative 4: Measure 18B (East)
- Alternative 5: Measure 19B (East)
- Alternative 6: Measure 13B (East)
- Alternative 7: Measure 14B (East)
- Alternative 13: Measure 9B (West)

Structural Alignments (Damage Reach 7)

- Alternative 8: Measure 21B (East)

Structural Alignments (Damage Reach 3)

- Alternative 9: Measure 12B, 12C, 12D (West)

Nonstructural (Damage Reach 9)

- Alternative 12: Mays Island-Nonstructural

All Damage Reaches

- Alternative 10: Combinations of Alternatives
- Alternative 11: Nonstructural Alternatives

4.2.3.2. Alternative Descriptions and Optimization. As more detailed hydraulic, hydrologic, economic, engineering design, and engineering cost estimates became available they were used to refine and optimize alternatives. Each alternative is described below including a map, area protected, and a summary of the results of the optimization process.
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Alternative 1: Measures 2B (West) and 16B (East)

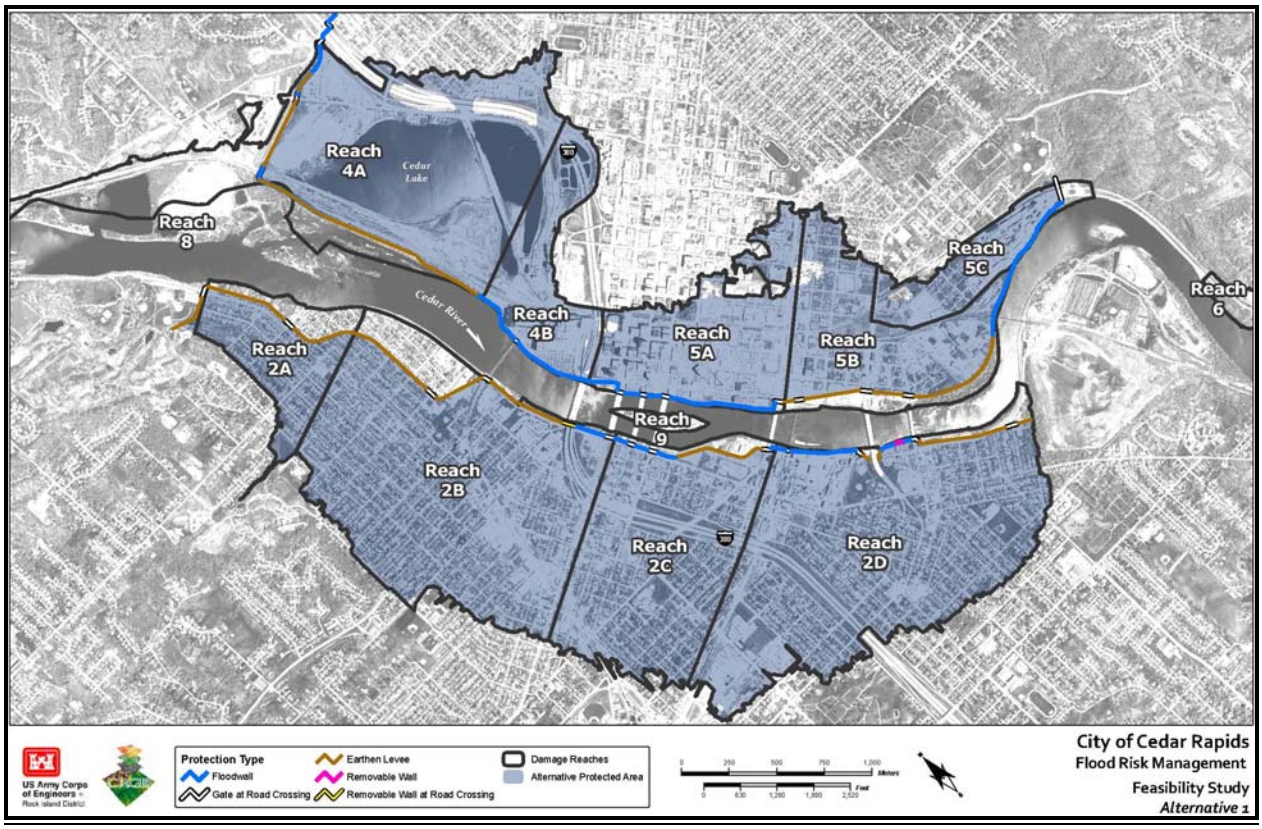

Figure 60. Alternative 1: Measures 2B (West) and 16B (East)

Areas Protected. This alternative alignment is for both the east and west sides of the Cedar River corridor (figure 60). 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 provides flood damage reduction to 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 McLoud 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 Avenue where it creates greenway between the alignment and the river through City-owned properties to 12th Avenue. From 12th Avenue 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 Cedar Rapids 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 Optimization

Measure 2B originally followed closely the City's Preferred Plan, but due to a low BCR the alignment was adjusted to further optimize. Recommendations for Optimizing Measure included:

1. Replacing all the existing removable wall sections with regular floodwalls and levees where possible
2. Minimizing and removing some of the non-essential gate closures
3. Adjusting alignments for less impacts to utilities, Real Estate and Cultural Resources considerations
4. FEMA (HMGP) funds were approved to purchase low lying (greenway identified by the City's Preferred Plan) residential properties in Reaches 2A and 2B; while the commercial/industrial area to the south (between I-380 and the Union Pacific Railroad) were not approved; so for optimization purposes those properties were protected into a new alignment for 2B which follows the River more closely

Recommendations for Optimizing Measure 16B included:

- Adjusting alignments for less impacts to utilities, Real Estate and Cultural Resources considerations
- Reconsideration of line of protection north of Cedar Lake, remove the northern tie-back levee and reestablish the alignment on the northern border of Cedar Lake, this removes the need for a large capacity pumping station for internal drainage, also there were limited benefits for providing flood damage reduction north of Cedar Lake.

Alternative 2 (Measure 2B)

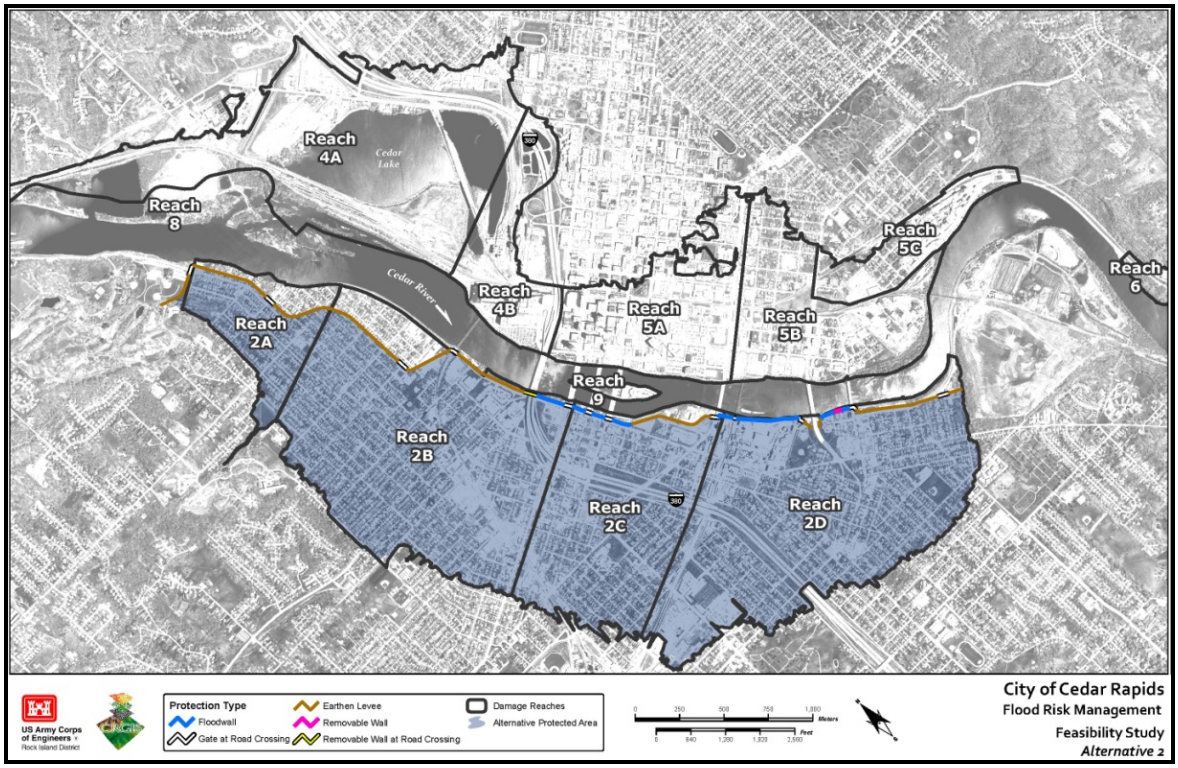

Figure 61. Alternative 2: Measure 2B

Areas Protected. This alignment is for the west side of the Cedar River corridor (figure 61). The neighborhoods included are from north to south the Time Check/Northwest neighborhood, Cedar Rapids Downtown-west/Taylor neighborhood, and the Czech neighborhood.

Description of Alignment . 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 Cedar Rapids 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 Optimization

Measure 2B originally followed closely the City's Preferred Plan, but due to a low BCR the alignment was adjusted to further optimize. Recommendations for Optimizing Measure 2B are the same as Alternative 1.

Alternative 3 (Measure 16B)

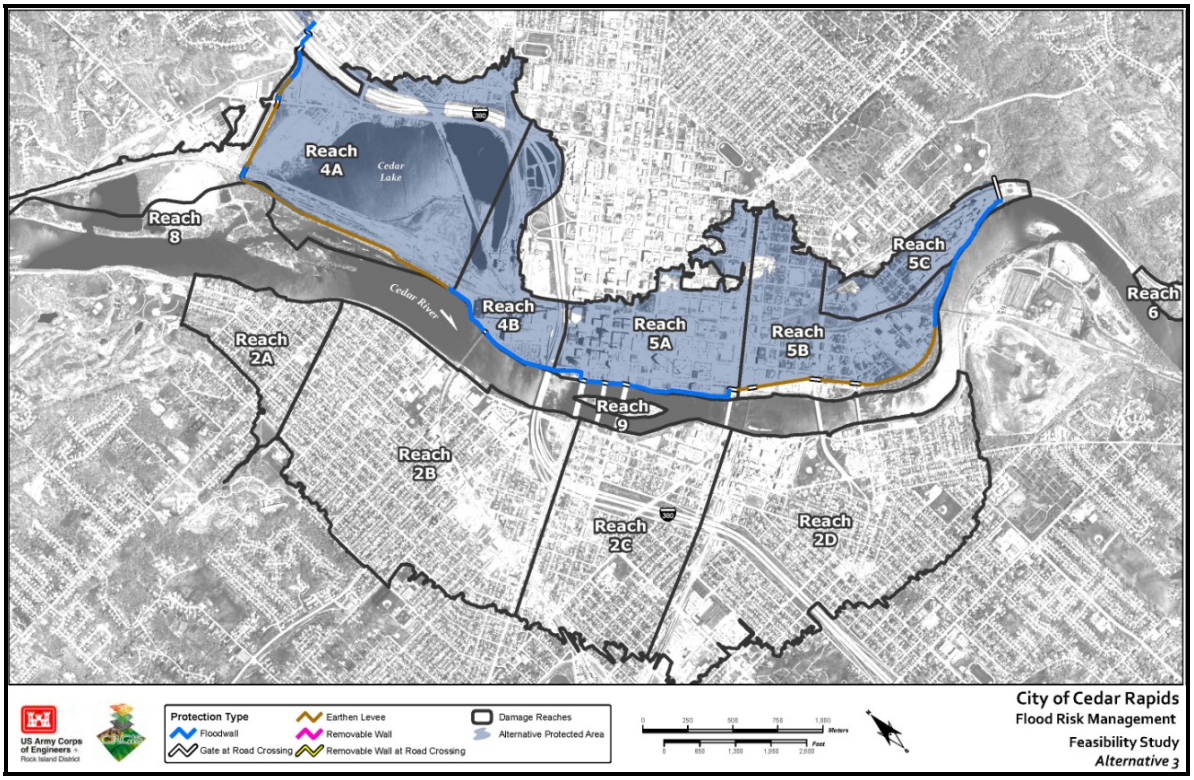

Figure 62. Alternative 3: Measure 16B

Areas Protected. This alternative alignment is for the east side of the Cedar River corridor (figure 62). The damage reaches in this alignment are all of Reach 4 and 5.

Description of Alignment. The east side alignment starts in the north with a tie-back levee along McLoud 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 Avenue where it creates greenway between the alignment and the river through City-owned properties to 12th Avenue. From 12th Avenue 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 Optimization. Recommendations for refining Measure 16B are the same as those for Alternative 1.

Alternative 4: Measure 18B (East)

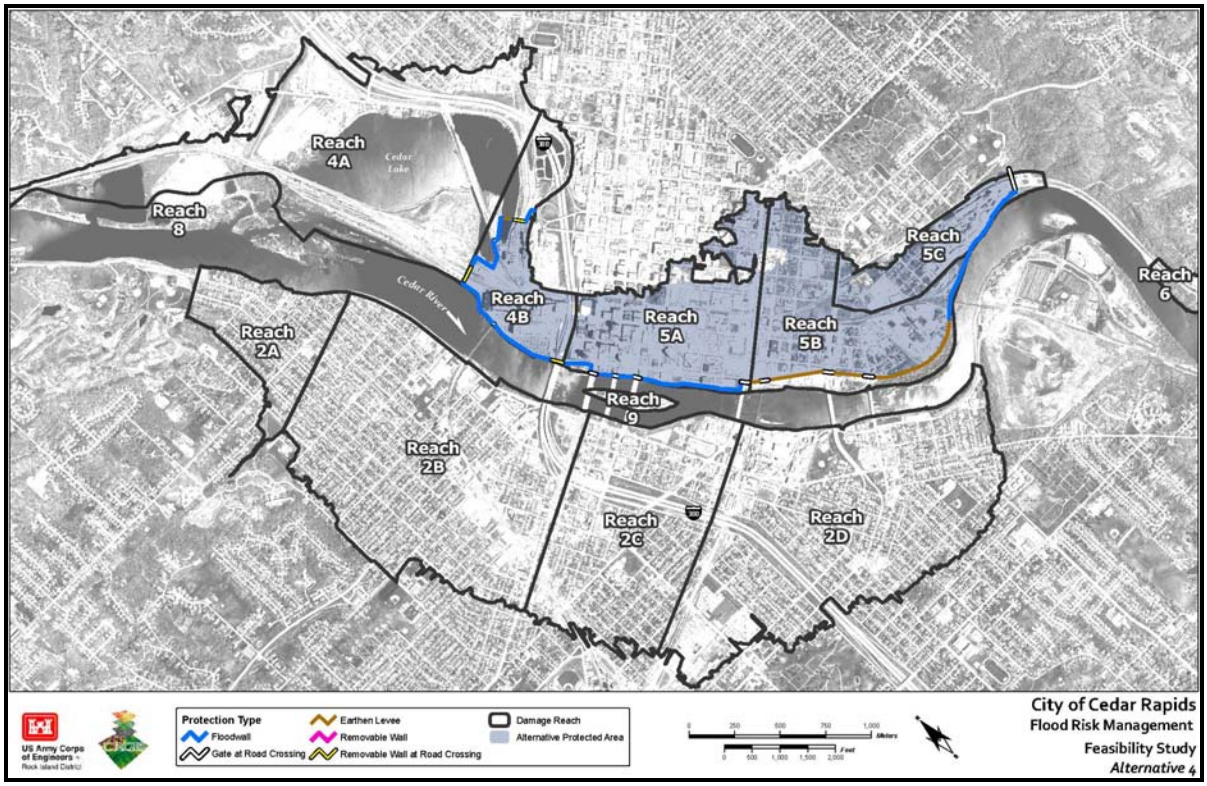

Figure 63. Alternative 4: Measure 18B (East)

Areas Protected. This alternative includes an east side alignment proceeding north to south; southern Cedar Lake Area, Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood (figure 63).

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 Avenue where it creates greenway between the alignment and the river through City owned properties to 12th Avenue. From 12th Avenue 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 Optimization. The recommendations for Optimizing include:

1. Adjusting alignments for less impacts to Real Estate and Cultural Resources considerations
2. Reconsideration of line of protection north of Cedar Lake, remove the northern tie-back levee and reestablish the alignment in Reach 4B, this provides substantial savings as there is a 42 inch water main (which has a high replacement cost) that runs parallel with the north-south alignment in Measure 18B along the West border of Cedar Lake (between the railroad tracks and Cedar River)

Alternative 5: Measure 19B (East)

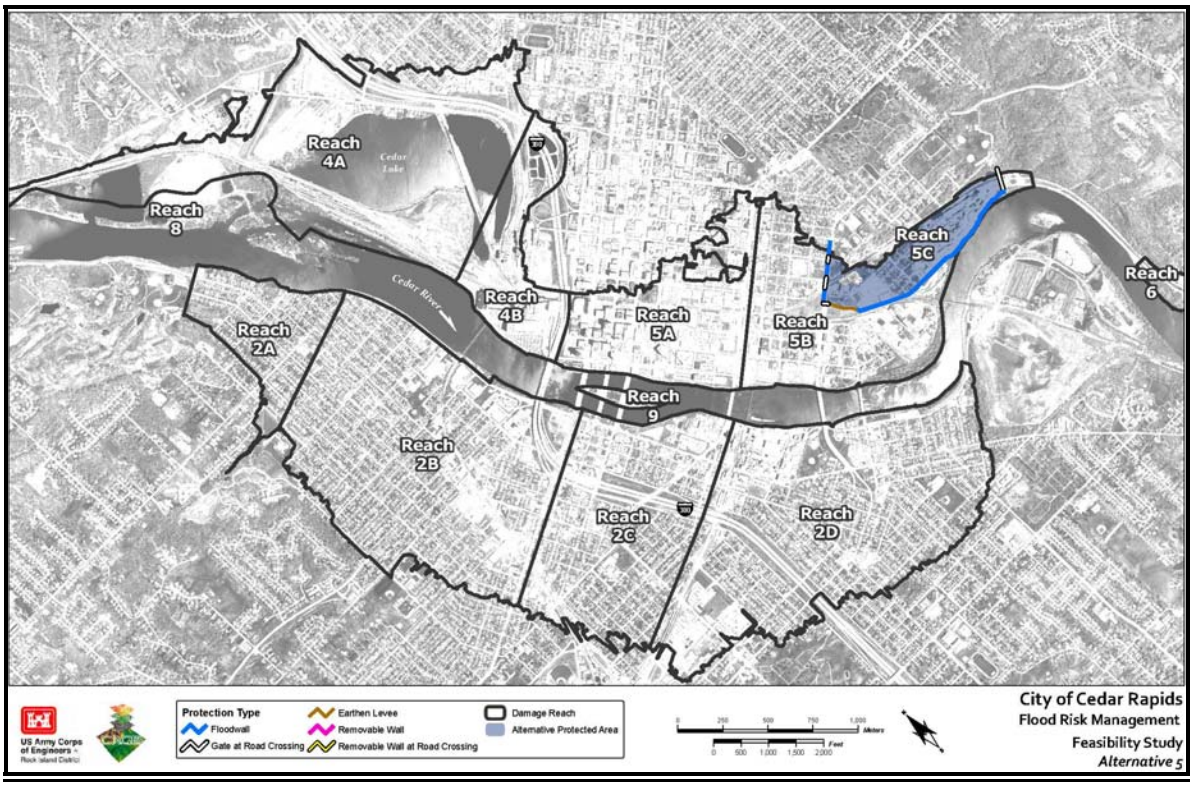

Figure 64. Alternative 5: Measure 19B (East)

Areas Protected. This alternative provides flood damage reduction to a small portion of the east side of the Cedar River corridor of Cedar Rapids (figure 64). The neighborhood protected is Otis Road South.

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 Optimization. The recommendation for optimizing for Measure 19B includes adjusting the alignment for fewer impacts to Real Estate and Cultural Resources considerations.

Alternative 6: Measure 13B (East)

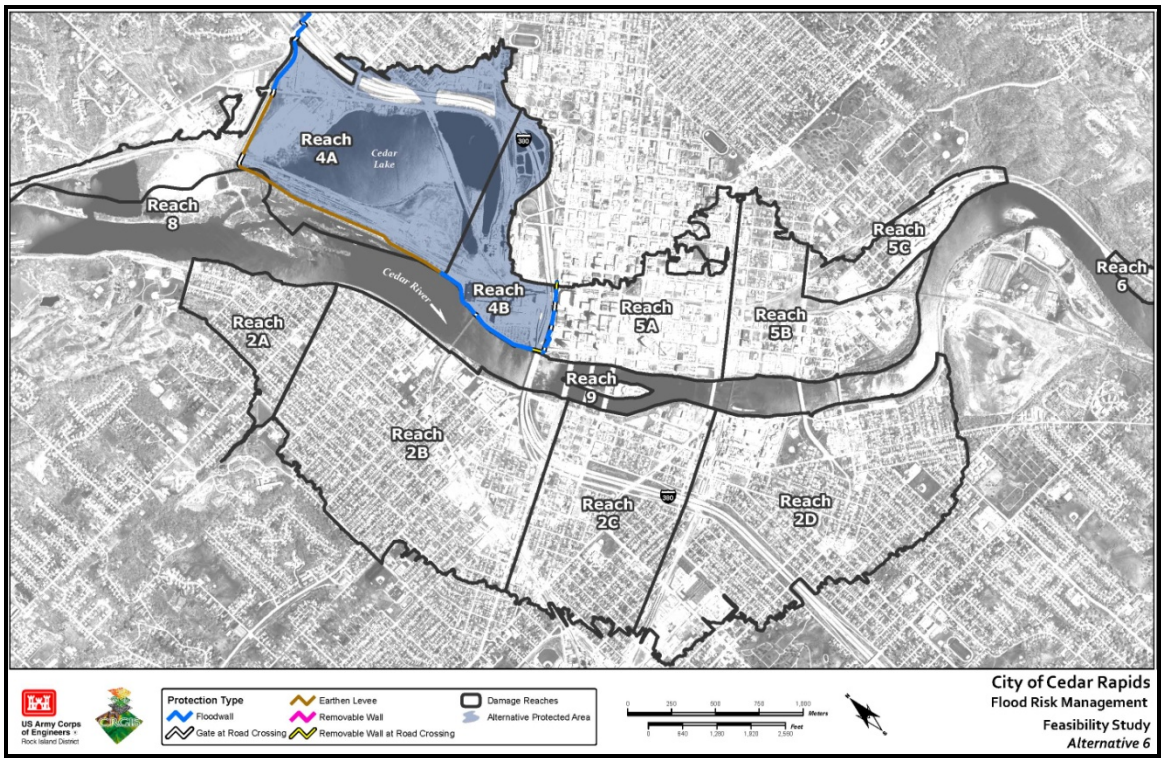

Figure 65. Alternative 6: Measure 13B (East)

Areas Protected. This alternative is shown in figure 65.

Description of Alignment. The east side alignment starts in the north with a tie-back levee along McLoud Run and proceeds to the Cedar River then turns south and runs parallel between the railroad tracks and the river. 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.

Alternative Optimization. The recommendation for optimizing includes adjusting the alignment for fewer impacts to Real Estate and Cultural Resources considerations.

Alternative 7: Measure 14B (East)

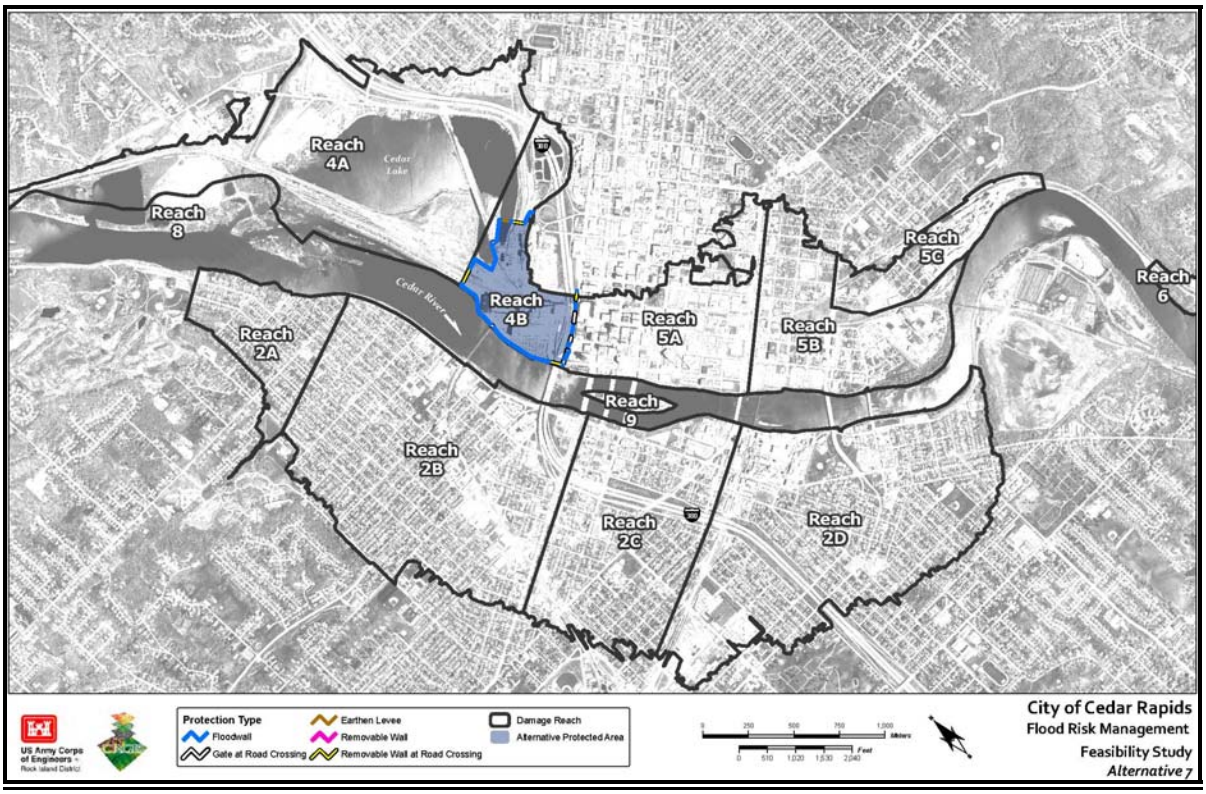

Figure 66. Alternative 7: Measure 14B (East)

Areas Protected. This alternative provides flood damage reduction to a small portion of the east side of the Cedar River corridor of Cedar Rapids (figure 66). The neighborhoods protected are the southern Cedar Lake Area.

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.

Alternative Optimization. The recommendation for optimizing includes adjusting the alignment for fewer impacts to Real Estate and Cultural Resources considerations.

Alternative 10: (Combination of Alternatives 5 and 7)

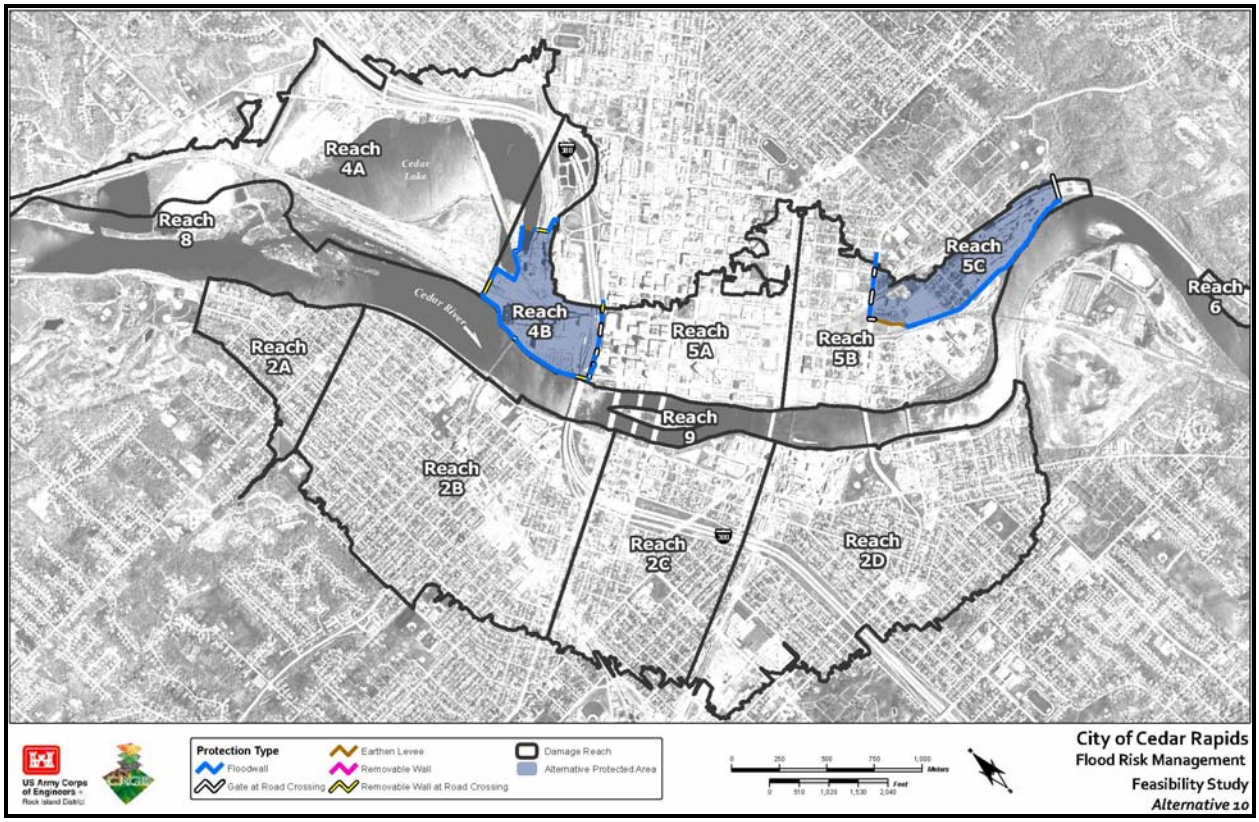

Figure 67. Alternative 10: (Combination of Alternatives 5 and 7)

Areas Protected. This alternative provides flood damage reduction to two small portions of the Study area (figure 67). The neighborhoods protected are the southern Cedar Lake Area and Otis Road South.

Description of Alignment. The alignment is described previously in this section; please see Alternatives 5 and 7.

Alternative Optimization. The recommendation for optimizing includes adjusting the alignment for fewer impacts to Real Estate and Cultural Resources considerations.

Alternative 13: Measure 9B (West)

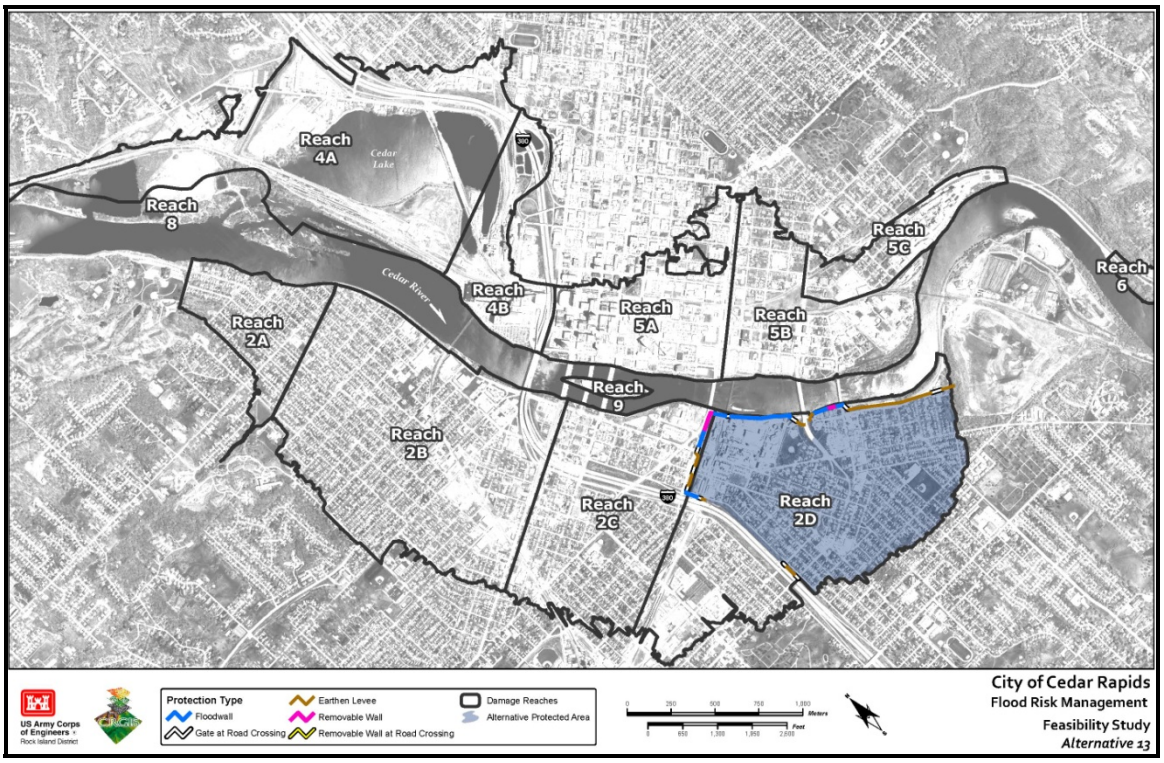

Figure 68. Alternative 13: Measure 9B (West)

Areas Protected. This alternative provides flood damage reduction to a small portion of the west side of the Cedar River corridor of Cedar Rapids (figure 68).

Description of Alignment. The alignment starts in the southwest at 16th Avenue SW and follows I-380 north until 8th Ave SE which turns the alignment northeast until it reaches the Cedar River. The alignment then follows the River to the tie-off at A Street SW.

Alternative Optimization. The recommendation for optimizing includes adjusting the alignment for less impact to Real Estate and Cultural Resources considerations.

Alternative 9: (Measures 12B & 13B)

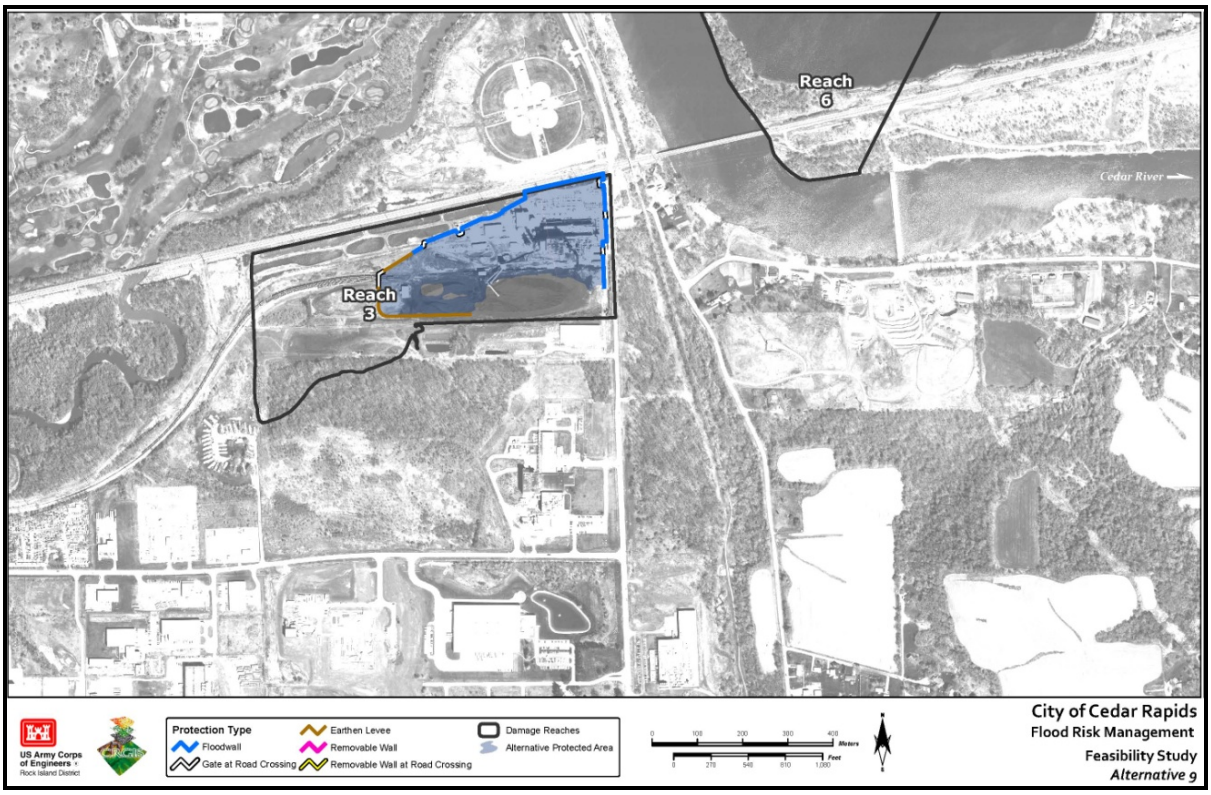

Figure 69. Alternative 9: Measures 12B & 13B

Areas Protected. This alternative provides flood damage reduction to the Prairie Creek Generation Station (figure 69).

Description of Alignment. The alternative varies between including all buildings (12B), main building (12C) and installation of gatewells (12D)**.**

Alternative Optimization. No optimization was identified for this alternative.

Alternative 12: (Measure 23)

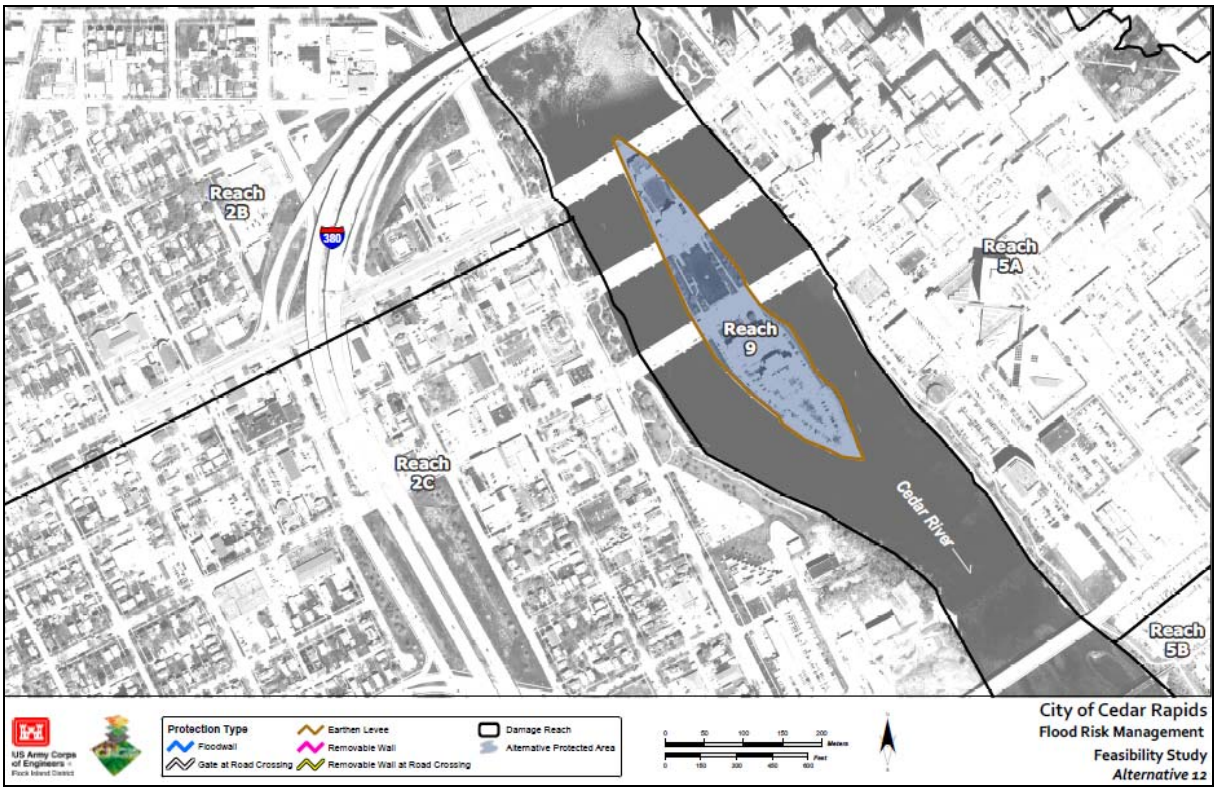

Figure 70. Alternative 12: Measure 23

Areas Protected. This alternative provides nonstructural FRM measures to Mays Island (figure 70).

Description of Alignment. The description varies depending on type of nonstructural alternative chosen.

Alternative Optimization. No further optimization was identified for this alternative.

Alternative 11 Nonstructural Alternatives. 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 nonstructural measure as listed in Appendix P. 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.

The City utilizes its 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.

Floodproofing and Permanent Acquisition were analyzed in this Study and were screened out due to negative net benefits (costs outweigh the benefits of implementing; see Appendix P 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 voluntary acquisition programs and continued buy-outs of flood-prone structures are encouraged.

4.2.3.3. Alternative Formulation Summary. Table 36 summarizes the formulation process. It shows the measures combined to form each alternative. This matrix provided the basis for the evaluation and comparison of the alternatives.

Table 36. Alternative Formulation Summary

	Alternative												
Measure	1	2	3	4	5	6	7	8	9	10	11	12	13
Nonstructural											x	x	
2B	x	x											
9B													x
12B									x				
12C									x				
12D									x				
13B						x							
14B							x			X			
16B	x		x										
18B				x									
19B					x					X			
21B								x					

4.2.3.4. Alternative Elevation Analysis. Various elevation levels were required for comparative evaluation. A system of letters associated with index crest elevations, approximate levee heights, and associated discharges were established (letters Z, A, B, C, D). This array of levee crest elevations is summarized using the most downstream Economic Damage Reach (Reach 5C) as a point of reference shown in the table 37. A detailed discussion of crest elevations used for all index stations appears in Appendix A. The alternatives were based upon the same array of index levee crest elevations at downstream Economic Damage Reach 5C. For Alternatives 1 and 1A, HEC-FDA project benefits were determined using levee crest elevations upstream of Reach 5C. The levee crest elevations came from a profile that simulated a levee on both banks. For Alternative alignments on one side of the Cedar River the HEC-FDA project benefits were determined using elevations upstream of Reach 5C that came from a profile that simulated a levee on only the one bank.

Table 37. Array of Alignment Options Evaluated for Each Alternative

Array Name	Index Crest Elevation 5C NAVD (ft)	5C Approx Levee Height in Reach 5C (ft)	Approx Discharge for 5C Index Crest Elevation (CFS)
Z	722.95	9	103,900
A	724.45	10	114,000
B	726.19	12	125,950
C	728.61	15	143,300
D	731.18	17	168,150

4.2.3.5. Evaluation and Comparison of Alternatives. These alternatives were subject to a more robust evaluation and comparison process than the other iterations. The initial alternatives are described in table 34 with associated draft BCRs, Study Objectives, Residual Risk, and Local Goals and Objectives. The following criteria to evaluate and compare measures:

- Preliminary Benefit- to-Cost Ratios (Range Z thru D)
- Planning Objectives
- Residual Risk
- Local Goals and Objectives

The following paragraphs discuss conclusions drawn from the initial alternatives screening that reduced the number of levee/floodwall alignments retained for final analysis for Iteration Four.

Evaluation and Comparison Criteria. The comparison for the screening of alternatives used the four formulation criteria established by the United States Water Resources Council in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). Also incorporated in the screening analysis are draft ranges of BCRs per Alternative, Planning objectives, Residual Risk, and Local Planning Objectives. A rating system was developed to rank the screening criteria as High (most acceptable), Moderate (acceptable), and Low (unacceptable).

Preliminary Benefit-to-Cost Ratios. Benefit-to-cost ratios were developed for each height level (Z, A, B, C, D) and for each alternative with the highest associated BCR listed in table 38. The BCRs are based on the best available information and were used as a screening tool to further refine alternatives. In this stage of the alternative screening analysis no alternatives had BCRs greater than one.

Table 38. Iteration Three - Evaluation and Comparison of Alternatives

		Planning Objectives					Local Planning Objectives		
Alternative	**Draft BCRs**	**Reduce Flood Damages**	**Improve Flood Response**	**Increase Flood Awareness**	**Recreational Opportunity**	**Residual Damages**	**Comprehensive FRM Project**	**Enhance Floodplain Mgmt**	**Enhance Recreational Opportunities**
1	< 0.5	High	High	High	High	High (10-20%)	High	High	High
2	< 0.35	Moderate	Moderate	Moderate	Moderate	Mod (40-55%)	Moderate	Moderate	Moderate
3	< 0.65	Moderate	Moderate	Moderate	Moderate	Mod (40-55%)	Moderate	Moderate	Moderate
4	< 0.8	Moderate	Moderate	Moderate	Moderate	Mod (40-55%)	Moderate	Moderate	Moderate
5	< 0.8	Low	Low	Low	Low	Low (70-85%)	Low	Low	Low
6	< 0.6	Low	Low	Low	Low	Low (70-85%)	Low	Low	Low
7	< 0.8	Low	Low	Low	Low	Low (70-85%)	Low	Low	Low
8	< 0.1	Moderate	Moderate	Low	Low	Low (85-95%)	High	Low	Low
9	< 0.5	Moderate	Moderate	Low	Low	Low (85-95%)	High	Low	Low
10	< 0.8	Low	Low	Low	Low	Low (70-85%)	Low	Low	Low
13	< 0.5	Low	Low	Low	Low	Low (70-85%)	Low	Low	Low

Planning Objectives. The Planning Objects are defined in Section 2.4. All of the alternatives considered meet the criteria for the Planning Objectives to varying degrees. The objectives and related analysis of this Study are:

Planning Objectives

- Reduce flood damages to private and public infrastructure caused by Cedar River flooding greater than the 1 percent chance event in the City through 2060.
- Improve the response by local, state, and Federal agencies to the all flood events along the Cedar River in the City.
- Increase public awareness to the risk of flooding from the Cedar River in the City through 2060.
- Increase recreational opportunities in the City along the Cedar River that is compatible with an implementable FRM plan.

Alternative Analysis

- There are no FRM benefits for the No Action Alternative. The City would be required to flood fight for flood events somewhere between the 1.3 percent and 1.0 percent chance events and flood damages will continue to occur in the future.
- Alternative 1 (High) meets all four of the objectives as it provides the most complete plan for both sides of the Cedar River. It provides the greatest FRM benefits, reduction of associated flood risk, and would greatly reduce the need for flood fighting and flood response as lines of dependable flood damage reduction would be in place. Flood awareness and recreational opportunities would also be the greatest with this alternative.
- Alternatives 2, 3, and 4 (Moderate) partially meet the planning objectives but not to the degree of Alternative 1. To provide the most comprehensive plan possible to meet the first three objectives; the ongoing City buyout plans of properties on the opposite side of the floodplain as well as ongoing flood proofing measures would be included with these alternatives. For the recreational objective only one side of the Cedar River would be eligible for a potential Corps recreational project.
- Alternatives 5, 6, 7, 10, and 13 (Low) provide flood damage reduction to small portions of the Study area with only minor flood damage reduction to residential areas. These alternatives do slightly reduce flood damages and reduction of risk, but do not add appreciable benefits to the reduction of flood fighting or flood response or awareness as they affect only small portions of the floodplain. There are no recreational benefits for these alternatives.
- Alternatives 8 and 9 (High) provide flood damage reduction to important public infrastructure therefore are considered highly valued alternatives. Both of these alternatives meet the planning objectives except for recreational opportunities.

Residual Risk. Also as part of the effectiveness of the Alternatives, best professional judgment was used to compare potential residual damages. By comparing the number of damage reaches within an alternative, a rough damage reduction estimate could be made for comparison purposes. There are

varying levels of flood damage reduction for each alternative so detailed analysis in the next planning iteration will provide clearer more defined numbers.

- Alternative 1 (High) is estimated to provide the greatest level of damage reduction to the major damage reaches throughout the downtown; so assigning an 80 to 90 percent risk reduction while leaving 10 to 20 percent residual damages is appropriate at this level of screening.
- Alternatives 2, 3, and 4 (Moderate) provide an estimated damage reduction in a range of 45 to 60 percent with residual damages ranging from 40 to 55 percent.
- Alternatives 5, 6, 7, 10, and 13 (Low) is estimated to provide damage reduction in the range of 15 to 30 percent with associated residual damages of 70 to 85 percent.
- Alternatives 8 and 9 (Low) are estimated to provide damage reduction in the range of 5 to 15 percent with associated residual damages of 85 to 95 percent.

Local Planning Objectives. The City's planning efforts, which began immediately after the June 2008 flood event have identified a comprehensive FRM plan that reduces flood risk to both sides of the river, as discussed in the RCRP. The City's main objectives that were considered in Iteration Three analysis are:

1. Implementation of a comprehensive FRM Project
    - There are no FRM benefits for the No Action Alternative. The No Action Alternative is not acceptable to the City.
    - Alternative 1 (High) is considered the most acceptable plan as it closely resembles the City's Preferred Plan.
    - Alternatives 2, 3, and 4 (Moderate) are considered marginally acceptable as they reduce flood risk for only one side of the floodplain. The City's ongoing buyouts and flood proofing efforts (along the west bank of the Cedar River) combined with any of these alternatives would reduce flood damages and associated risk. The City could accept this approach and reduce flood risks by constructing a levee and floodwall along the west bank.
    - Alternatives 5, 6, 7, 10, and 13 (Low) are not acceptable as they provide flood damage reduction to small areas within the floodplain. The City does not support further investigation of these alternatives.
    - Alternatives 8 and 9 (High) reduce flood risk for critical infrastructure, and therefore are a priority. The City would support alternatives associated with these alternatives.

2. Enhanced floodplain management through the development of FEMA – CRS and NFIP. The NFIP CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS:
    - Reduce flood losses;
    - Facilitate accurate insurance rating; and
    - Promote the awareness of flood insurance.

Based on data from FEMA on NFIP policies in force within the 100 year floodplain (FIRM 1991) as of 10/31/2009, the alternative analysis results are:

- Alternative 1(High) provides the greatest reduction in administrative costs and reduction of flood insurance policies of approximately 90 percent.
- Alternatives 2, 3, and 4 (Moderate) partially meet the objective and provide a reduction in NFIP benefits ranging from approximately 12 to 75 percent.
- Alternatives 5, 6, 7, 8, 9, 10, and 13 (Low) do not provide a reduction to the NFIP.

3. Enhanced recreational opportunities throughout the Cedar Rapids-Cedar River floodplain.
    - Alternative 1 (High) provides the greatest recreational opportunities for both sides of the Cedar Rapids-Cedar River floodplain
    - Alternatives 2, 3, and 4 (Moderate) have the ability to provide recreational benefits to only one side of the Cedar River.
    - Alternatives 5, 6, 7, 8, 9, 10, and 13 (Low) There are no recreational benefits for these alternatives.

Iteration Three Summary

- Alternative 1 performs the best in regards to ratings and meeting the planning criteria presented and has a BCR less than 0.5. This alternative will be analyzed further.
- Alternatives 2, 3, and 4 partially meet the planning criteria outlined. Alternative 4 has the greatest BCR (less than 0.8) of the group and will therefore be further analyzed in Iteration Four.
- Alternatives 5, 6, 7, 10, and 13 have BCRs from 0.5 to 0.8 but do not meet any of the P&G, or Study and City Planning Objectives. Alternatives 5, 7, and 10 have the highest BCRs (less than 0.8) of the group and Alternative 10 will be further analyzed because it maximizes the benefits for both alternatives.
- Alternatives 8 & 9 are considered important public infrastructure but will not be looked at further because BCRs are low and flood proofing and other Federal funds are being used to upgrade the facilities. No further analysis will be completed on these alternatives.
- Alternative 11 & 12 – Nonstructural analysis was completed on various nonstructural alternatives as outlined in Appendix P. The BCRs ranged from 0.1 to 0.8. The most efficient means of providing nonstructural flood damage reduction in the floodplain is to continue to use FEMA-HMGP, HUD-CDBG, and local funding sources as outlined in the City's Preferred Plan (RCRP, November 2008). The City planning efforts have focused on the buyout programs and are effectively removing properties from the existing 100-year (DFIRM 2010) floodplain as well as the rest of the floodplain thereby reducing future flood damage and risk.

Based on the analysis presented, the PDT continued to refine as optimize Alternatives 1, 4, and 10.

4.2.4. Planning Process Iteration Four. From March to July 2010, the Study team reworked and refined the alternatives from Iteration Three. During this iteration Study team continued to analyze and assimilate the updated data gathered during the Study process on hydraulic, hydrologic, economic, engineering design, and engineering cost estimates to refine and optimize alternatives.

4.2.4.1. Formulation of Alternatives. In re-analyzing and attempting to optimize the alternatives wherever possible all alternatives were re-evaluated; recommendations for refining alternatives are:

- Alternative 1, 4, and 10: further adjustments and considerations to adjust alignments for fewer impacts to utilities, Real Estate and Cultural Resources considerations.

- Alternative 1: further refine this recommendation by removing Reach 4A from the alternative as there are higher costs associated with a large protection area with fewer benefits.

- Alternative 1: for optimizing a comprehensive plan, combine Alternative 2 and Alternative 4 into a new alternative, Alternative 1A (figure 71)

4.2.4.2. Alternative Descriptions and Optimization. Alternative 1A has been added to this iteration to maximize Alternative 1. Alternatives 1, 4, and 10 are also considered further in this section.

Alternative 1A

Areas Protected. This alternative provides FRM for both the east and west sides of the Cedar River corridor. The neighborhoods protected on the east side are, proceeding north to south; southern Cedar Lake Area, Cedar Rapids Downtown-east, Oakhill Jackson neighborhood, and the Otis Road Southeast neighborhood. The west side alignment is the same as Alternative 1.

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 Avenue where it creates greenway between the alignment and the river through City owned properties to 12th Avenue. From 12th Avenue the alignment follows just east of 1st Street SE and proceeds downstream with a tie-back levee crossing Otis Road SE. The west side alignment is the same as in Alternative 1.

Alternative Optimization. For the west side alignment Alternative 1A uses the same assumptions as Alternative 1. For the east side alignments it incorporates Alternative 4.

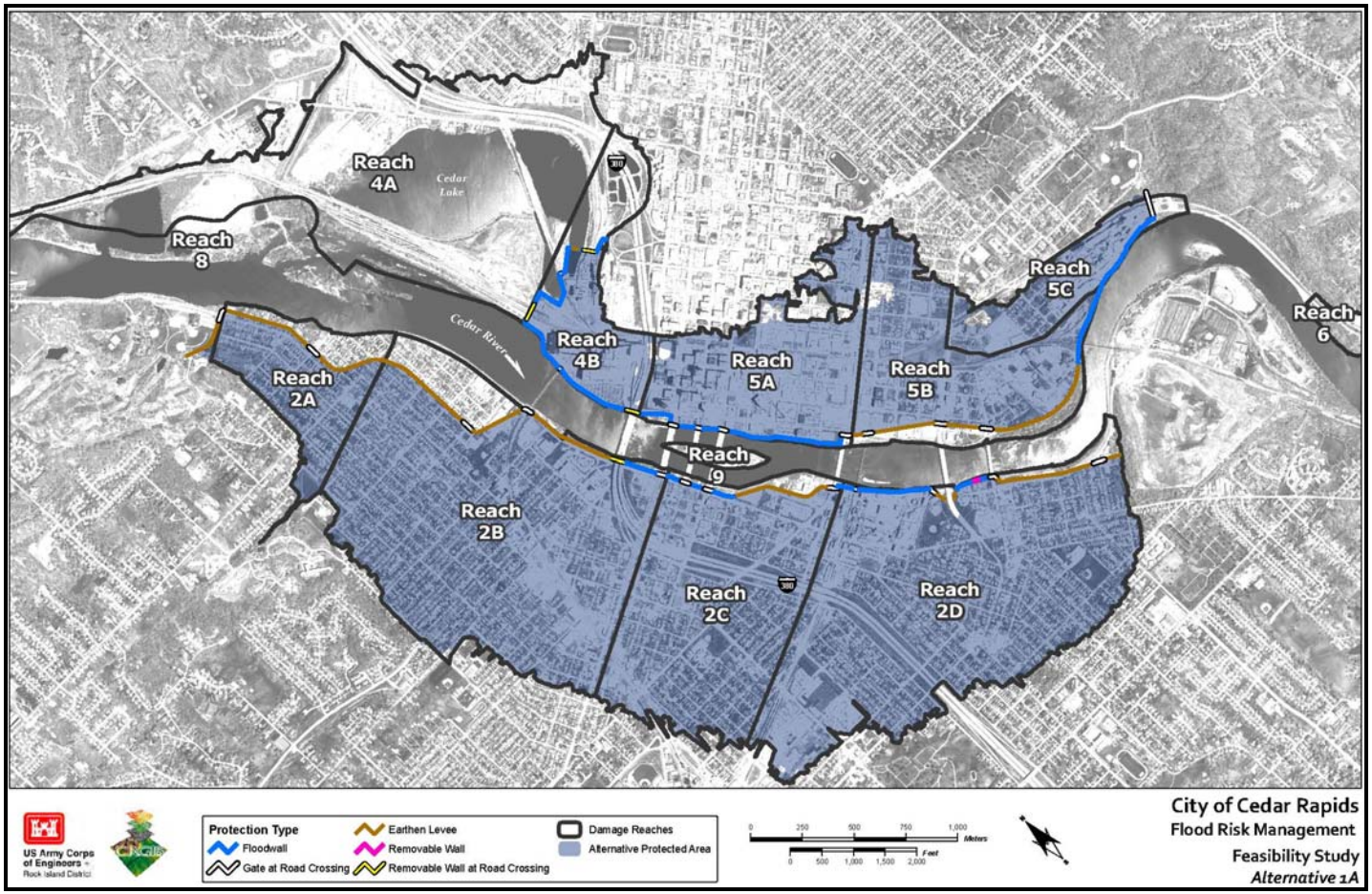

Figure 71. Alternative 1A

4.2.4.3. Evaluation and Comparison of Alternatives. The evaluation and comparison criteria developed for this iteration are similar to the previous iteration. The key focus of this iteration was to further refine and optimize alternatives.

As stated previously in Iteration Three, Review & Coordination (table 34), the varying FRM heights are based on the new Corps flow frequency data. For comparative evaluation purposes, a system of letters associated with approximate levee heights were established (letters Z, A, B, C, D). Also to maximize Alterative 10, a sixth letter designation (E) was made to symbolize the combination of two alternatives at two different levee heights. Alternative 10E is formed from combining Alternatives 5A and 7B. The alternative plans were analyzed based on four alternative alignments with varying levee heights:

Alternative 1:	1Z, 1A, 1B, 1C, 1D
Alternative 1A:	1A-Z, 1A-A, 1A-B, 1A-C, 1A-D
Alternative 4:	4Z, 4A, 4B, 4C, 4D
Alternative 10:	10Z, 10A, 10B, 10C, 10D, 10E

Evaluation and Comparison Criteria. For this iteration the screening of alternatives used criteria similar to Iteration Three. The criteria used for comparison purposes are the NED, Planning Objectives, and Local Planning Objectives.

1. National Economic Development. For this iteration, alternatives with several different levee heights were evaluated based on comparisons of net benefits (table 39). As indicated by the evaluation results in table 35, Alternatives 4 and 10 have positive BCR's and associated net annual benefits.

> **Summary Results:** For Alternatives 1 and 1A, 1C and 1A-C provide the greatest reduction in residual damages and have the highest annual benefits but BCR's less than 1.0. Alternative 4C is effective at reducing residual damages and reasonably maximizes the net NED benefits while addressing the Study objectives. Alternative 10E maximizes the annual net benefits but does not meet any of the criteria as set forth. The plan which reasonably maximizes net benefits or the NED Plan has not been identified at this time. The plans that maximize annual benefits for the four alternatives individually are 1C, 1A-C, 4C, and 10E.

2. Planning Objectives. The planning objects are described in Section 2.4. All of the alternatives considered meet the criteria the Planning Objectives to varying degrees. Table 40 displays the damage reaches that have a levee/floodwall present under each Alternative condition. Table 41 displays the amount of flood damage reduced (benefit) for the array of alternatives as a percentage of without project damages in the entire study area and the without project damages in the reaches the alternative would protect. Alternatives 1C and 1A-C (87.8 and 85 percent, respectively) provide the maximum amount of flood damage reduction potential. Alternative 4C reduces damage to the entire Study area by 56.8 percent and Alternative 10E by 36.5 percent.

Table 39. Economic Performance of the Alternatives [1]

Alternative	With Project Residual EAD	Project First 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
1D	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
10Z	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	8,673	60,347	3,009	3,740	1.24	731

[1] February 2010 Prices, 4.375% Interest Rate, 50 year period of analysis, $1,000's

Table 40. Damage Reaches Protected Under Each Alternative Condition

Damage Reach	Alternative 1	Alternative 1A	Alternative 4	Alternative 10
1				
2A	Levee/Floodwall	Levee/Floodwall		
2B	Levee/Floodwall	Levee/Floodwall		
2C	Levee/Floodwall	Levee/Floodwall		
2D	Levee/Floodwall	Levee/Floodwall		
3				
4A	Levee/Floodwall			
4B	Levee/Floodwall	Levee/Floodwall	Levee/Floodwall	Levee/Floodwall
5A	Levee/Floodwall	Levee/Floodwall	Levee/Floodwall	
5B	Levee/Floodwall	Levee/Floodwall	Levee/Floodwall	
5C	Levee/Floodwall	Levee/Floodwall	Levee/Floodwall	Levee/Floodwall
6				
7				
8				
9				

Table 41. Planning Objectives Effectiveness for Alternatives [1, 2]

Alternative	W/out Project EAD (Entire Study Area)	W/out Project EAD (by reach)	Flood Damage Reduced (by reach)	Residual Flood Damage	Damage Reduced (%) w/out Project EAD (Entire Study Area)	Damage Reduced (%) w/out Project EAD ((by reach)
No Action	10,257,330	10,257,330	0	10,257,330	0.0%	0.0%
1Z	10,257,330	9,871,580	5,332,120	4,925,210	52.0%	54.0%
1A	10,257,330	9,871,580	6,579,560	3,677,770	64.1%	66.7%
1B	10,257,330	9,871,580	7,599,520	2,657,810	74.1%	77.0%
1C	10,257,330	9,871,580	9,001,360	1,255,970	87.8%	**91.2%**
1D	10,257,330	9,871,580	9,825,430	431,900	95.8%	99.5%
1A-Z	10,257,330	9,645,780	5,275,820	4,981,510	51.4%	54.7%
1A-A	10,257,330	9,645,780	6,467,650	3,789,680	63.1%	67.1%
1A-B	10,257,330	9,645,780	7,392,170	2,865,160	72.1%	76.6%
1A-C	10,257,330	9,645,780	8,714,910	1,542,420	85.0%	90.3%
1A-D	10,257,330	9,645,780	9,510,260	747,070	92.7%	98.6%
4Z	10,257,330	6,427,770	3,959,460	6,297,870	38.6%	61.6%
4A	10,257,330	6,427,770	4,779,760	5,477,570	46.6%	74.4%
4B	10,257,330	6,427,770	5,285,770	4,971,560	51.5%	82.2%
4C	10,257,330	6,427,770	5,829,390	4,427,940	56.8%	90.7%
4D	10,257,330	6,427,770	6,120,590	4,136,740	59.7%	95.2%
10Z	10,257,330	4,279,100	2,913,960	7,343,370	28.4%	68.1%
10A	10,257,330	4,279,100	3,405,220	6,852,110	33.2%	79.6%
10E[3]	10,257,330	4,279,100	3,739,750	6,517,580	36.5%	87.4%
10B	10,257,330	4,279,100	3,820,230	6,437,100	37.2%	89.3%
10C	10,257,330	4,279,100	4,014,740	6,242,590	39.1%	93.8%
10D	10,257,330	4,279,100	4,100,930	6,156,400	40.0%	95.8%

[1] This table includes overbank flood damages to residential, commercial, industrial, and public structures. It does not include the Public Damages reported in FEMA Project Worksheets or NFIP administrative costs reduced.

[2] Induced damages upstream were not calculated or included for alternatives 1 and 1A. Alternative 4 and 10 do not induce damages upstream.

[3] Alternative 10-E is the combination of Alt. 5 at the "A" crest elevation and Alternative 7 at the "B" crest elevation.

3. **Local Planning Objectives.** The City established objectives for the Study through their planning efforts as outlined in the RCRP and Section 2.4. The RCRP began gathering and compiling public input only days after the June 2008 flood event. The City's main goals and objectives that were considered in Iteration Four analysis are:

    - **Potential Flood Risk Management Alignment.** The City of Cedar Rapids endorsed Alternative 1A-C as the City's Preferred Plan in a letter to the Rock Island District dated June 22, 2010. In this letter the City also expressed support for Alternative 4C as an integral portion of the City's Preferred Flood Management System. Alternative 10 is unacceptable to the City as it provides flood risk management to only two small industrial areas on the East side.

    - **Flood Level Impacts.** The flood level impacts of the alternatives are listed in table 42. For more details, see Appendix A, *Hydrology and Hydraulics.*

        - Alternatives 1C and 1A-C could have significant impacts to flood levels upstream, which have not been investigated during this Study.

        - Alternatives 4C and 10E: There will be minor increases in water levels across the western floodplain. There are no expected downstream effects from either of these alternatives.

    - **Overall Study Area Impacts.** Alternatives 1 and 1A provide the greatest reduction in flood risks, from an aerial standpoint, at A and D levee heights (table 43), as they provide flood risk reduction ranging from approximately 750 to 1,600 acres. Alternative 4 significantly reduces flooding ranging from approximately 425 acres to 525 acres. Alternative 10 provides flood risk management for approximately 100 acres for both the A and D elevations.

As a result of the comparisons in Iteration Four, the following Alternatives were recommended for the Final Array.

No Action
Alternative 1C
Alternative 1A-C
Alternative 4C
Alternative 10E

Table 42. Increase in Water Surface Elevation for Various Alternatives

Alternative	Economic Damage Reach	25-yr, 4% Chance Event Increase (ft)	50-yr, 2% Chance Event Increase (ft)	100-yr, 1% Chance Event Increase (ft)	200-yr, 0.5% Chance Event Increase (ft)	500-yr, 0.2% Chance Event Increase (ft)
1 & 1A	Average Increase	0.01	0.06	0.27	1.20	2.35
4	Reach 1 Average	0.00	0.02	0.12	0.14	0.31
4	Reach 2A Average	0.01	0.06	0.22	0.24	0.50
4	Reach 2B Average	0.01	0.06	0.24	0.25	0.56
4	Reach 2C Average	0.02	0.03	0.23	0.61	0.89
4	Reach 2D Average	0.01	0.02	0.13	0.32	0.55
10	Average Increase	Insignificant	0.01	0.08	0.16	0.19

Table 43. Acres Per Alternative Height

	USACE 2010 Floodplain Delineation (Acres per Index Crest Elevation)	
	Elevation A	**Elevation D**
Alternative 1	1035	1620
Alternative 1A	755	1285
Alternative 4	425	525
Alternative 10	90	120

4.3. Final Iteration * This section describes the final analysis of alternative plans that address the planning objectives, the comparison of those plans, and the identification of the Recommended Plan.

4.3.1. Evaluation of Alternatives. A final array of alternatives was assembled using those alternatives that were retained for further consideration. The alternatives were evaluated using 1) the non-Federal Sponsor's Views; 2) NED Benefits and Residual Damages; 3) Reducing Flood Risk; 4) Emergency Measures; 5) Critical Public Infrastructure; and 6) Study Objectives. The on-going implementation of nonstructural measures throughout the floodplain was considered as additional features to each alternative. The final array is as follows:

- The No Action Alternative assumes that that no project would be implemented by the District to achieve the planning objectives. Critical assumptions in defining the No Action Alternative include: Emergency flood fighting activities would continue to occur. Development in the floodplain would comply with floodplain regulations meaning development would occur above the FEMA 1 percent chance event.
- Alternative 1C provides FRM to both the east and west sides of the Cedar River in downtown Cedar Rapids including the Cedar Lake Area. This alternative was initially favored by the City but is not justified based on NED benefits with a maximum BCR of 0.75.
- Alternative 1A-C provides FRM to both the east and west sides of the Cedar River in downtown Cedar Rapids excluding the Cedar Lake Area. This is the alternative favored by the City and the subject of their letter of June 22, 2010 requesting a waiver that would allow selection of Alternative 1A-C as the recommended plan. This alternative is not justified based on NED benefits with a maximum BCR of 0.77.
- Alternative 4C provides FRM to 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. This alternative is acceptable to the City and is economically justified.
- Alternative 10E provides FRM to two separate industrial areas on the east side of the Cedar River in downtown Cedar Rapids using two ring levees. These areas are also included within area protected by Alternative 4C. This alternative is not acceptable to the City but is economically justified.

These 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: (1) development of a preferred long-term flood strategy to reduce risks on both sides of the Cedar River through structural and nonstructural measures; (2) implementation of a robust interim flood response plan; (3) utility and infrastructure improvements; (4) voluntary property acquisitions in conjunction with FEMA, HUD , and LOST (over 1,200 structures have been identified for these programs); (5) community education on flooding, including encouraging residents to buy down risk through flood insurance; (6) building code review/revisions; and (7) assistance to homeowners to flood proof their homes. The City fully recognizes that FRM is a shared responsibility among the Federal, state, and local governments and public. The City's efforts have been significant, but to substantially reduce flood risk, a structural solution is required. The following tables summarize the features of each alternative in the final array for both the west side (table 44a) and the east side (table 44b) of the Cedar River.

Table 44a. Summary of Project Features of Final Array – **WEST SIDE**

	Alternative 1C				Alternative 1A-C				Alternative 4C				Alternative 10E			
	Height (ft)	Length (ft)	Avg Height(ft)	Unit	Height (ft)	Length (ft)	Avg Height (ft)	Unit	Height (ft)	Length (ft)	Avg Height (ft)	Unit	Height (ft)	Length (ft)	Avg Height (ft)	Unit
	West Side				West Side				West Side - None				East Side (Damage Reach 4B)			
Clay Levee																
		11337				11337								174		
Concrete Floodwalls																
	9	134			9	134							3	627		
	12	1865			12	1865							6	533		
	15	1466			15	1466							9	114		
	18	597			18	597							12	2232		
	24	739			24	739							15	1815		
													18	71		
Total		**4801**	**15**			**4801**	**15**							**5392**	**11**	
Removable Floodwalls																
	9	231			9	231							3	268		
	15	150			15	150							9	61		
													12	200		
													15	215		
Total		**381**	**11**			**381**	**11**							**744**	**9**	
Closure Structures																
	7	70		1	7	70		1					2	70		1
	10	60		1	10	60		1					6	80		1
	12	20		1	12	20		1					10	40		1
	12	40		1	12	40		1								
Roller Gates	12	90		3	12	90		3								
	15	60		2	15	60		2								
	16	40		1	16	40		1								
	18	60		1	18	60		1								
	21	20		1	21	20		1					2	50		1
Swing Gates													3	30		1
													15	40		1
Total		**460**	**13**	**12**		**460**	**13**	**12**						**310**	**6**	**6**
Summary of Closures	11 traffic & 3 railroad				11 traffic & 3 railroad								6 traffic & 4 railroad			
Storm Water Pump Stations – gallons per minute																
Station 1				14,000				14,000								
Station 2				54,000				54,000								
Station 3				24,000				24,000								
Station 4				1,500				1,500								
Station 5				17,000				17,000								
Station 6				6,000				6,000								
Station 8																1,500
Total				**116,500**				**116,500**								**1,500**

Table 44b. Summary of Project Features of Final Array– **EAST SIDE**

	Alternative 1C				Alternative 1A-C				Alternative 4C				Alternative 10E			
	Height (ft)	Length (ft)	Avg Height(ft)	Unit	Height (ft)	Length (ft)	Avg Height (ft)	Unit	Height (ft)	Length (ft)	Avg Height (ft)	Unit	Height (ft)	Length (ft)	Avg Height (ft)	Unit
	East Side				East Side				East Side				East Side South (Damage Reach 5C)			
Clay Levee																
		9338				3950				3950				557		
Concrete Floodwalls																
	3	793			3	525			3	525			3	1079		
	6	430			6	75			6	75			6	1590		
	9	1267			9	781			9	781			9	1228		
	12	3402			12	3290			12	3290			12	325		
	15	2750			15	4113			15	4113			15	575		
	18	2255			18	2533			18	2533						
					21	131			21	131						
Total		**10897**	**13**			**11448**	**14**			**11448**	**14**			**4797**	**8**	
Removable Floodwalls																
	6	211			6	200			6	200						
					12	61			12	61						
					15	200			15	200						
					18	215			18	215						
Total		**211**	**6**			**676**	**13**			**676**	**13**					
Closure Structures																
Roller Gates	9	60		1	9	75		1	9	75		1	2	50		1
	9	75		1	10	90		1	10	90		1	2	60		1
	10	90		1	11	20		1	11	20		1	8	70		1
	11	20		1	11	80		2	11	80		2				
	11	80		2	12	50		1	12	50		1				
	12	50		1	12	60		1	12	60		1				
	12	60		1	14	40		1	14	40		1				
	13	90		1												
	14	40		1												
Swing Gates	3	20		1	12	90		1	12	90		1	9	90		1
	3	30		1	19	40		1	19	40		1				
	12	90		1												
Total		**705**	**11**	**13**		**545**	**12**	**10**		**545**	**12**	**10**		**270**	**6**	**4**
Summary of Closures	12 traffic & 4 railroad				10 traffic & 6 railroad				10 traffic & 6 railroad				5 traffic & 2 railroad			
Storm Water Pump Stations – gallons per minute																
Station 9				1,500												
Station 8				5,000				5,000				5,000				
Station 11				1,500				1,500				1,500				
Station 10				15,000				15,000				15,000				
Station 13				500				500				500				
Station 15				1,500				1,500				1,500				1,500
Total				**25,000**				**23,500**				**23,500**				**1,500**

Tables 45 and 46 outline the costs of each alternative.

Table 45. Total Project Costs for Final Array of Alternatives
Dollars Shown in ($000)

Alternative	1C	1A-C	4C	10E
Construction Cost – Measure [1]	$148,039	$142,504	$70,896	$40,321
Total Construction Costs	**$148,039**	**$142,504**		**$40,321**
PE&D (18%)	$26,647	$25,651	$12,761	$7,258
S&A (10%)	$14,804	$14,250	$7,090	$4,032
Subtotal	**$189,490**	**$182,405**	**$90,747**	**$51,611**
Real Estate [2, 3, 4]	$52,600	$49,800	$11,100	$4,400
Environmental Mitigation	$908	$0	$0	$0
Cultural Mitigation (1%)	$1,480	$1,425	$709	$403
Total	**$244,478**	**$233,630**	**$102,556**	**$56,414**
Annual O&M Costs	**$80**	**$75**	**$35**	**$17**

[1] Costs based on estimates from Stanley Consultants dated 2-2-2010, 2-8-2010, 2-11-2010, and 3-24-2010.
[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.

Table 46. Annual Costs to Implement Final Array of Alternatives
Dollars Shown in ($000) [1]

Alternative	1C	1A-C	4C	10E
Construction Cost	$28,563	$28,563	$28,563	$40,321
PE&D	$5,141	$5,141	$5,141	$7,258
S&A	$2,856	$2,856	$2,856	$4,032
Year 1				
PE&D (50%)	$1,542	$1,542	$1,542	$3,629
Construction (20%)	$2,856	$2,856	$2,856	$8,064
S&A (20%)	$286	$286	$286	$806
Year 2				
PE&D (30%)	$1,542	$1,542	$1,542	$2,177
Construction (50%)	$7,141	$7,141	$7,141	$20,161
S&A (50%)	$714	$714	$714	$2,016
Year 3				
PE&D (20%)	$771	$771	$771	$1,452
Construction (30%)	$8,569	$8,569	$8,569	$12,096
S&A (30%)	$857	$857	$857	$1,210
Year 4				
PE&D (15%)	$771	$771	$771	
Construction (20%)	$5,713	$5,713	$5,713	
S&A (20%)	$571	$571	$571	
Year 5				
PE&D (10%)	$514	$514	$514	
Construction (15%)	$4,284	$4,284	$4,284	
S&A (15%)	$428	$428	$428	

[1] Assumes 5-year construction duration

A summary of the economic performance of these alternatives is shown in table 47.

Table 47. Economic Performance of the Final Array of Alternatives [1]

Alternative	Total Residual EAD	Project First Costs	Total Annual Costs	Total Annual Benefits	BCR	Annual Net Benefits
10E	8,673	60,347	3,009	3,740	1.24	731
4C	6,269	115,760	5,774	6,144	1.06	370
1A-C	2,244	266,081	13,267	10,169	0.77	-3,098
1C	1,954	278,571	13,891	10,455	0.75	-3,436

[1] Feb. 2010 Prices, 4.375% Interest Rate, 50 year period of analysis, $1,000's

4.3.2. Comparison of Alternatives. Alternatives 1C and 1A-C are not economically justified. Only two alternatives, Alternatives 4C and 10E, remained for comparison and consideration as the Recommended Plan.

4.3.2.1. Non-Federal Sponsor's Views. The City conducted an intensive public planning process immediately following the June 2008 flood that included input from nearly 3,000 citizens. This process resulted in identification of the City's Preferred Flood Management System which was approved by the City Council in November 2008. This plan includes a system of levees and floodwalls on both sides of the river, integrated with recreation and a voluntary property acquisition program to reduce risk. The City has requested an exception to allow Alternative 1A-C to be identified as the Recommended Plan based on the beneficial effects from the Other Social Effects (OSE) and Regional Economic Development (RED) accounts in addition to the NED account. This request is discussed in the City's letter to the ASA(CW) dated June 22, 2010.

The June 22, 2010 letter further states the City's support for Alternative 4C as an integral portion of the City's Preferred Flood Management System. Alternative 4C is consistent with their Preferred Flood Management System and reduces risk for the predominantly commercial and industrial properties on the east bank of the river.

The City has stated that it does not support Alternative 10E. This plan is not compatible with their Preferred Flood Management System and does not reduce risk to enough of the community to be acceptable. The City has voiced strong objections to alternatives that protect only higher value industrial properties without protecting adjacent smaller businesses and residences.

Construction of either Alternative 4C or 10E would have negligible negative effects on terrestrial, wetland, or aquatic resources in the project area. Neither alternative would result in downstream 1 percent chance flood stage increases or significant upstream stage impacts. Alternative 10E would result in a maximum increase of 0.1 foot and Alternative 4C would result in a maximum increase of 0.4 foot for the 1 percent chance flood stage. These amounts have been coordinated with the State of Iowa and FEMA and are considered acceptable

4.3.2.2. NED Benefits and Residual Damages. The economic analyses presented in tables 35, 37, 41, and 43 are based on construction cost contingencies of 25 percent. A technical review of the Cost Schedule Risk Analysis [(CSRA), see Section 4.6 for additional details] found that the cost contingency could be reduced for Alternative 4C to 20 percent. This cost contingency reduction was extrapolated to refine the cost estimate for Alternative 10E to allow for the equal comparison of Alternatives 4C and 10E. Also further review found that the construction period used for Alternative 10E was not the same as what was used for Alternative 4C. The construction period for Alternative

10E was changed to five years of construction to match Alternative 4C because of their similar construction footprints and alignments length. The assumptions and subsequent changes in the analysis were reviewed by the Agency Technical Review (ATR) Team. The costs and benefits per plan are shown in table 48.

In comparing the two alternatives, Alternative 4C produces larger overall economic benefits to more people (more than 500 residents compared to fewer than 100 residents) and positively affects a greater geographic area than Alternative 10E (523 acres compared to 122 acres). As shown in table 49, Alternative 4C produces 65 percent greater average annual benefits: $6,144,000 compared to $3,740,000 for Alternative 10E. Alternative 4C would require an additional Federal investment of $28.6 million compared to Alternative 10E to get increased NED benefits of $2,404,000 per year. Alternative 4C also results in 33 percent less annual residual damages than Alternative 10E: $6,056,000 compared to $8,460,000. Estimated Annual Damages (EAD) for the east side of the river exclusively is approximately $7.3 million. Thus, for a reduction of $7,000 in net NED benefits, Alternative 4C achieves approximately an 84.2 percent reduction in residual damages on the east side of the river as compared to approximately a 51.2 percent reduction associated with Alternative 10E.
:

Table 48. Costs and Benefits by Plan
(FY2010 prices, 4-3/8% discount rate, 50-year evaluation period)

Cost Estimated Date	Plan	NED Cost Estimate	# Years Construction	Interest During Construction	Total First Costs	Annualized First Costs	Annual O&M Costs	Total Annual Costs	Total Annual Benefits	BCR	Net Annual Benefit
6/28/2010	4C [1]	98,328,000	5	9,388,000	107,716,000	5,340,000	17,000	5,358,000	6,144,000	1.15	786,000
9/20/2010	10E [2]	54,335,000	5	5,017,000	59,352,000	2,943,000	4,000	2,947,000	3,740,000	1.27	793,000

[1] The total project cost including the contingency estimate that resulted from the Cost Schedule Risk Analysis for Alternative 4C is $98,788,000. The Relocation Expenses ($460,000) were subtracted (per ER 1105-2-100 and Public Law 91-464) from the total project cost of $98,788,000 to calculate $98,328,000 in NED costs. Total annual NED cost is $5,358,000. Total annual benefits are $6,144,000. The benefit-to-cost ratio is 1.15 to 1.00, with net benefits of $786,000.

[2] The total project cost including the contingency estimate of 20% for Alternative 10E is $54,355,000. No Relocation Expenses ($0) were estimated or subtracted from the alternative (per ER 1105-2-100 and Public Law 91-464). With 5 years of construction and IDC of $5,017,000, total annual NED cost is $2,947,000. Total annual benefits are $3,740,000. The benefit-to-cost ratio is 1.27 to 1.00, with net benefits of $793,000.

Table 49. Summary of Comparison of Alternative 10E and Alternative 4C

	Alternative 10E	**Alternative 4C**	**Difference**
Total First Cost	$54,335,000	$98,328,000	+$43,973,000
Federal Cost Share	$35,320,000	$63,910,000	+$28,590,000
Non-Federal Cost Share	$19,015,000	$34,418,000	+$15,403,000
Annual Cost	$2,947,000	$5,358,000	+$2,411,000
Avg. Annual Benefits (Damage Reduced)	$3,740,000	$6,144,000	+$2,404,000
Net Annual Benefits	$793,000	$786,000	-$7,000
Residents at Risk	100	600	+500
Employees at Risk	1,366	9,340	+7,974
Total Population at Risk (east bank only)	1,466	9,940	+8,474
Area Positively Affected	122 acres	523 acres	401 acres
Top of Levee (Based on Elevation/Stage-(feet) @ gage)	Reach 4B 29.3 Reach 5C 27.1	732.4	
Annual Damages w/o Project	$12,200,000	$12,200,000	0
Total Residual Damages	$8,460,000	$6,056,000	-$2,404,000
Percent Reduction in Damage	30.7%	50.4%	+19.7%
East Side Annual Damages w/o Project	$7,300,000	$7,300,000	
East Side Annual Benefits	$3,740,000	$6,144,000	+$2,404,000
Percent Reduction in Damage	51.2%	84.2%	+33%
Emergency Measures w/ Project at 0.1 percent flood event	Flood fighting required. Temporary sandbag levees/closure, street closures, plugging of storm sewers, constructs wells at storm intakes & manholes, etc	Minimal measures required.	
Critical Public Infrastructure Protected		City Administration Bldg, Mercy Hospital, Ground Transportation Center, US Post Office, electrical substations, underground steam heating network, buried fiber optics network, sanitary sewer mains, water mains, gas lines, storm sewer network	
RED Benefits	$75,000,000	$131,000,000	+$56,000,000

4.3.2.3. Reducing Flood Risk. Because of the large area of the City that is susceptible to flooding and the considerable depth and velocity of the flood waters, there is a risk for loss of life during flood fighting and other emergency measures; evacuation of residents, employees, and students. Despite a recorded 423 boat rescues during the flood, there were no fatalities. In the 2008 flood event, the flood forecast dramatically increased in the last 24 hours preceding the flood crest. he uncertainty of the forecasts and the possibility of very rapid increases in flood depths, combined with a population of nearly 10,000 residents and employees in the floodplain on the east side of the river, cause a significant risk for loss of life. Alternative 4C would substantially reduce flood risk to the east bank of the river in Cedar Rapids which includes approximately 600 residents and 9,340 employees. The City has indicated that constructing levees at an elevation of 32.4 feet would provide an acceptable degree of risk reduction. Alternative 10E would be constructed to a lower level of flood damage reduction and would reduce risk to fewer than 100 residents and fewer than 1,500 employees. Alternative 10E would minimally reduce the community's flood risk.

4.3.2.4. Emergency Measures. Because the flood forecasts for the 2008 flood event changed dramatically in the hours preceding the flood crest, the City's flood fighting strategy changed repeatedly. Efforts were ultimately abandoned when it became clear there was not be enough time left to construct the required temporary measures (temporary levees, sandbagging manholes and storm sewer intakes, and flood proofing public buildings) to protect the entire downtown area. The uncertainty of the forecasts and the possibility of very rapid increases in flood depths, make it impractical to effectively fight large flood events that impact the entire downtown. The 2008 flood event resulted in nearly $85.7 million in costs for emergency protection measures and $7.7 million in costs for debris removal after the event.

Alternative 10E would provide no substantial benefits to the City in reducing flood fighting or emergency measures since very few public facilities would be protected; the businesses protected by the ring levees are independent of City flood fighting efforts. The areas between the ring levees in Alternative 10E (designated as Reaches 5A and 5B on the map) contain several public buildings, Mercy Hospital, and numerous utilities that, along with private homes, require emergency measures to protect during flood events. Alternative 4C would protect these facilities and infrastructure and would reduce the City's need for flood fighting and emergency measures on the east side of the river, allowing them to focus their flood fighting and emergency response efforts on the people and property on the west side of the river.

4.3.2.5. Critical Public Infrastructure. Alternative 4C would reduce risks to critical infrastructure and public facilities including Mercy Hospital, the U.S. Post Office, the Federal Courthouse, electric utilities, sanitary sewers, gas lines, streets, railroads, and water lines that were damaged or destroyed by the 2008 flood event. This alternative would also allow limited operation of some local railroad lines during flood events, although the main lines would likely be out of service. Alternative 10E does not protect critical infrastructure or significant public facilities. Because the utilities and infrastructure serving structures protected by Alternative 10E would be flooded, none of the businesses protected by Alternative 10E would be able to function during floods.

4.3.2.6. Study Objectives. The P&G defines effectiveness as a measure of the extent to which a plan achieves its objectives. Both Alternatives 4C and 10E meet the criteria of effectiveness to varying degrees. The two objectives relevant to this discussion are:

1. Provide a comprehensive solution to the City's flooding problems by reducing flood damages to private and public infrastructure from flooding greater than the 1 percent chance event. This objective is focused on minimizing the number of people/structures which remain vulnerable to flooding.
2. Improve the response by local, state, and Federal agencies to the flood events along the Cedar River in the City. Inherent in this objective is providing a technically sufficient FRM system.

Alternative 10E provides flood damage reduction to limited portions of the Study area with minimal flood damage reduction to residential areas. This alternative reduces flood damages and risk primarily for key industrial facilities, but because this alternative does not protect the City infrastructure serving these facilities, the facilities are not able to stay in operation during a flood event. This alternative also does not add appreciable benefits to the reduction of flood fighting or flood response as it affects only small portions of the floodplain.

Alternative 4C meets the planning objectives to a greater degree than Alternative 10E because it reduces risk to the City business district and public facilities as well as key industrial facilities, and allows these facilities to remain functional during all but the largest flood events. Although the City continues to support structural flood risk management for both sides of the river, the Alternative 4C structural measures in combination with the on-going City voluntary property acquisition program and flood proofing measures on the west side of the river provide a comprehensive solution to the City's flooding problem.

4.3.2.7. Regional Economic Development Benefits. As reported in Appendix R, *Regional Economic Development*, due to the 2008 flood event, the City has estimated an economic loss of $2.5 billion in business sales and 14,500 work-years of employment in the County during the flood recovery period. Alternative 4C would provide estimated total regional economic development benefits of $131 million; $56 million more in benefits than Alternative 10E. Alternative 4C will also provide significant additional regional benefits since it would allow the businesses to continue to function during major flood events.

4.3.2.8. Plan with the Greatest Net NED Benefits. Alternative 4C has been identified as the plan that reasonably maximizes net NED benefits (i.e., annual net NED benefits $786,000). This plan includes the construction of levees and floodwalls on the east bank of the river that provide flood risk reduction to 41 public structures, 150 commercial/industrial structures and 155 residential structures. The estimated first cost of this alternative is $98.3 million which would be cost-shared 65/35 percent between the Federal government and the City. This results in a Federal cost share of $63.9 million and a non-Federal cost share of $34.4 million. A summary of the economic analysis for Alternative 4C is outlined in Section 4.3.2.2. .

4.3.2.9. Recommended Plan. Alternative 4C provides flood damage reduction for the east bank of downtown Cedar Rapids and is comprised of a system of 3.15 miles of levees and floodwalls. It includes the industrial facilities protected by Alternative 10E plus 120 additional residential structures, 150 additional commercial/industrial structures, and 41 additional public structures located between the two ring levees of Alternative 10E. The estimated first cost of this alternative is $98.3 million which would be cost-shared 65/35 percent between the Federal government and the City. This results in a Federal cost share of $63.9 million and a non-Federal cost share of $34.4 million.

Alternative 4C would require an additional Federal investment of $28.6 million to get increased NED benefits of $2.4 million per year. The protected area includes a resident population of over 500 people and approximately 9,000 employees. Important public facilities protected include the U.S. Federal Courthouse; the U.S. Post Office; the Ground Transportation Center; the Science Museum; Mercy Hospital; US Cellular Center; and the City Administration Building. 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 to the area. A summary of the economic analysis for Alternative 4C is outlined in Section 4.3.2.2. Alternative 4C has annual net NED benefits of $786,000, reduces residual damages on the east bank of the river by 84.2 percent, and reduces the devastation associated with flooding, a significant factor in terms of the community's viability and sustainability. Because Alternative 4C is the most effective at reducing flood risk in Cedar Rapids while providing only slightly fewer net benefits than Alternative 10E, it is identified as the NED Plan and is being recommended as the Recommended Plan.

4.3.3. Trade-off Analysis. The first trade-off to be considered in evaluating the final alternative plans is to distinguish between the No Action Alternative and the other action alternatives. This is followed by the trade-off between the action alternatives.

4.3.3.1. Action Versus No Action. The No Action Alternative fails to meet any of the planning objectives. It has no positive benefits or impacts, since it is the basis from which the impacts and benefits are measured. The No Action Alternative leaves the Study area at significant and unacceptable risk from flooding. Federal involvement in future flood-fighting can be expected in the absence of a Federal FRM project. This Study has shown from a variety of perspectives that there is a Federal and non-Federal interest in taking action to reduce the flood risk in the Study area.

4.3.3.2. Trade-Offs Between Action Alternatives. The second level of trade-offs to consider is those between the action alternatives. Of the action alternatives considered, there are two key trade-offs: 1) the level of flood damage reduction the alternative selected provides and 2) the location of the alternative.

In comparing the level of flood damage reduction, it appears that the highest level of reduction that meets the four formulation criteria for completeness, effectiveness, efficiency, and acceptability and generates the most positive net benefits is Alternative 4C (figure 72).

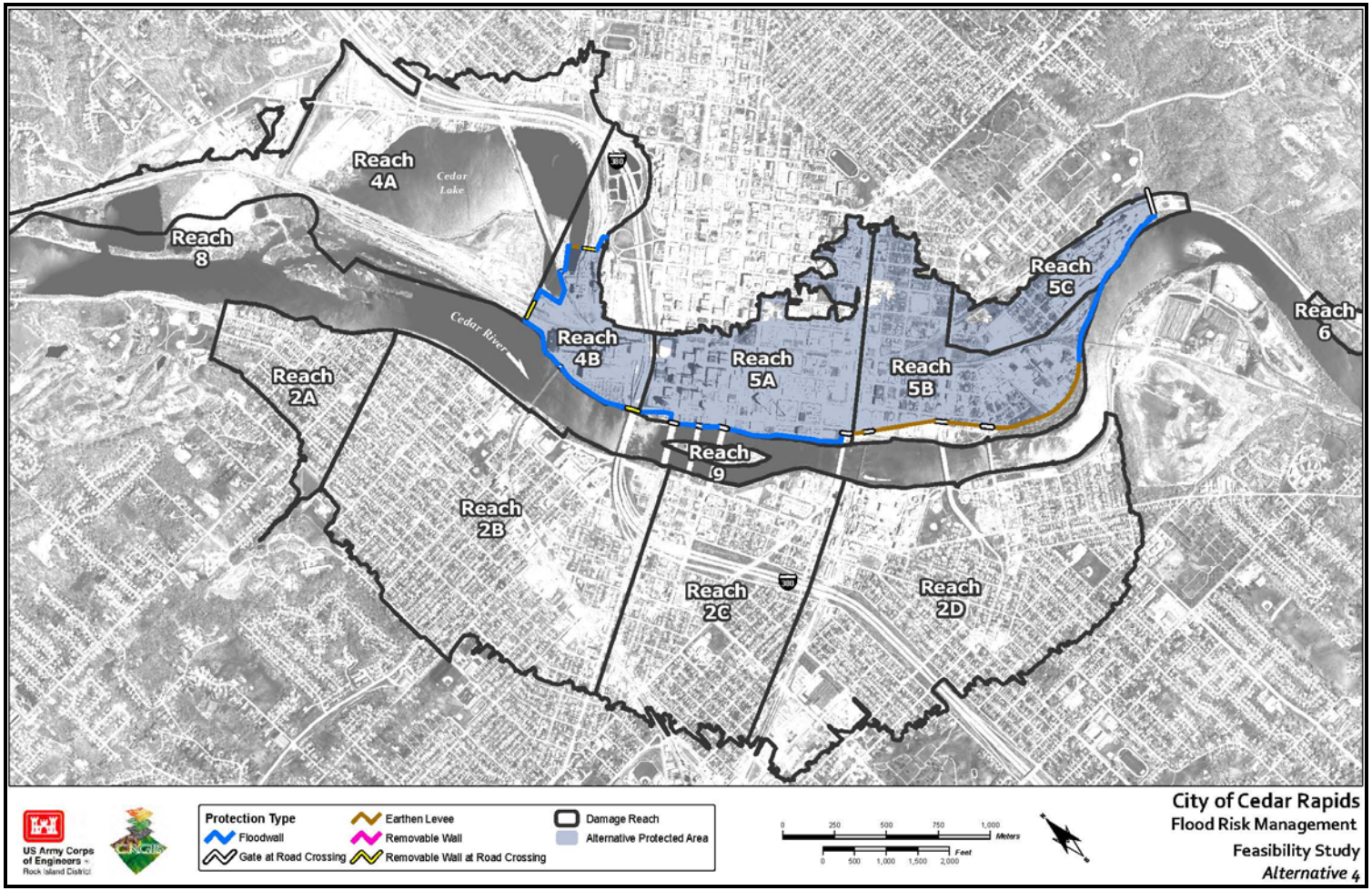

Figure 72. Alternative 4C, Areas Protected

4.4. System of Accounts

4.4.1. Methodology. *The Economic and Environmental Principles for Water and Related Land Resources Implementation Studies*, established by the Water Resources Council in 1983, created four criteria known as "accounts" to facilitate evaluation and effects of alternative plans:

- The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services.
- The Environmental Quality (EQ) account displays non-monetary effects on significant natural and cultural resources.
- The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan.
- The Other Social Effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

The economic feasibility of each alternative was determined by performing a cost-benefit 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 (Appendix O, *Planning Formulation*). The economic performance of the final array of alternatives is presented in table 43.

4.4.2. National Economic Development (NED). The intent of comparing alternative FRM plans in terms of NED is to evaluate the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects are considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED are expressed as the plan's economic benefits, and the adverse NED effects are the investment opportunities lost by committing funds to the implementation of a plan. Comparison of the plans under consideration using the NED account is shown on table 35. The values for net benefits shown on the table are the differences between the average annual economic benefits and the average annual cost associated with each plan.

For the final array of alternatives several top of levee heights were evaluated for benefits and costs. As indicated by the evaluation results in table 35 and outlined in Section 4.3.2.2., Alternative 4 reasonably optimizes at the levee height designated as "C", and Alternative 10E optimizes at levee height "E" which is a combination of levee heights "A" and "B". Alternative 4C is identified as the plan that maximizes net annual benefits.

Summary of Results. Among the final array of alternatives considered and presented in Section 4.3.2.2., Alternative 4C and 10E are economically feasible. Alternatives 1C and 1A-C have BCRs less than 1.0 and accordingly, have negative net benefits. Alternative 4C has been identified as the plan that reasonably maximizes NED benefits and has been identified as the NED Plan and the Recommended Plan.

The No Action plan has zero net benefits and results in average annual damages of approximately $12 million for all damage reaches.

4.4.3. Environmental Quality (EQ). The EQ account is another means of evaluating the alternatives to assist in making a plan recommendation. The EQ account is intended to display the long-term effects that the alternative plans may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. Significance is derived from institutional, public, or technical recognition that a resource or an effect is significant. There are no significant environmental resources associated with this project.

The District has determined that there is a high potential for the Project to contain significant archeological and architectural properties based upon the findings and recommendations of the Bear Creek Archeology report (Benn, Thompson, Bettis, and Lee, 2010) and the site-specific information contained within the state files of the Iowa Office of the State Archaeologist.

The District considered the protection and avoidance of cultural resources and NRHP properties during the evaluation of Study alternatives and will continue to avoid and minimize effects to those NRHP properties under the appropriate cultural resource laws and the executed Programmatic Agreement (PA) found in Appendix C.

4.4.4. Regional Economic Development (RED). The RED account is intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically, regional income and regional employment. The comparison of possible effects that the plans may have on these resources is shown in table 50.

In response to a rare flooding event that impacted the City in 2008, the District is currently examining three levee alignments (Alternatives 1, 4, and 10) for the evaluation area. The analysis included various levee heights—A, B, C, D—as defined in table 33. The construction period for these levee alignments is 5 years based on the design of the levees, and the estimated costs of the levee alignments range from approximately $16 million to $221 million. The complete RED report is included in Appendix B, *Economics*.

This (RED) analysis was conducted using the Impacts for Planning (IMPLAN) computer model, which 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 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 gross regional product 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

The City, at its own expense, prepared *"Regional Economic Impacts of the 2008 Cedar Rapids Flood"* by Dennis P. Robinson, Ph.D (Appendix R). This report addressed three types of regional economic development:

- the direct, indirect, and induced economic impacts of business losses caused by the 2008 flood event;
- the direct, indirect and induced economic impacts of permanent job losses caused by the 2008 flood event; and
- the impacts of periodic flooding of businesses not protected by some type of mitigation facility

The report summarizes the temporary and permanent economic consequences of the 2008 flood. In general, the analysis states that without flood damage reduction, the local business will see increased costs due to periodic damages and the associated higher insurance rates. The regional economic development effects specific to the 2008 flood event were not evaluated in the Corps analysis because existing guidance states that the RED account is intended to illustrate the effects that proposed plans would have on regional economic activity.

Table 50. Summary of Regional Economic Impacts (dollars in 000's) [1]

			Employment		Income		Output		Regional Product		Tax Revenue	
Alternative [2]	**Years [3]**	**Total Construction Stimulus [4]**	**Peak [5]**	**Average [6]**	**Peak [5]**	**Average [6]**	**Peak [5]**	**Average [6]**	**Peak [5]**	**Average [6]**	**Peak [5]**	**Average [6]**
1D	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
10E	3[7]	$52,014	261	182	13,932	9,743	35,901	24,883	17,807	12,431	1,184	824

[1] 2010 Price Level
[2] See narrative for definition of alternatives.
[3] Years = Number of Years that construction activities impact the regional economy.
[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 flood damage reduction.
[6] Average is the average value of all years of construction for a particular alternative's measure of flood damage reduction and represents the recurring benefits of an alternative over the years of its construction.
[7] This table reflects 3-year construction period for Alternative 10E. The length of construction for Alternative 10E was revised to 5 years after completion of the RED analysis.

4.4.5. Other Social Effects (OSE). The purpose of this OSE analysis is to show the beneficial and adverse effects of an FRM alternative on the social well-being of the City and the surrounding area. This is done by examining the Existing Condition (Section 3.1.10), Future Without Project Condition (Section 3.2.10), and Future With Project Condition with the Recommended Plan (Section 5.2.11) as they relate to important social effects.

The City, at its own expense, prepared the *Other Social Effects Report (City of Cedar Rapids, Iowa – Flood of 2008).* This report is included as Appendix Q and presents the social impacts of the Flood of 2008 and the impact of not implementing the City's Preferred Plan. The analysis presented is only with the City's Preferred Plan and without the City's Preferred Plan. The report does present Other Social Effects factors that capture the benefits of any specific alternatives evaluated in the Study.

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, as presented in the City's report:

- 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 undeveloped areas supports the redevelopment of the flood-impacted area. Rebuilding within the flood-impacted area encourages families to move back to the multigenerational 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 risk management for all residents to ensure that environmental justice is upheld. This is why the City's preferred flood management system provides flood damage reduction for 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 undeveloped 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 that City plans to provide.
- Redevelopment of as much of the flood-impacted area as possible is key to the City's recovery. Flood risk management 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 either no flood damage reduction or partial flood damage reduction.

It is the City's opinion that the Existing Federal Principles and Guidelines that determine the BCR do not take into account that a community which has already sustained a natural disaster, such as the City, has much greater social, environmental, and fiscal impacts than those that are performing this analysis based on a hypothetical disaster. The City feels that it is in a more vulnerable position now than before the flood because sustaining another flood without its preferred flood management strategy could leave lasting scars on the City, its residents, and its businesses, and could decrease the possibility of a full recovery in the future. Many of the residents in the 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. The City would

like to see rebuilding within the flood-impacted area to encourage families to move back to the multigenerational neighborhoods where they have built personal relationships. According to the City, environmental justice, the equal distribution of environmental risks and benefits without discrimination, must also be taken into account when evaluating these flood mitigation plans. The City feels that it must be able to guarantee future flood risk management for all residents to ensure that environmental justice is upheld.

Alternatives 1C and 1A-C proposed by the Study 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 of sustainability, environmental justice, reconnection to the river, and redevelopment. These two alternatives reduce flood damages to the east and west sides of the river. This comprehensive approach to flood management includes structural FRM measures for 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.

4.5. Selection of Recommended Plan. * The Corps' Planning Guidance Notebook, ER 1105-2-100 states "A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objectives, is to be formulated. This plan is to be identified as the NED plan. Alternative 4C is the plan that reasonably maximizes net benefits and is the most effective in reducing residual risk and addressing the planning objectives. Based on the information contained in this report, the Recommended Plan is Alternative 4C.

A CSRA was performed on the Recommended Plan (Alternative 4C). The total project cost including the contingency estimate that resulted from the CSRA for Alternative 4C is $99, 004,000. The Relocation Expenses ($460,000) were subtracted (per ER 1105-2-100 and Public Law 91-464) from the total project cost ($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 1.2 to 1.0, with net benefits of $1,019,000.

4.6. Risk and Uncertainty. * Areas of risk and uncertainty are analyzed and described so that decisions can be made with knowledge of the degree of reliability of the plan. For example, table 51 shows that for Alternative 4C there is a 91.24 percent probability that the top of the levee would not be exceeded, given the occurrence of a 500-year flood (0.2 percent chance event). On the other hand there is still an 8.76 percent probability (1 - 0.9124) that the 500-year flood would exceed the elevation of the top of the levee. See Appendix B, *Economics,* for more details.

Table 51. Performance for Alternative 4C (East Bank Levee Only, Not 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**
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

[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.

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The drop in contingency for Alternative 4C is attributed to the CSRA taking into consideration items such as conservative design development, additional field data collection and development of a contracting acquisition strategy. The following outlines some of the major items impacting the overall project contingency:

- Two thirds of Alternative 4C alignment is comprised of floodwalls. Conservative assumptions exist in the cost estimate quantities. This includes rounding up heights of all floodwalls to the next 3-foot interval. For example, if the design profile height indicated a 3.5-foot high floodwall, it was rounded up to a 6-foot high floodwall in the construction cost estimate. No floodwalls were rounded down.
- A conservative estimate of 6 feet of over excavation and fill replacement was estimated for all floodwall and closure structure foundations.
- All levee earthwork was computer modeled off of surface models generated from 2-foot contour mapping data. Thus, earthwork quantities should be very consistent with final construction amounts.
- As-builts of all existing utilities were obtained for the selected alignment. All impacted utilities were identified and accounted for within the final cost estimate based off as-built data.
- A suitable borrow area at the Eastern Iowa Regional Airport was identified as the study advanced. The site has more than an ample supply of lean clay needed for construction of earthen levees that is readily available on lands owned by the City controlled by the airport authority.
- Construction work is considered to be routine in nature with no work being unique from projects that have been constructed in the past.
- Location of work is higher up in the floodplain so it is at a lower risk from river flooding during construction.
- An acquisition strategy was developed in coordination with Contracting Division. The strategy is to minimize cost by awarding one large construction contract. The contract will be advertised unrestricted Request for Proposals. The lowest price technically acceptable source selection process will be used to evaluate the Request for Proposals.
- Given the total construction cost of the project, it was determined that funding would not come through regular USACE funding sources but instead would come from congressional action. It was further decided that congressional funding would only likely come within the first 2 years after the project receives authorization. If funding does not come within the first couple of years, then it is very unlikely that the impetus to fund this project would exist within Congress.

4.6.1. Flood Risk. 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. 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 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 in the content damage curve. The assumption for the without project and the With Project condition was that contents were left in place and were not elevated above the damage zone.

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 are as follows:

		Structures by Category			
Depth of Flooding	Structures 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)**

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.

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. In the worst case of a massive With Project levee failure it would take 60 to 180 minutes to flood the entire area. With two new stream gages on the Cedar River between Waterloo and Cedar Rapids it is more likely that 6 to 12 hours at a minimum are available to evacuate after threat of overtop recognition. The future Without Project case would most likely resemble the existing case with an increase in warning time. During the 2008 even, the river elevation rose 5.6 feet in 18.5 hours. Several elderly people were removed by boat from their homes but no one drowned.

The most critical time for capacity exceedance of the proposed levee would be at night. About 208 residences (estimate of 600 people) and 8 apartments could eventually be surrounded by water. People living in about 20 of these residences (60 people) would have the time and the necessary low water depths to easily walk to safety. 10 residences (30 people) would have water depths greater than 8 feet above their first floor making their situation very serious. The people living in the remaining 178 residences (530 people) would probably be safe if they left the area immediately. If the flood were in the summer, people unable to evacuate could survive by going to the second floor or by

standing on a desk or appliance until rescued. 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 social networks offered by the two main commercial centers at Quaker and Cargill. Many of the studies of past floods due to dam breaks have shown that people endanger themselves by staying with their car or trying to reach safety by driving through water. This same behavior would probably occur during evacuation of the area landward of Alternative 4C levee but could be anticipated and overcome by planned evacuation routes and pre-flood evacuation training exercises.

The City of Cedar Rapids currently maintains a Flood Response Manual that is updated on a regular basis. Major items contained within this manual include: emergency points on contact; Cedar River flood response tasks and maps; inundation maps; excavation route maps; flash flood response for local creeks; and supplemental flood fighting materials. This manual will be updated as appropriate after construction of the selected plan. In addition to the Flood Response Manual, an OMRR&R Manual will be written specifically for the selected plan. All closure structures contained within the selected plan are permanent in nature and can be erected and closed in advance of a coming flood on the Cedar River. The City will be required to execute periodic closure of all structures at least once every 3-years as part of the operation and maintenance schedule. Periodic installation exercises will ensure erection crews remain trained and are at appropriate numbers to assure closures can be made in a timely matter.

4.6.2. Cost and Schedule Risk Analysis. In compliance with Engineering Regulation (ER) 1110-2-1302 Civil Works Cost Engineering, a Cost and Schedule Risk Analysis (CSRA) was conducted on the selected plan, Alternative 4C. The CSRA was facilitated by the Cost Engineering Directory of Expertise (Cost DX) and developed in conjunction with the Cedar Rapids PDT. The purpose of this assessment was to establish an overall project contingency by indentifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost.

The draft CSRA report, as contained within the Appendix I, *Cost Estimate* resulted in a contingency amount of 17.23 percent. However, based on historical experience and reasonable prudence, the Cost DX recommended utilizing a contingency value of 20 percent in lieu of the calculated 17.23 percent. The product delivery team agreed with this assessment and applied a 20 percent contingency to each line item listed on Total Project Cost Summary that is contained in Appendix I. One exception to application of the 20 percent contingency amount was on the line item for Lands and Damages. A 35 percent contingency was applied against this line item. The 35 percent contingency for Lands and Damages was separately developed based on real estate incremental costs assessment completed by a real estate appraiser.

Economic analysis for Alternative 4C was re-calculated based on the refined cost estimate from that of the initial screening cost estimate that utilized a 25 percent contingency. The BCR increased from 1.08 to 1.2 as a result of the reduced contingency on the cost and the lower FY2011 Federal interest rate. The new ratio will be used for budgeting and authorization purposes.

4.7. Description of the Selected Plan. * The Recommended Plan, Alternative 4C, is an alignment comprised of floodwalls and levees that totals 3.15 miles in length. 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 alignment provides flood damage reduction for the central business and industrial corridor on the east side of the Cedar River. The alignment begins along the southern edge of Cedar Lake (Alliant Energy, Cargill, Quaker Oats facilities) and extends down the along the bankline of the Cedar River through downtown, the Oakhill Jackson neighborhood, and the Sinclair-Cargill neighborhood until it reaches high ground by crossing Otis Road SE just south of Cargill. The system would be designed and built to meet all applicable FEMA requirements as provided in 44 CFR Section 65 thus enabling it to be a certified system (figure 73).

4.7.1. Plan Components. Major components of the selected plan include concrete floodwalls, earthen levees, closure structures, and pump stations. Concrete floodwalls comprise approximately two thirds of the total alignment length totaling 2.17 miles. The remainder of the alignment length includes 0.75 mile of earthen levee and a total length of 0.23 mile for all closure structures. All major components were developed as utilitarian designs in order to minimize estimated construction cost.

4.7.1.1. Floodwalls. A majority of the selected plan is comprised of concrete floodwalls. Floodwalls are planned through the downtown and industrial areas where space for the alignment is very limited. Existing infrastructure such as major buildings, structures and roadways make earthen levees through these areas not a feasible option.

In order to minimize construction cost for this project, floodwalls were estimated as plain concrete. No aesthetic treatments such as the use of colored concrete or architectural form liners.

The typical floodwall section developed for this Study is a T-wall design varying 1.5 to 3.0 feet in wall thickness depending upon total wall height. Floodwall heights range from 3 to 21 feet high for the Recommended plan. The average floodwall height is 14 feet above the ground surface. Figure 74 depicts the typical floodwall section utilized in this Study.

A trench 10 feet deep is estimated for the floodwall footing. The bottom 6 feet of the trench accounts for over excavation in anticipation of poor soils typically encountered along riverbanks through urban areas. Material removed from the over excavation would be replaced with compacted lean clay. A 15-foot-long steel sheetpile curtain is to be driven underneath the concrete footing to minimize underground seepage.

4.7.1.2. Earthen Levees. Earthen levees are incorporated into the selected plan through the Oakville Jackson Neighborhood. This area was not restricted by large structures or infrastructure where construction of an earthen levee was determined to be feasible. The footprint width for a levee is significant. The selected plan has an average levee height of 12 feet. The minimum footprint width needed for an earthen levee 12 feet high is 122 feet. This includes 15 feet of permanent real estate interest beyond the toe of the levee on both the land and river sides of the levee for operations and maintenance.

The proposed levee section (figure 75) represents a clay levee with a 10-foot top width and 3H:1V side slopes. A 10-foot deep inspection trench is to be excavated below existing ground elevations through areas where adjacent structures have basements. Basements are a concern as they typically have utilities that run into them at various depths including below the floor slab. Both active and old abandoned utilities need to be identified and appropriately addressed during the construction of the levee. Only a 6-foot deep inspection trench is required through areas where basements are not nearby.

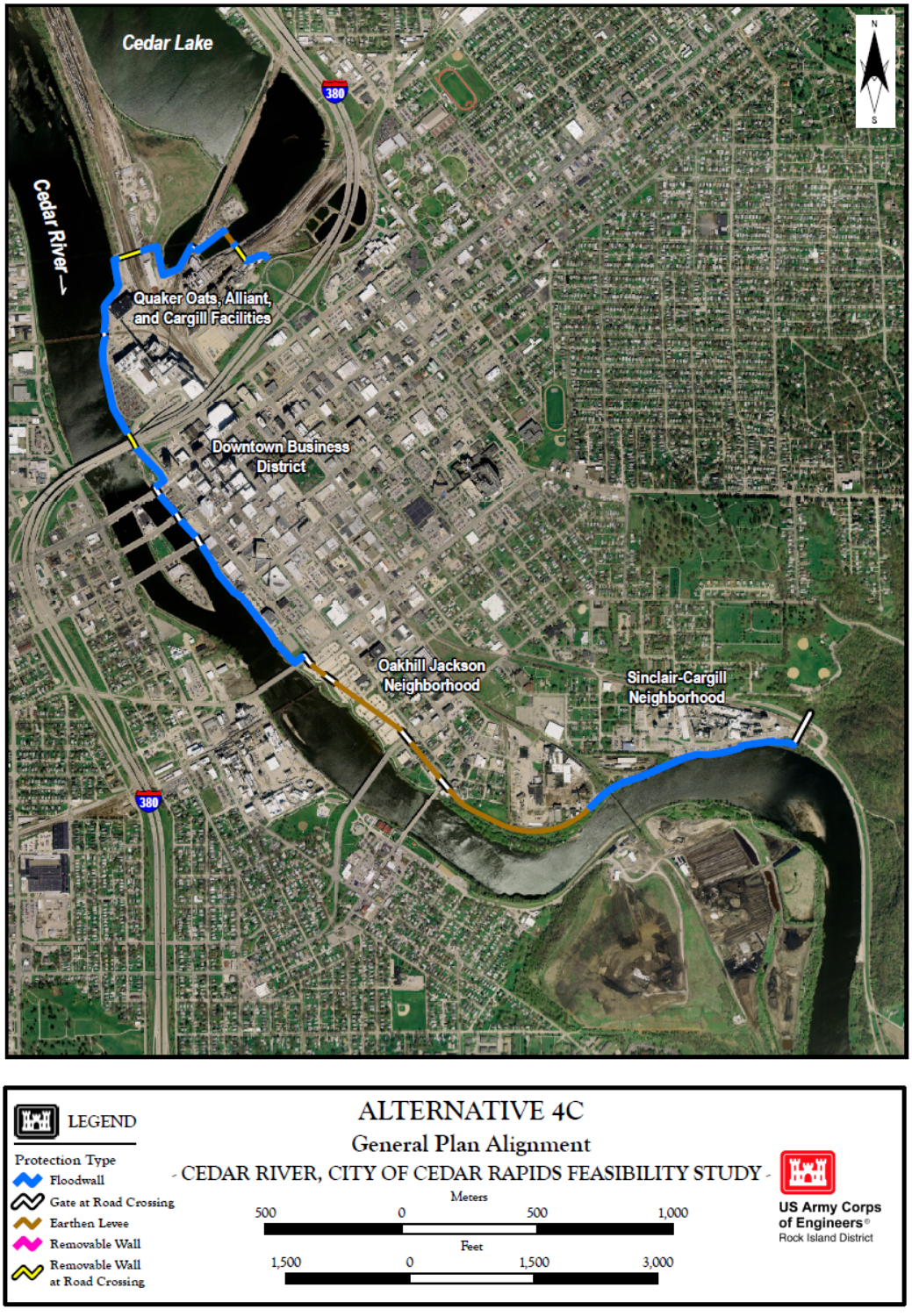
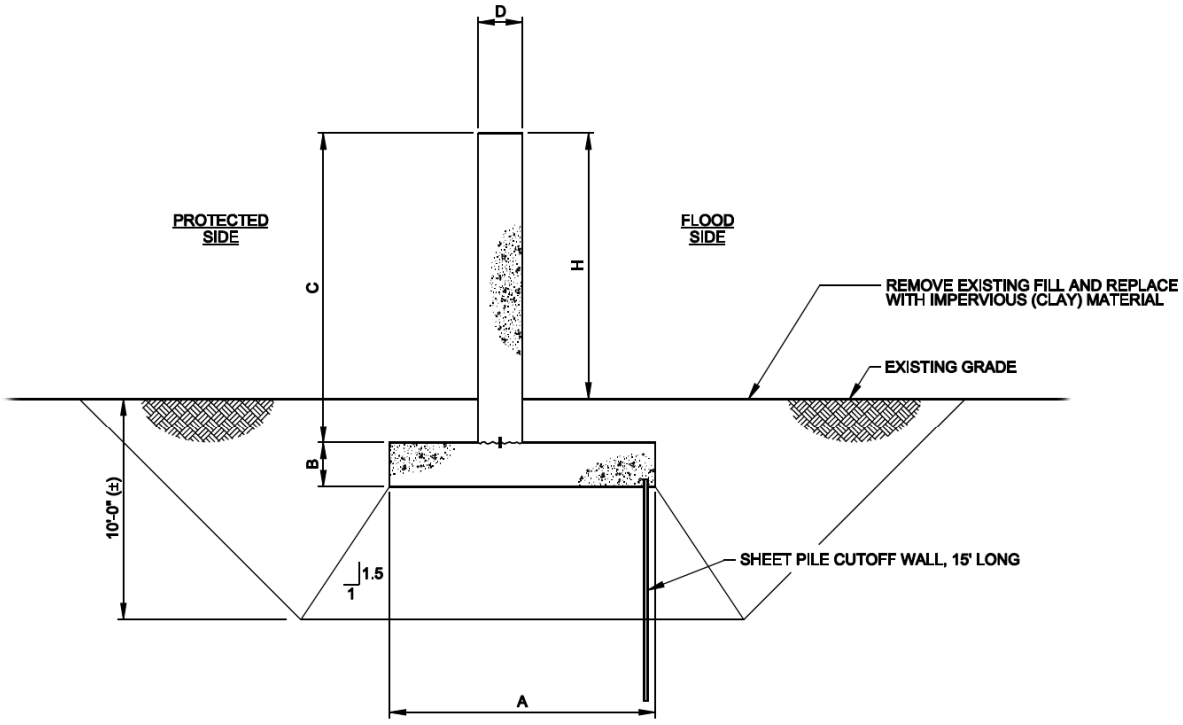


Figure 73. Alternative 4C – General Plan Alignment



TYPICAL FLOODWALL DIMENSIONS				
H	A	B	C	D
24'-0"	28'-0"	3'-0"	25'-0"	3'-0"
21'-0"	21'-0"	3'-0"	22'-0"	2'-6"
18'-0"	18'-0"	2'-6"	19'-6"	2'-0"
15'-0"	15'-0"	2'-0"	17'-0"	2'-0"
12'-0"	12'-0"	2'-0"	14'-0"	2'-0"
9'-0"	8'-0"	2'-0"	11'-0"	2'-0"
6'-0"	5'-0"	1'-6"	8'-6"	1'-6"
3'-0"	5'-0"	1'-6"	5'-6"	1'-6"

TYPICAL FLOODWALL SECTION
SCALE: NO SCALE

Figure 74. Typical Floodwall Section Looking Downstream

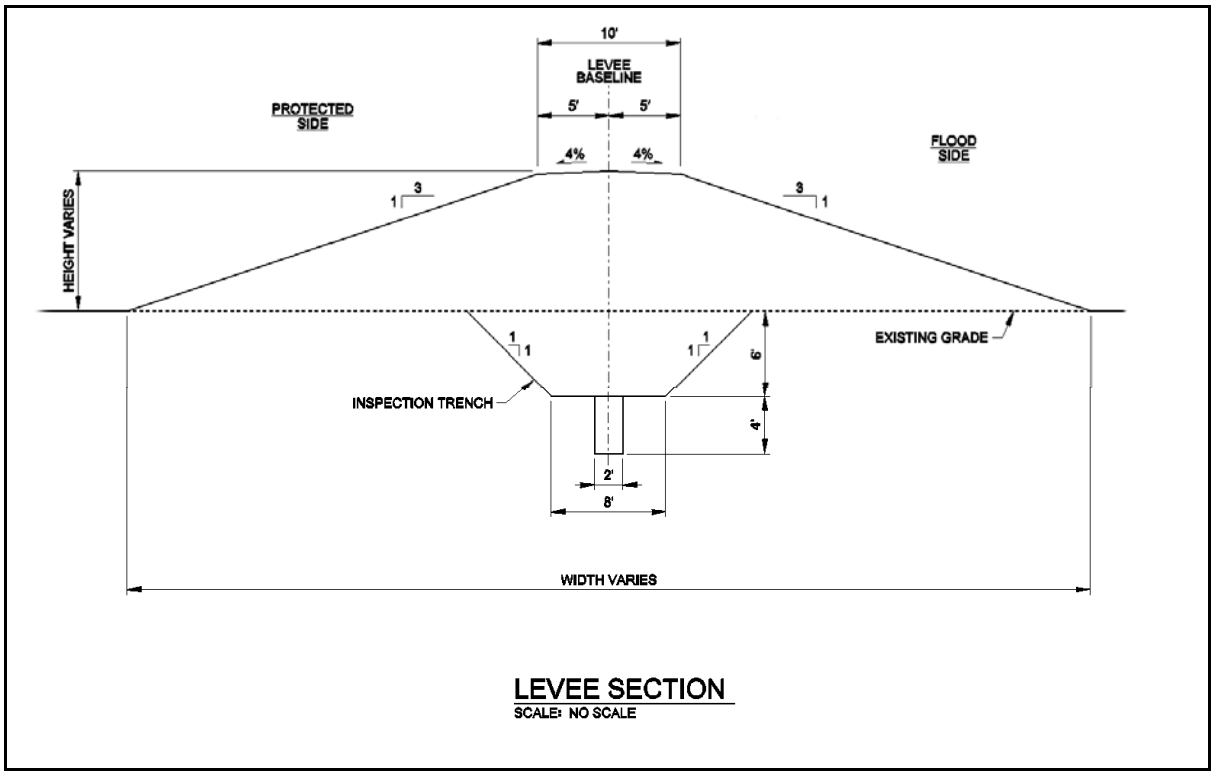
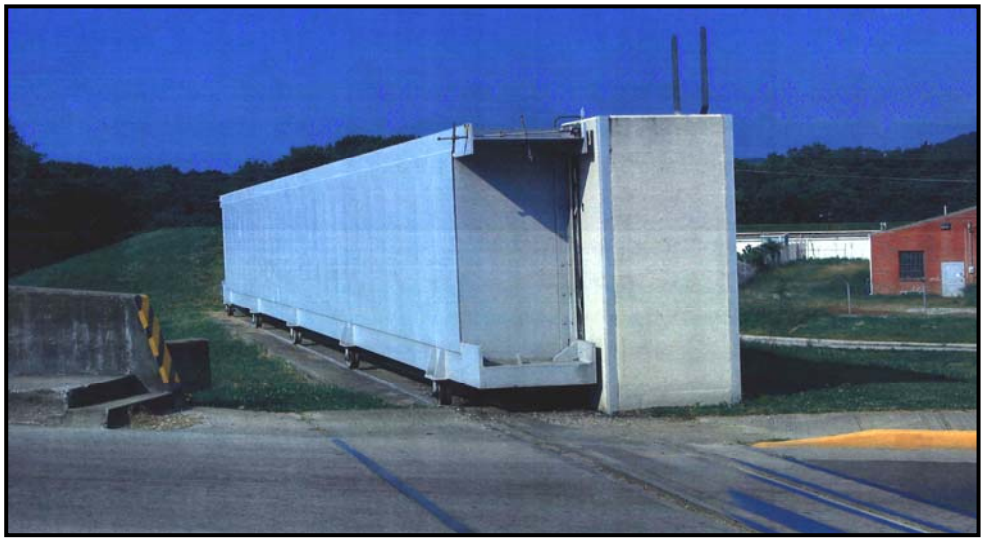


Figure 75. Levee Section Looking Downstream

The total amount of compacted clay fill needed for the levee is estimated to be 150,000 cubic yards. Fifty percent of the soil removed from the inspection trench is anticipated to be suitable clay fill material for use in the construction of the levee. The other 50 percent of soil removed from the inspection trench is anticipated to be unsuitable fill material. This material would be placed adjacent to or on top of the levee side slopes as extra material in order to lessen the steepness of the levee slope.

4.7.1.3. Closure Structures. Fifteen individual closure structures are included in the selected plan. General location and type of closure is called out in the plan sheets attached with this report. The number and types of closure structures include seven steel roller gates, four steel swing gates and four removable floodwalls. Heights of the closure structures range from 6 to 19 feet. The closure gates serve locations identified in the City's River Corridor Redevelopment Plan as critical traffic corridors, which include streets, railroad tracks, and trail systems.

4.7.1.3.1. Steel Roller Gates. Steel roller gates are utilized at street and railroad closures where adequate storage and level ground exists adjacent to the proposed floodwalls. Steel roller gates are basically a steel bulkhead placed on wheels that run along a track to open and close. Roller gate locations for the selected plan are shown on the attached plan plates. Each gate is physically stored in the open position on the floodside and upstream of each opening. Hydraulic forces during a flood serve to seal the gates tight once they have been closed. Photograph 2 shows a typical steel roller gate.

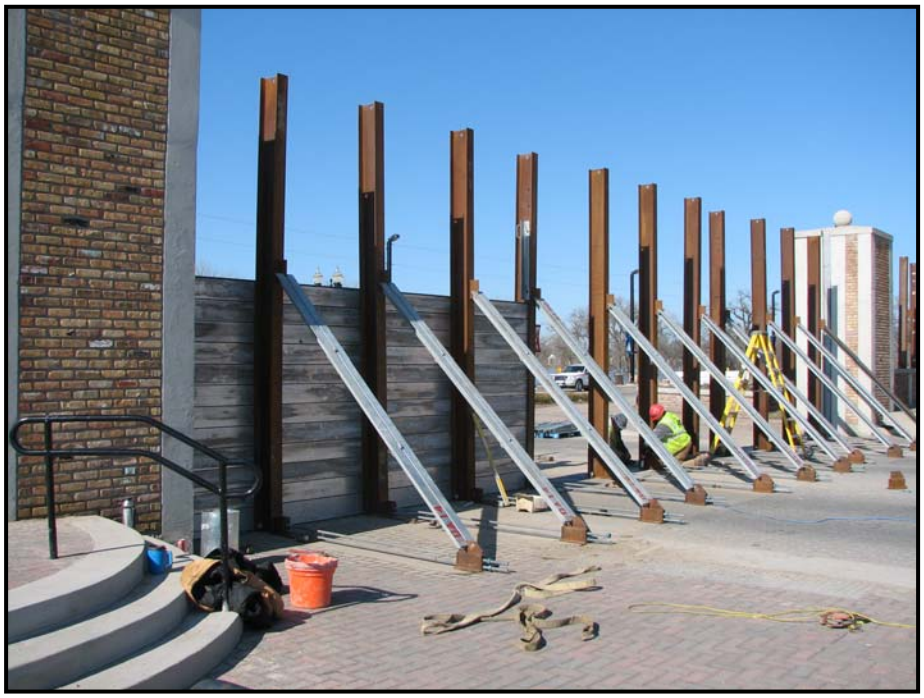


Photograph 2. Steel Roller Gate

4.7.1.3.2. Steel Swing Gates. Steel swing gates are utilized at street and railroad closure locations where openings are less than 50-feet. Steel swing gates are hinged to the vertical concrete abutment in order to allow them to be swung open and closed. Each gate is physically stored in the open position towards the floodside of the line of protection. Hydraulic forces during a flood serve to seal the gates tight once they have been closed. Swing gate locations for the selected plan are shown on the attached plan plates. Photograph 3 is a picture of a typical steel swing gate.

Photograph 3. Steel Swing Gate

4.7.1.3.3. Removable Floodwalls. Removable floodwalls are planned for use at street and railroad closure locations that have large opening widths, widths that are greater than 100 feet. Removable floodwalls consist of aluminum stoplogs that fit into slots of vertical concrete and steel columns. Steel columns are removable but require large equipment to erect. Steel columns are braced diagonally with steel supports. Aluminum stoplogs are light in weight and can be easily lifted and placed by two laborers. Stoplogs are slid into the steel columns and interlocked together. Tight seals are formed by rubber gaskets located along the edges of each aluminum stoplog. Locations of removable floodwalls are shown within the attached plan plates. Photograph 4 depicts a typical removable floodwall being erected.



Photograph 4. Removable Floodwall

4.7.1.4. Pumping Stations. The selected plan includes six separate pump stations. Pump stations range in size from 500 GPM to 15,000 GPM. Pump station locations were determined based on interior drainage basins and current underground infrastructure. Five of the pump stations serve storm water runoff. The sixth pump station serves a sanitary sewer line located in the Sinclair-Cargill neighborhood area. Detailed analysis for the sizing of the pump stations can be found in Appendix A, *Hydrology and Hydraulics.*

Pump stations consist of a concrete structure located over existing storm or sanitary lines. The concrete structure consists of two chambers separated by a sluice gate. During non-flood conditions the sluice gate remains open, allowing for gravity flow. When floods occur, the sluice gate is closed, forming two chambers that act as a wet well and discharge chamber. Vertical shaft pumps located in the wet well side are driven by motors located on top of the chamber and pump water up through a pipe which outlets on the discharge side. A stop log closure is also provided on the outlet side of the discharge chamber. The pumps provided are Crisafulli pumps whose size was estimated based on the required capacity and estimated total required head. The pumps provided do not include any redundant pumping capacity. The pump station costs do not include costs for emergency generators.

The structure for each pump station is sized based on the number of pumps and the size of the stormwater pipe. An existing pump station that was utilized as the conceptual design for the selected plan can be seen in photograph 5.

Photograph 5. Pump Station

4.7.1.5. Borrow Sites. Four separate locations were identified as possible borrow sites for this project. Figure 76 depicts a map of the location and name of the potential borrow sites.

Ultimately, the Eastern Iowa Airport property was identified as the preferred borrow site for the selected plan. Field borings have determined that the airport property has an ample amount of lean clay spread across 2,144 acres. The amount of borrow material needed for the selected plan is estimated at 132,000 cubic yards. It is estimated that approximately 18,000 cubic yards from the inspection trench excavation will be used. This equates to roughly 10 acres at a depth of 8 feet.

Good access to and from the Airport Borrow site exist to the project site. The haul route mainly consists of major roadways, Wright Brothers Blvd., and Interstate 380, to reach the project located downtown. Several blocks of local City arterial streets would serve as access from Interstate 380 to project placement locations. The District is coordinating with the Federal Aviation Administration to determine if only special requirements would be needed.

A total of 17 borings, each to a depth of 20 feet, were drilled throughout the airport potential borrow areas. Most of the borings obtained have lean clay layers between 3 to 20 feet below the ground surface. This is suitable fill material for the construction of an earthen levee.

Three out of 34 HTRW samples had chemical or metal concentrations above the IADNR Statewide Standards. Each of the three samples with high concentrations occurred in soil between 0 and 5 feet deep. The soil layers at these sample locations cannot be used as borrow for the levee.

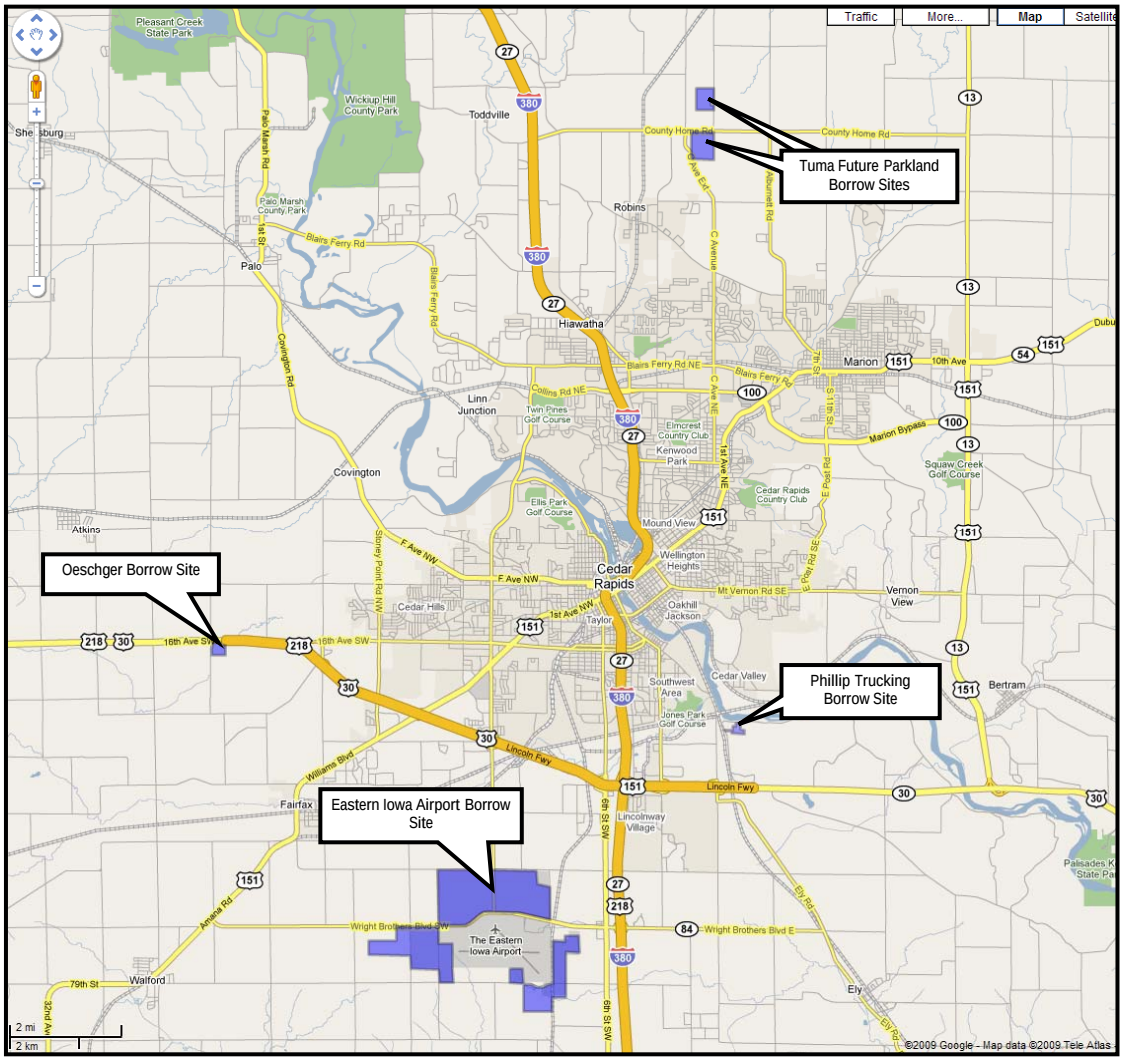


Figure 76. Potential Borrow Sites

4.7.1.6. Nonstructural Features. Although there are no nonstructural features that justified a Corps interest associated with the Study; continued City (local), FEMA, and HUD (Federal) voluntary acquisition programs concentrated on the west side of the Cedar River continue to effectively reduce flood risk and future flood damages. The details of the Study nonstructural analysis are described in Appendix P, *Nonstructural Measures*.

4.7.1.7. Recreational Features. Recreational features considered included Option One: 1.2 miles of a 12-foot wide multipurpose trail. The trail would run along the Cedar River along the river side of the Alternative 4C alignment. Analysis determined that such a trail is not economically justified according to existing Federal criteria. The cost estimate for Recreational Option 1 trail is $595,000. Average annual costs, including Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R), are $35,300. Average annual benefits are $32,200. Recreational Option 1 has a BCR of 0.91 to 1.00 and net benefits of $-3,100. Details of the recreational features are described in Appendix M, *Recreational Facilities*.

4.7.1.7.1. Cost Estimate: A detailed estimate of the cost to construct Recreational Option 1 is contained in Appendix M Table 52 is a summary of the construction cost.

4.7.1.7.2. Economic Summary. The annual benefits and costs for Recreational Option 1 are presented in the table 53. More detailed information on the costs and benefits is contained in the Appendix B, *Economics* and Appendix M.

Table 52. Recreational Option 1 Project Cost Summary
Effective Price Date: June 10th, 2010

WBS Number	Civil Works Feature & Sub-Feature Description	Total
14	Recreation Facilities (Option 1)	$465,000
Construction Estimate Total (Includes 25% Contingency)		**$465,000**
30	Planning, Engineering & Design - 18%	$84,000
31	Construction Management - 10%	$47,000
	Recreation (Option 1) - Total Project Cost	**$595,000**

Table 53. Annual Costs and Benefits of Recreational Option 1

Annual Benefits	$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	0.91
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. It is assumed 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, plus $200,000 at 25 and 50 years for project overhaul. The present value of these costs are summed and annualized over the project life.

4.7.1.7.3. Project Implementation. Relocation of the Cedar River Trail as proposed in Recreational Option 1 would be at 100 percent local expense. Although the Corps has the authority to participate on a 50/50 cost share basis in the construction of a trail system as part of an FRM project, the trail must have a BCR equal to or greater than 1 and positive net benefits. Recreational Option 1 does not satisfy either of these criteria.

4.7.1.8. Environmental Mitigation. There are three main considerations for environmental mitigation. They are natural resources, cultural resources, and HTRW. The natural resources would be minimally impacted during construction for Alternative 4C but would have no overall long term impacts. Any potential impacts to cultural resources would be coordinated with the appropriate agencies. The HTRW impacts are still being determined. The Phase I Environmental Site Assessments (ESAs) have been completed and indicated that there are 11 parcels on which recognized

environmental conditions (RECs) exist along the alignment for Alternative 4C. The RECs require a Phase II ESA that will entail characterization of soil and groundwater.

The 11 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. Three Phase II ESAs have been completed to date out of the 11 parcels identified. Initial sample results indicate three boring locations exceed the statewide standards for benzo(a)pyrene, benzo(a)anthracene, benzo(p)flourene, and dibenzo(a,h)anthracene.

The path forward involves obtaining samples from the remaining seven parcels identified for Phase II ESAs. The City continues to pursue ROE agreements with the parcel owners. It is likely that the ROE process will take several more months. Collection and analysis of HTRW samples will not be completed until December 2010.

4.7.1.9. City Measures for Reducing Flood Risk for Commercial & Industrial Properties. Subsequent to the formulation and identification of a Recommended Plan, one of the primary businesses within the Cedar Rapids floodplain indicated interest in proceeding with interim measures to reduce flood risk to their facilities. The business was aware of the feasibility study and supportive of alternatives to provide flood risk reduction to the City, but felt interim measures were appropriate until permanent comprehensive structural flood risk management measures could be constructed. The City has since proactively worked with this business to develop a partnership that would provide for construction of structural FRM measures only as would be integral to the Recommended Plan, as further discussed in paragraph 4.8.1 and addressed in a letter to the District dated November 19, 2010 (Exhibit A) As a result of this partnership, the City intends to design and construct a segment of floodwall on the east side of the Cedar River upstream of Interstate 380 from approximately station 165+00 to approximately station 186+00 as shown on Drawings C-101-4C and C-102-4C.

The local business has indicated its support for this plan. This 2100-foot segment of floodwall would effectively reduce flood risk for the 1 percent flood event in this area and eliminate the necessity for the business to construct independent permanent flood risk reduction measures to address riverine flooding. The likely future without project condition would now include the City implementing a structural flood risk reduction measure that will be integral to the Recommended Plan. Although the City's work is part of the Future Without Project Condition and is an integral part of the formulated Recommended Plan, the benefits and costs of the City's advanced work was considered in the evaluation of the Recommended Plan.

4.7.2. Design and Construction Considerations. The selected plan establishes a defined alignment corridor for this project. Major features are generally shown approximately where they would exist. More in depth data and analysis would be needed to determine exact locations of all the major components. A Design Documentation Report will be completed during the plans and specification phase.

4.7.2.1. Design Considerations. In depth design considerations for the selected plan can be found in the report appendices.

4.7.2.2. Utilities. As-builts for all major utilities were obtained in order to analyze project costs. Major utilities as-builts obtained include: water, sanitary sewer, storm water, gas, electric, cable, phone, fiber optic and steam.

4.7.2.3. Construction Considerations. Construction is estimated to occur over a 5-year period. The critical path for construction is based on the construction of the closure structures. The construction schedule calls for no more than two road closures to be taking place at one time. One large construction contract is scheduled for this project.

4.7.2.4. Value Engineering. A Value Engineering report that captures the applicable process utilized in the development of project alternatives will be generated. Two separate efforts accomplished this during the development of the project.

An initial screening of all various flood mitigation options is documented in a report titled *Cedar Rapids River Corridor Development – Flood Mitigation Options* written by Stanley Consultants in March 2009. This report analyzed 30 separate structural options that included upstream reservoirs, diversion channels & tunnels, channel widening, dredging, bridge modifications, and levees & floodwalls. The report also analyzed 10 nonstructural options that included voluntary acquisitions, relocations, elevating, wet floodproofing, dry floodproofing, and rezoning. The result of this screening of options justified levees and floodwalls as the viable option to pursue for this project. Additional value engineering was completed during the final screening process. In order to minimize costs, decisions were made to make the project utilitarian as possible. Changes made included simplifying pump stations, utilization of permanent concrete floodwalls over removable floodwalls, and the removal of architectural treatments to the floodwalls.

4.7.3. Real Estate Requirements. A preliminary Real Estate Plan (Appendix E) has been developed as part of this project. The plan identifies the plan under consideration, the types of interest that may be used as part of this project, and a cost breakout for Alternative 4C.

4.7.4. Local Betterments. The City has not officially indicated that any additional betterments are necessary at this time. The District anticipates that with the City's development of a detailed OSE and RED (Appendices Q and R, respectively), it will request an incremental adjustment to Alternative 1D or 1A-D.

4.7.5. Operations, Maintenance, Repair, Rehabilitation and Replacement Considerations. Section 3 of the Flood Control Act of 1936 and Section 103 of the Water Resource Development Act of 1986 (WRDA 1986) require that the non Federal sponsor, i.e. the City of Cedar Rapids, pay 100 percent of the costs for OMRR&R of structural flood damage reduction projects. The responsibilities of the City in this regard are detailed in the OMRR&R Manual which will be furnished to the City at the completion of construction. Operation is those activities required for the safe and efficient functioning of the project to achieve the intended project benefits. Maintenance is the performance of those activities needed for proper care and efficient operation of the project. Repair is generally defined as including those activates that are of a routine nature and will maintain the project in a well kept condition. Replacement covers those activities required to replace all or a portion of a worn out project elements. Rehabilitation refers to those activities which are required to bring a deteriorated project back to its original condition.

The following are typical operation requirements:

- maintenance and emergency operation of pump stations
- maintenance and emergency operation of gatewells and shut-off valves
- maintenance and emergency erection of all closure structures and removable walls

- continual updating of the OMRR&R Manual and emergency response plans; includes accounting for any modifications made to the system and updating all emergency contacts and suppliers

The following are typical maintenance requirements:

- regular mowing of grass areas
- maintaining a 15-foot clear zone out from toe of levees and from face of floodwalls
- eradicating burrowing animals and repairing any damage
- spraying and removing woody brush and trees in riprap areas
- maintaining pump stations per manufacturer guidelines
- removing siltation in drainage ways and detention ponds
- repairing any identified deficiencies pertinent to the project

Continual inspections are required throughout the life of the project. All inspections of the system serve to identify any deficiencies that may have occurred since the last inspection. Inspections determine if the system is being maintained at an acceptable level. This is important in order to maintain a levee certification status under the NFIP administered by FEMA. Types of inspections include the following:

- Annual inspections. An annual inspection is conducted by the Corps of Engineers that results in a report. The annual inspection report identifies any deficiencies found during the inspection and provides individual and overall ratings.
- Mid-year inspections performed between each year's annual inspections. This inspection is conducted solely by the City.
- Visual/video inspection by the City of all discharge pipes every 5 years
- Inspection by the City before and after major flood events
- Periodic mechanical and electrical inspection of pump stations by the Corps with the City

The City would be responsible for coordinating all project modifications subsequent to completion of the construction project. Modifications to the system include any plans that impact the function or physical footprint. This includes any work not coordinated before its placement. All modifications impacting the system shall be submitted from the City to the Corps of Engineers for review. Impacts include physical changes to the system, encroachments, drainage system disruption.

The City would be responsible for funding and carrying out annual operation and maintenance of the system. Annual OMRR&R costs that the City would take on for Alternative 4C were estimated from historic expenses obtain from four existing urban levee systems, Bettendorf, Cedar Falls, Dubuque, and Waterloo, Iowa. Their estimates included all labor, materials and contracts necessary to maintain the system at an acceptable level. Estimated annual OMRR&R costs averaged out to be roughly $8,000 per mile for clay levees and $500 per mile for concrete floodwalls. A separate cost was developed for pump stations based on the expectation that each pump will have a 30-year life.

Alternative 4C has a total length of 3.15 miles that is comprised of 2.4 miles of floodwalls/closure structures, 0.75 mile of earthen levee, and a total of six pump stations. Over two thirds of Alternative 4C consists of concrete floodwalls. Concrete floodwalls would require little to no annual maintenance

especially when placed in an urban setting. Existing pavement and mowing activities will minimize any new maintenance requirements by the City in these areas. Based on the preceding, the following OMRR&R costs for Alternative 4C were derived:

Annual OMRR&R Items

Feature	Length(mi)	Estimated OMRR&R (per mile)	Annual Costs
Earthen Levee	0.75	$8,000	$6,000
Floodwalls/Closure Structures	2.40	$500	$1,200
		Total	**$7,200**

Feature	Number	Avg Per Pump Cost	30-year Replacement Cost
Pump Stations	6	$120,000	$720,000

4.8. Implementation Requirements. * To implement Alternative 4C, several steps related to project authorization, funding, and regulatory approval need to be taken. These steps are:

4.8.1. Institutional Requirements. Subject to project authorization, funding, and regulatory approval, construction is scheduled to be complete December 2015. The Planning, Engineering and Design (PED) phase can begin once the Division Commander's transmittal has been sent (completed October 21, 2010), the Design Agreement has been signed by the City of Cedar Rapids as the non-Federal sponsor, and funds are available. The project will require authorization in the next WRDA, or possibly other legislation, and the appropriation of construction funds. A continuous funding stream is needed to complete this project within the anticipated time line, and this will require continuing appropriations from Congress and the City in order to fund the design phase and to fully fund the construction contract.

Milestone	Start Date	Finish Date
Review of Public Review Draft	Aug 2010	Sep 2010
Issue Public Notice for Permit	Aug 2010	Sep 2010
Review of Policy Review Draft	Sep 2010	Oct 2010
District Commander's Submittal	Oct 2010	----
Civil Works Review Board	Nov 2010	----
State and Agency Review	Nov 2010	Dec 2010
Execute Design Agreement	Dec 2010	----
Sign the Report of the Chief of Engineers	Jan 2011	----
Chief's Report sent to the ASA (CW)	Feb 2011	----
PED Phase	Jan 2010	Aug 2012
Real Estate Acquisition	Aug 2011	Aug 2012
Construction Contract Advertising and Award	Sep 2012	Dec 2012
Project Construction	Jan 2013	Dec 2015

The City has requested that it be allowed to design and construct the segment of the Recommended Plan (Alternative 4C) from approximately Station 165+00 to 186+00 under the authority of Section 221 of the Flood Control Act of 1970, as amended by Section 2003 of the 2007 WRDA. This portion of the Recommended Plan consists of approximately 2100 feet of concrete floodwall and appurtenant structures upstream of Interstate 380 in Reach 4B and would effectively reduce flood risk to the business facilities located between the floodwall and the railroad tracks for the 1 percent flood event. Figure 77 shows the location of this floodwall in relation to the 2010 Floodplain Delineation. This floodwall would tie off to higher ground on either end and would eliminate approximately 22 acres of major business facilities from the 100-year floodplain. Construction of this segment of floodwall would eliminate the need for independent structural measures along the river to reduce flooding risk to the structures in this portion of Reach 4B from riverine flooding. The property owner in this area has

provided a letter fully supporting Alternative 4C and stating their commitment to work in partnership with the City to reduce flood risk.

In accordance with EC 1165-2-208, following approval of the Chief of Engineers Report, the City and the Assistant Secretary of the Army (Civil Works) would need to enter into a Memorandum of Understanding (MOU) for work provided or performed prior to execution of a Project Partnership Agreement (PPA). Execution of this MOU would allow the City to design and construct this portion of the project in advance of construction authorization and be eligible to receive work-in-kind credit for their allowable expenses which are determined integral to the project as part of its cash contribution, excluding the required minimum cash contribution of 5 percent of the total project cost, and are incurred after the date of signing the MOU. These work-in-kind credits are subject to subsequent entry into the MOU covering the work prior to its performance, authorization of the project, determination by the ASA (CW) that the work is integral to the project, and execution of a PPA. Including the benefits and costs of a project component integral to the Recommended Plan, to be constructed by the City under the authority of Section 221 of the Flood Control Act of 1970 as amended, in the economic analysis is consistent with Federal policy since it is an integral part of the Recommended Plan. The City understands that any design and construct work pursued that is integral to the Recommended Plan will not be eligible for credit unless Congress authorizes and appropriates funds for the project and a PPA is executed.

Once construction funds are appropriated for this project the City and the Department of the Army will enter into a PPA. After the signing of the PPA, the City can begin to acquire the necessary land, easements and rights of way to construct the project. Since the project cannot be advertised for construction until all real estate interests have been acquired, obtaining all of the necessary real estate in a timely fashion is critical to achieving the project completion date.

At the completion of construction, the entire flood control system will be turned over to the City, which will then be fully responsible for the OMRR&R of the system.

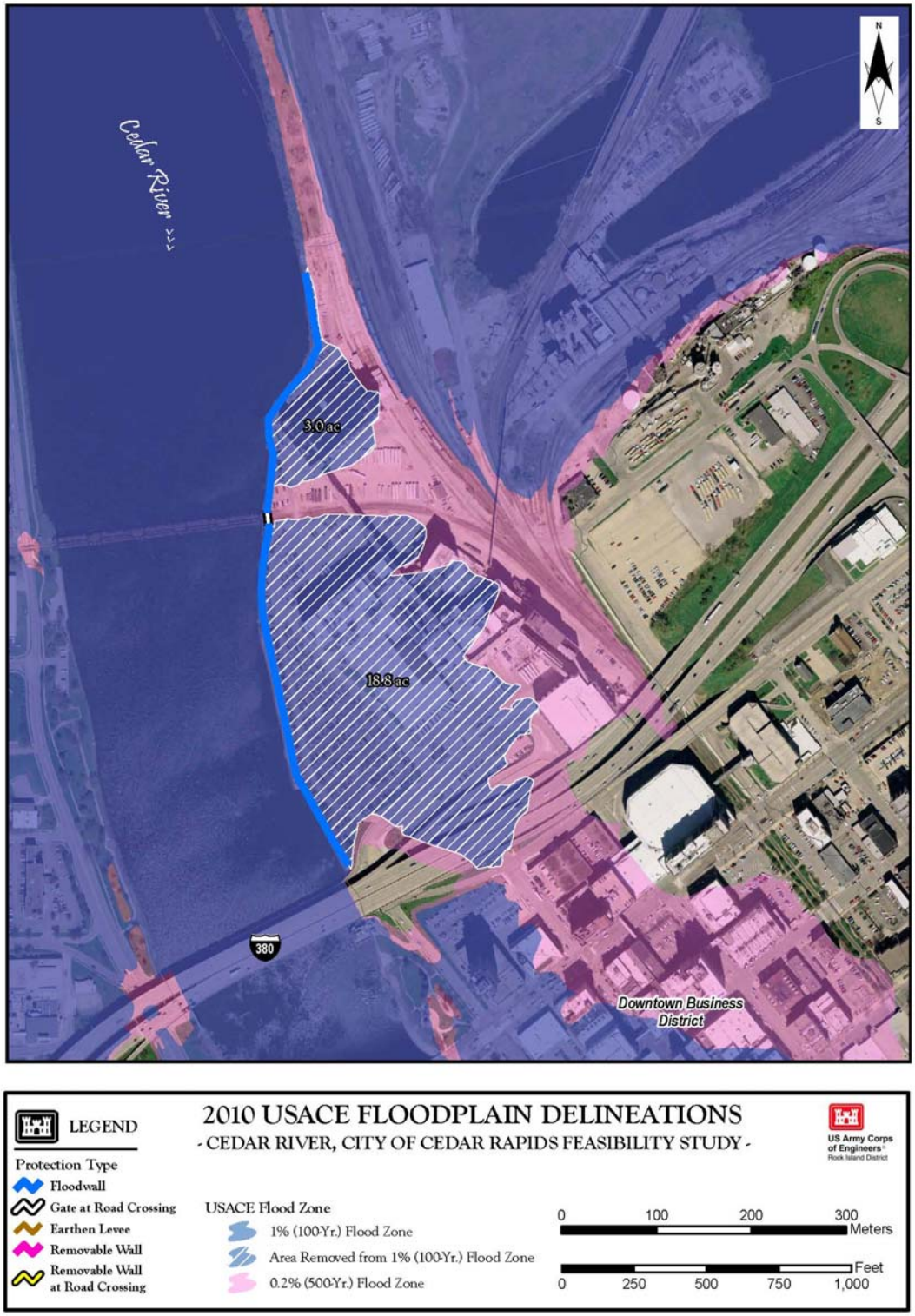


Figure 77. Proposed City Floodwall and Its Effects on the Floodplain

4.8.2. Cost Apportionment. Table 54 indicates the allocation of funds between the City and the Federal government.

Table 54. Project Cost Apportionment – October 2010 Price Level

Non-Federal Cost Share – 35%	
Non-Federal Lands, Damages, Relocations	$23,460,000
Non-Federal Cash Contribution	$11,191,000
Total Non-Federal Cost Share	**$34,651,400**

Federal Cost Share – 65%	
Total Federal Cost Share	**$64,352,600**
Total Project Cost Estimate	**$99,004,000**

4.8.3. Fully Funded Cost Estimate. The fully funded cost estimate for the Recommended Plan includes price escalation using Office of Management and Budget inflation factors. Project funding requirements by fiscal year are summarized in table 55, as fully funded estimates.

4.8.4. Permits. As part of the project the City would be required to obtain all appropriate permits. The contractors would be responsible for acquiring all local licenses/permits required to comply with state and municipal laws, codes and regulations (road, borrow, construction, etc).

4.8.5. Views of the City and Any Agencies Having Implementation Responsibilities. The City has expressed the desire to implement the project in accordance with the items of local cooperation that are set forth in the recommendations chapter of this report.

Table 55. Total Project Cost Summary

PROJECT: Cedar Rapids Flood Study, Alternative 4C
LOCATION: Cedar Rapids, Iowa

DISTRICT: Rock Island District
POC: CHIEF, COST ENGINEERING,

PREPARED: 7/13/2010

This Estimate reflects the scope and schedule in report; Cedar Rapids Flood Study, Alternative 4C

Program Year (Budget EC): 2011
Effective Price Level Date: 13-Jul-10

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Spent Thru: 1-Oct-10 ($K)	L	FULLY FUNDED PROJECT ESTIMATE COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
02	RELOCATIONS	9,787	1,957	20%	11,745	0.5%	9838.5	1967.7	11806.3			10406.2	2081.2	12487.4
11	LEVEES & FLOODWALLS	44,356	8,871	20%	53,227	0.5%	44588.3	8917.7	53505.9			47160.5	9432.1	56592.6
13	PUMPING PLANT	2,114	423	20%	2,536	0.5%	2,125	425	2549.7			2,210	442	2651.7
	CONSTRUCTION ESTIMATE TOTALS:	56,257	11,251		**67,508**	0.5%	56551.6	11310.3	67861.9			59776.4	11955.3	**71731.7**
01	LANDS AND DAMAGES	8,674	3,026	35%	11,700	0.5%	8719.0	3042.1	11761.1			8879.6	3098.1	11977.7
18	CULTURAL RESOURCE PRESERVATION	563	113	20%	675	0.5%	566	113	678.6			598	120	717.8
30	PLANNING, ENGINEERING & DESIGN	10,128	2,026	20%	12,154	0.5%	10181.1	2036.2	12217.3			10338.2	2067.6	12405.9
31	CONSTRUCTION MANAGEMENT	5,626	1,125	20%	6,751	0.5%	5655.5	1131.1	6786.6			5981.7	1196.3	7178.1
	PROJECT COST TOTALS:	81,247	17,541	22%	**98,788**	0.5%	81672.7	17632.8	99305.5			85574.2	18437.0	104011.2

_____ 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

ESTIMATED FEDERAL COST: **67607**
ESTIMATED NON-FEDERAL COST: **36404**
ESTIMATED TOTAL PROJECT COST: 104011

Filename: 2010-07-13 ATR_TPCS Cedar Rapids Flood Study TPCS

5.0. ENVIRONMENTAL IMPACTS/EFFECTS *

5.1. Environmental Evaluation. * An environmental analysis was conducted for the proposed project and a discussion of those impacts is presented below. In accordance with the Clean Water Act, a Section 404(b)(1) Evaluation has been prepared. The No Action Alternative assumes no Federal action but does assume full implementation of emergency protection actions so that some level of flood risk management would continue for the community.

This chapter describes the potential impacts of the alternatives, including the consequences of the No Action Alternative, on the relevant environmental resources described in Section 4. It evaluates direct, indirect, and cumulative effects, and quantifies these effects whenever possible. Measures and commitments intended to mitigate adverse environmental impacts are also described.

- **Natural Resources**
- **Hydrology and Future Flood Impacts**
- **Created Resources**
- **Floodplain Management**
- **Recreational Impacts**
- **Air Quality**
- **Water Quality**
- **Hazardous, Toxic, and Radioactive Waste**
- **Cultural Resources**
- **Cumulative Impacts**
- **Socioeconomic Resources**

5.1.1. Natural Resources

5.1.1.1. No Action. The No Action Alternative should have no significant impact on bald eagles, migratory waterfowl or wading birds. It is likely that, in time, more greenspace will appear where now exists flood impacted residences and businesses. Landscape planting in any increased greenspace could benefit song birds/neotropical migrants over existing conditions.

The No Action Alternative should not result in significant impacts to mussels/fish in the river, McLoud Run or Cedar Lake. Also, no impacts are anticipated to wetlands or any endangered or threatened species.

Alternative 1C. As with the No Action Alternative, Alternative 1C should result in considerably more greenspace, including the vegetated levee, than exists now. This should result in increased habitat for song birds/neotropical migrants. The east side levee alignment for Alternative 1C would come within approximately 400 feet of an existing eagle nest located in the riverine backwater island complex adjacent to Cedar Lake in the Cedar River. Construction activities may cause minor disturbance to nesting eagles, but removal of the nest tree is not anticipated. Construction activities on the east side section of Alternative 1C, adjacent to Cedar Lake should cause migratory waterfowl and wading birds to avoid the project area but should return after construction is complete.

McLoud Run would be subject to the same flooding frequency as exists now and should not be significantly impacted over existing conditions. Riverine fishes in the near shore area of the east side alignment of the Cedar River would avoid the area during construction but would return when

construction is complete. No mussel resources are expected to inhabit the near shore area of the river adjacent to Cedar Lake.

Depending on the height of the east side levee alignment, some wetland impacts would be expected in the near shore area in the riverine backwater island complex adjacent to Cedar Lake in the Cedar River.. The levee footprint and construction area could impact as much as 24 acres of wetland in the backwater area of the Cedar River. If Alternative 1C were to be implemented, mitigation would be required to replace lost wetland functions. No effects/impacts to any endangered or threatened species are anticipated.

Alternative 1A-C. Alternative 1A-C should have no significant impact on bald eagles, migratory waterfowl or wading birds. The east side levee alignment would cross a small portion of Cedar Lake. Shorebirds, wading birds and migratory waterfowl that could normally utilize that portion of Cedar Lake would avoid the area during construction. It is likely that, in time, more greenspace will appear where now exists flood impacted residences and businesses. Landscape planting in any increased greenspace could benefit song birds/neotropical migrants over existing conditions.

Alternative 1A-C should not result in impacts to mussels/fish in the river, McLoud Run or Cedar Lake. No significant impacts are anticipated to wetlands or any endangered or threatened species.

Alternative 4C. Alternative 4C should have no significant impact on bald eagles, migratory waterfowl or wading birds. The levee alignment would cross a small portion of Cedar Lake. Shorebirds, wading birds and migratory waterfowl that could normally utilize that portion of Cedar Lake would avoid the area during construction. It is likely that, in time, more greenspace will appear where now exists flood impacted residences and businesses. Landscape planting in any increased greenspace could benefit song birds/neotropical migrants over existing conditions.

Alternative 4C should not result in impacts to mussels/fish in the river or McLoud Run. No significant impacts are anticipated to wetlands, fish, or invertebrates in Cedar Lake, or to any endangered or threatened species in the area. Aquatic species in Cedar Lake would avoid the area during construction. No tree or understory vegetation would need to be cleared for the levee section through Cedar Lake.

Alternative 10E. Alternative 10E should have no significant impact on bald eagles, migratory waterfowl or wading birds. The levee alignment would cross a small portion of Cedar Lake. Shorebirds, wading birds and migratory waterfowl that could normally utilize that portion of Cedar Lake would avoid the area during construction. It is likely that, in time, more greenspace will appear where now exists flood impacted residences and businesses. Landscape planting in any increased greenspace could benefit song birds/neotropical migrants over existing conditions.

The Coordination Act Report from the USFWS (Appendix D, *U.S. Fish and Wildlife Service Draft Coordination Act Report*) is summarized as follows:

Conclusions

1. The implementation of the proposed project as discussed would have negligible negative effects on terrestrial, wetland, or aquatic resources in the project area.

2. Given the proximity of the Airport Borrow areas to the municipal airport, it is unlikely that any vegetative cover that would grow after removal of borrow material, would have substantial value to wildlife.

3. Completion of levee segments 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.

Recommendations

1. The FWS is concerned about the lack of proposed flood damage reduction for the WPCF, given the potential effects of untreated discharges on the aquatic ecosystem of the Cedar River, and recommend that investigations continue regarding protecting or relocating such critical infrastructure.

2. Abandoned properties may continue to harbor hazardous materials and provide a source for invasive exotic plant species or undesirable wildlife. However, as no flood damage reduction 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.

3. Disturbance of sediment in Cedar Lake should be minimized to reduce re-suspension and availability of contaminants in the aquatic food web.

Because the requisite habitats for prairie bush clover and western prairie fringed orchid are not present in the impact zone (levee footprint or staging and construction zone), it is the Districts determination that the proposed project will have no effect on any listed species or their designated critical habitat.

5.1.2. Hydrology and Future Flood Impacts. Development within the basin over the next 50 years is not expected to alter the discharge-frequency curve at Cedar Rapids. Nor would the proposed levee alignment alter the discharge-frequency relationship. For these reasons, the discharge-frequency curve for the existing condition is applicable for the Alternative 4C future condition (year 2059).

Discharge estimates are subject to uncertainty due to their nature of trying to estimate the magnitude of rare flood events from comparatively short periods of observation. Recognizing this, the flood damage analysis procedures discussed in the H&H Appendix for HEC-FDA incorporate uncertainty in evaluating the performance of proposed alternatives.

Weather patterns over the last 16 years have produced multiple years of heavy and prolonged precipitation events across watersheds in the Midwest. These conditions have resulted in many all time record floods during this short time period. The hydrologic analysis conducted for the Study estimates that at Cedar Rapids the 2008 flood was a very rare event. This estimate is based upon stationary hydrologic analysis utilizing historical data from the 106 year period of record. Projected influences of climate change influences are not included in the hydrologic analysis of this 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 Raids. In addition, no accepted methods are currently available to incorporate such global predictions at a local scale.

5.1.3. Created Resources. Neighborhoods, historic districts, industrial areas, commercial districts, roads, highways, Interstates highways, dams, bridges, parks, golf courses, recreational trails, etc are all created resources. It is not anticipated that any of the alternatives evaluated for this project, including the No Action Alternative, would result in significant adverse impacts to any component of Cedar Rapids' created resources compared to existing conditions. Parks/greenspace may well increase in portions of the area flooded in 2008, with or without a new levee.

5.1.4. Floodplain Management. Floodplain management impacts are discussed in detail in Sections 5.2 and 5.5.

5.1.5. Recreational Impacts. The City owns and routinely maintains a number of recreational facilities along the Cedar River. Implementation of Alternative 4C would impact the City of Cedar Rapids trail system to a limited extent, requiring only the relocation of a portion of one trail. The proposed trail alignment is discussed in detail in Appendix M, *Recreation*, while Appendix B, *Economics*, analyzes the economic feasibility of constructing a recreational trail facility adjacent to the Alternative 4C alignment.

5.1.5.1. Future Recreational Opportunities. Implementation of Alternative 4C would not alter existing recreational opportunities available to the citizens of Cedar Rapids, as the recreational component of the Alternative is not economically justified.

5.1.5.2. Impacts on Recreational Elements. Masaryk, Osborn, and Riverfront East Parks may be impacted by the construction of Alternative 4C. These impacts are of short duration and could range from possible ground disturbance during construction to the use of the park for the construction of the flood risk management works. The degree of impact will be more clearly understood once the final alignment of Alternative 4C is selected. Impacts to these parks are addressed in the City's, *Parks and Recreation Master Plan Elements.*

The Cedar River Trail is the only recreational venue to be impacted by Alternative 4C. As the levee alignment crosses the trail, it would be necessary to construct two closure structures to maintain trail continuity. However, as part of Alternative 4C, it is proposed that the trail be moved to the west so as to be more nearly aligned with the bank of the Cedar River; this revised trail is referred to as Recreational Option 1, which has been determined not economically justified. This proposed realignment is shown in figure 78. Alternative 4C is shown in figure 79.

5.1.5.3. Implementation of the No Action Alternative would have no impact on existing or proposed recreational opportunities.

5.1.5.4. Implementation of Alternative 1C would result in disruption of use of portions of numerous existing recreational trails in Cedar Rapids. The following recreational features would be impacted until construction of this alternative was complete: Ellis Trail, Time Check Park/Recreation Center, Riverfront West, Cedar River Trail (west), Osborn Park, Masaryk Park, Cedar River Trail (east), and Riverfront East.

5.1.5.5. Implementation of Alternative 1A-C would result in similar recreational impacts as Alternative 1C. See Appendix M, *Recreational Facilities*, for detailed evaluation of recreational components impacted if Alternative 1A-C were to be implemented.

5.1.5.6 Implementation of Alternative 4C would not alter the recreational opportunities available to the citizens of Cedar Rapids. It is proposed that as part of Alternative 4C, the Cedar River Trail would be relocated riverward of the proposed floodwall alignment beginning at Cedar Lake and rejoining the existing trail at 8th Avenue SE. This new trail alignment would provide users with a river based recreational opportunity. However, this trail realignment, referred to Recreational Option 1, is not economically justified and will not be included in Alternative 4C.

5.1.5.7 Implementation of Alternative 10E would result in temporary impacts/disruption to a portion of the Cedar River Trail (east).

Additional information on recreational facilities can be found in Appendix M, *Recreational Facilities*.

5.1.6. Air Quality and Noise. The No Action Alternative would not impact air quality or noise. Concerning Alternatives 1C, 1A-C, 4C and 10E minor, temporary increases in airborne particulates and noise levels are anticipated to occur as a result of mobilization and use of construction equipment. Disturbances to nearby residences during workdays would be minimal, and no air quality standard or noise violations are anticipated. This project would be in full compliance.

5.1.7. Water Quality. The No Action Alternative would not impact water quality. Concerning Alternatives 1C, 1A-C, 4C and 10E erosion of land-based construction sites may result in turbidity increases in the Cedar River (Alternative 1C) and Cedar Lake (Alternatives 1A-C, 4C, and 10E). Turbidity levels are expected to return to pre-construction levels after construction is complete. No long-term impacts to water quality are anticipated. No violation to any State of Iowa water quality standard is anticipated. This project would be in full compliance. A Clean Water Act 401 Water Quality Certification would be received from the State of Iowa prior to any construction.

Figure 78. Proposed Trail Realignment

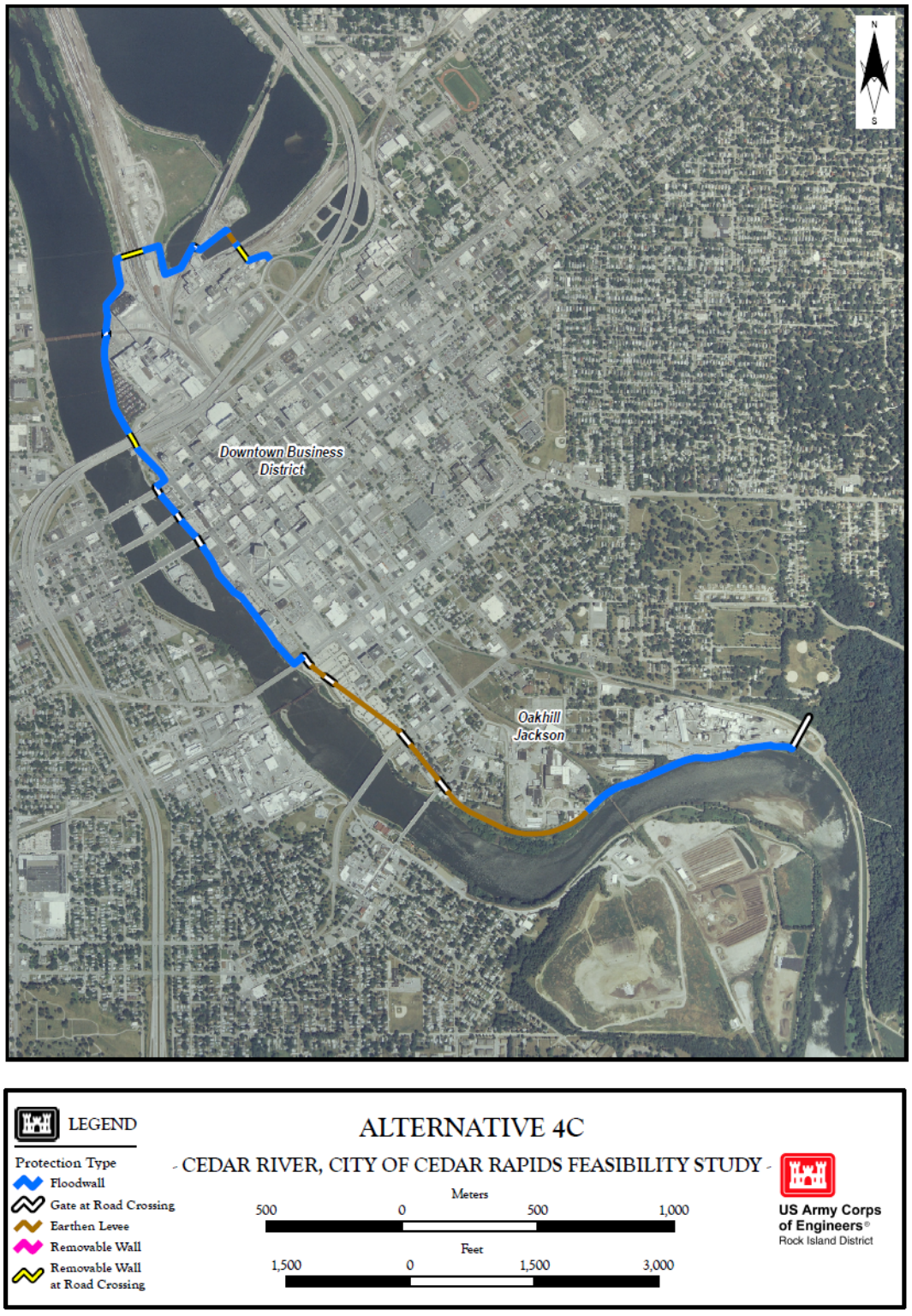


Figure 79. Alternative 4C

5.1.8. Hazardous, Toxic, and Radioactive Waste. This section summarizes the Phase I Hazardous, Toxic, and Radioactive Waste (HTRW) Environmental Site Assessments (ESA) for the Study. The Phase I ESA was completed in accordance with ER 1165-2-132, *HTRW Guidance for Civil Works Projects*; ER 405-1-12, *Real Estate Handbook*, and ASTM Practice E 1527-05.

The HTRW Study Area of Interest 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 parcels, 89 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. Forty-eight parcels along the Alternative 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 Alternative 1C and 1A-C alignments 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. Soil samples were analyzed for the presence of volatiles, semi-volatiles, polychlorinated biphenyl (PCBs), pesticides, herbicides, Toxic Characteristic Leaching Procedure (TCLP) metals and total metals. Hazardous, Toxic, and Radioactive Waste sampling was also completed on nine parcels of concern in conjunction with geotechnical investigations along the footprint of Alternative 4C. There are six parcels (two Cargill facilities, two Alliant Energy facilities and two Midwest Railroad facilities) where access was not granted.

5.1.8.1. 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 indicated 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 on the west side of the Cedar River. 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: Target Analyte List metals; volatile organic compounds (VOCs); semi volatile organic compounds (SVOCs); poly chlorinated biphenyls (PCBs); and pesticides and herbicides. The estimated cost to complete the 48 Phase II ESAs is $150,000. Phase II ESAs (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 City's responsibility, 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.

5.1.8.2. 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.

5.1.8.3. 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; and 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 City's responsibility, 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.

5.1.8.5. Airport Borrow HTRW Sampling. 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, PCBs, pesticides, herbicides, TCLP metals and total metals. Three soil sample locations indicate chemical or metal concentrations above the Iowa DNR Statewide Standards for soil. The samples were collected from the 0- to 5-foot depth. Therefore, no soil from the boring locations B1, B11 and B13 in the range of 0-to 5-foot depth can be used as borrow material. The remaining areas that were proposed for borrow material from the airport property may be utilized.

5.1.8.6. Alignments 1C, 1A-C and 4C HTRW Sampling. Hazardous, Toxic, and Radioactive Waste sampling was also completed 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. Analytical 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 Alignment 4C 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.

5.1.8.7. 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 FRM measure.

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 CSRA Report, located in Appendix I-A. The HTRW implications for project cost and schedule were assigned a High Risk rating, which was incorporated into the final contingency value of 20 percent.

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.

5.1.8.8. HTRW 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 ESAs required are as follows: Alternatives 1C and 1A-C at least 40; 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

Future planners and designers shall coordinate with the District's Environmental Engineering and Geotechnical branches 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 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:

1. 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.

2. 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.

3. 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.

5.1.8.9. Limitations. No EA 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, it will be revisited. Title searches and research into environmental liens were not conducted for this Study, but will be required prior to construction phase of the preferred alternative.

5.1.9. Cultural Resources. The District and the City have determined that implementation of Alternative 4C or Alternative 10E and the proposed borrow area may have an effect upon properties listed on, or eligible for listing on, the NRHP. Other alternatives encompassed more lands, and hence, increase the number of historic properties affected. The District and the City have initiated consultation with the Advisory Council and the Iowa 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 City completed two architectural and structural reconnaissance surveys to document NRHP-eligible/listed properties prior to the Flood of 2008. The FEMA conducted numerous architectural and structural reconnaissance surveys in the aftermath of the 2008 flooding episode prior to debris removal and demolition. The NRHP status was reviewed by FEMA, and FEMA received concurrence from SHPO.

5.1.9.1. Architectural Properties. Within the Study area, 122 structures have been previously determined eligible for listing in the NRHP. Of these eligible structures, three are Historic Districts: 1) the Bohemian Commercial District has 30 buildings; 2) the St. Wenceslaus District has 14 buildings, and 3) the Mays Island District has 6 buildings. Of the 122 buildings or structures of potential significance, 8 would be directly impacted by Alternative 4C; whereas 2 would be impacted by Alternative 10E. Alternative 4C would leave 8 structures/buildings unprotected, while the flood risk for the remaining 106 buildings/structures would be reduced. Alternative 10E would reduce flood risks for 16 structures and leave 98 structures unprotected. Table 56 provides the data on which buildings would be protected or within the area of potential effect (APE) resulting from the construction of Alternative 4C or Alternative 10E.

Figure 80 depicts locations of NRHP Districts and indicates that Alternative 4C would have potential effects upon the St. Wenceslaus and Mays Island Historic Districts, as the proposed floodwalls/levee system enter into these historic district boundaries and encompass buildings/structures which are contributing to the NRHP eligibility.

In compliance with Section 106 of the NHPA, as amended (and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties"), the District entered into 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,* to address the mitigation of adverse effects to the NRHP eligible or listed structures (Appendix C)..

Table 56. Buildings/Structures That Are Listed or Eligible to the National Register of Historic Places, Contributing to Historic Districts, or Potentially Eligible in a Potential Historic District

Alternative 4C	Alternative 10E			
P = Protected, U = Unprotected, I = Impacted		Address	Name	NRHP District
I	U	119 14th Ave, SE	Krejcl Blacksmith Shop	Bohemian Commercial District
I	U	121 14th Ave, SE	Darragh & Loufek Building	Bohemian Commercial District
I	U	123-125 14th Ave, SE	Karban Building	Bohemian Commercial District
I	U	131 14th Ave, SE	Martinek Hardware	Bohemian Commercial District
P	U	1118 2nd Street, SE	Residence	Bohemian Commercial District
P	U	1120 2nd Street, SE	Kapoun Meat Market	Bohemian Commercial District
P	U	1312 2nd Street, SE	Residence	Bohemian Commercial District
P	U	1314 2nd Street, SE	Residence	Bohemian Commercial District
P	U	1324 2nd Street, SE	Vobejda Shoe Store	Bohemian Commercial District
P	U	1326 2nd Street, SE	P. Hach Building	Bohemian Commercial District
P	U	1006 3rd Street, SE	Suchy Building (Ryder's Saloon)	Bohemian Commercial District
P	U	1010 3rd Street, SE	(White Elephant Antiques)	Bohemian Commercial District
P	U	1029 3rd Street, SE	Matyk Building	Bohemian Commercial District
P	U	1105 3rd Street, SE	C.S.P.S. Hall (Service Press)	Bohemian Commercial District
P	U	1121 3rd Street, SE	Jacobs Building	Bohemian Commercial District
P	U	1317 3rd Street, SE	Lessinger Block (Little Bohemia)	Bohemian Commercial District
P	U	1318 3rd Street, SE	Zitek's Skelly Station	Bohemian Commercial District
P	U	211 13th Ave, SE	Lunak, Jarislav, & Rose	Bohemian Commercial District
P	U	213-215 14th Ave, SE	Ideal Theatre	Bohemian Commercial District
P	U	219-221 14th Ave, SE	Pugh & Kucera Building	Bohemian Commercial District
P	U	227 14th Ave, SE	Friendly Service Station	Bohemian Commercial District
P	U	1304 2nd Street, SE	Funeral Home Annex	Bohemian Commercial District
P	U	1308 2nd Street, SE	Residence	Bohemian Commercial District
P	U	1111 3rd Street, SE	Hose Co. No. 4	Bohemian Commercial District
P	U	1200 3rd Street, SE	Z.C.B.J. Building (Left Bank)	Bohemian Commercial District
P	U	1201 3rd Street, SE	Iowa State Savings Bank (First Trust & Savings Bank)	Bohemian Commercial District
P	U	1129-31 3rd Street, SE	Iowa State Savings Bank (First Trust & Savings Bank)	Bohemian Commercial District
P	U	1125 3rd Street, SE	Kreji Building	Bohemian Commercial District
P	U	329 10th Ave, SE	J.G. Cherry Co.	Bohemian Commercial District
P	P	510 16th Ave, SE	Rectory	St. Wenceslaus District (proposed)
P	P	1201 5th Street, SE	Residence	St. Wenceslaus District (proposed)

Alternative 4C	Alternative 10E				
P	P	1205	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1207	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1209	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1211	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1225	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1227	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1230	5th Street, SE	school and gym	St. Wenceslaus District (proposed)
P	P	1231	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1215	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1217	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1221	5th Street, SE	Residence	St. Wenceslaus District (proposed)
P	P	1224	5th Street, SE	St. Wenceslaus church	St. Wenceslaus District (proposed)
P	U	301	1st Ave, SE	Iowa Theatre Building	
P	U	411	1st Ave, SE	Burlington, Cedar Rapids & Northern Building	
P	U	417	1st Ave, SE	Irvine Building	
P	U	101	1st Street, SE	Old Post Office (Federal Building)	
P	U	600	1st Street, SE	John Blaul's Sons (Great Furniture Mart)	
P	U	616	1st Street, SE	Baker Paper Co. Building	
P	U	618	1st Street, SE	Baker Paper Co. Building	
P	U	620	1st Street, SE	Aurox Tool & Die Building	
I	U	401-411	1st Street, SE	Hamilton Brothers Bldg	
P	U	610-612	1st Street, SE	Orr-Newell Building	
P	U	305	2nd Ave, SE	Cedar Rapids Post Office, Wiltwer Senior Center)	
P	U	419	2nd Ave, SE	Coffits Building	
P	U	526	2nd Ave, SE	Inter-State School Building	
P	U	201-207	2nd Ave, SE	Dows Building	
P	U	215-221	2nd Ave, SE	Martin Dry Goods (Ginsberg Jewelry)	
P	U	103	2nd Street, SE	American Building	
P	U	118	2nd Street, SE	(Ajax Balloon)	
P	U	125	2nd Street, SE	United Fire & Casualty	
P	U	203	2nd Street, SE	Security Building	
P	U	225	2nd Street, SE	Higley Building	
P	U	230	2nd Street, SE	Granby Building	
I	U	97	3rd Ave, SE	Smulekoff's Furniture	
P	U	116	3rd Ave, SE	Sindelar Saloon	

Alternative 4C	Alternative 10E				
P	U	311	3rd Ave, SE	Cedar Rapids Supply Company	
P	U	420	3rd Ave, SE	Cedar Rapids Public Library (Cedar Rapids Museum	
P	U	302-308	3rd Ave, SE	Cedar Rapids Savings Bank (Guaranty Bank & Trust)	
P	U	314-318	3rd Ave, SE	Strand Theatre (World Theatre)	
P	U	321	3rd Street, SE	Welch Cook Beals Co.	
P	U	419	3rd Street, SE	Hutchinson Building (Borden Building)	
P	U	900	3rd Street, SE	Witwer Grocery Co.	
P	U	100-112	3rd Street, SE	Iowa Theatre Building (Community Theatre)	
P	U	302-308	3rd Street, SE		
P	U	221	4th Ave, SE	Lyman Building (Iowa Building)	
P	U	318	5th Street, SE	YMCA	
P	U	308	6th Ave, SE	Petersen Baking Co. (Norand)	
P	U	411	6th Ave, SE	Harper & McIntire Co. (Smulekoff's Warehouse)	
P	U	317	7th Ave, SE	Parlor Furniture Manufacturing Co. (Voelkers)	
P	U	200	8th Street, NW	Chandler Pump Company	
P	U	406	9th Ave, SE	Ellis & Roth Co. (Cedar Rapids Sheet Metal Co.)	
P	U	616	A Ave, NE	Scottish Rite Temple	
P	P	130	B Ave, NE	Jones, Douglas & Co Cracker factory (Ohsman & Sons	
U	U	761	J Ave, NE	Cedar Rapids Water Purification Plant	
P	U	350	S 2nd Ave, SE	(Kurtz Pub)	
P	U	620	17th Street, NE	Vetter & Parks Lumber Co.	
P	U	200	1st Ave, NE	Roosevelt Hotel	
P	U	510	1st Ave, NW	St. Patrick's Church Residence	
P	U	203	1st Ave, SE	Golden Eagle Building	
P	U	205	1st Ave, SE	Reserve National Insurance Co.	
I	U	427	1st Street, SE	Fire Station No.1 (Science Station)	
P	U	614	1st Street, SE	Grissell Co. Building	
P	U	222	2nd Ave, SE	Merchants National Bank Building	
P	U	325-329	2nd Ave, SE	Muskvaki Block (Dragon Restaurant)	
P	U	900	2nd Street, SE	Churchhill Drug Co. / McKesson & -Robbins Co.	
P	U	219-223	2nd Street, SE	Mullin Building (Drake's Salad Bar & Enzler's)	
P	U	3rd Ave @ 10th Street, SE		Immaculate Conception Catholic Church	
P	U	119	3rd Ave, SE	Fawcett Building	
P	U	123	3rd Ave, SE	Paramount Theatre Building	
P	U	200	3rd Ave, SE	Granby Building	

Alternative 4C	Alternative 10E			
P	U	600 3rd Ave, SE	First Universal Church	
P	U	313-315 3rd Ave, SE	Cedar Rapids Marble & Granite Works (Foreman &	
P	U	417 3rd Street, SE	Sokolovna Gymnasium Building	
P	U	600 3rd Street, SE	Brown-Evans Manufactoring Co.	
P	U	216-224 3rd Street, SE	Cedar Rapids Savings Bank (Guaranty Bank & Trust	
P	U	3rd Street, SE, SE & 16th	Sinclair and Co. - Wilson Co. site	
P	U	217 4th Ave, SE	Lattner Auditorium Building	
P	U	310 5th Street, SE	First Presbyterian Church	
P	U	117-123 5th Street, SE	Palmer Building (MCI)	
P	U	402 9th Ave, SE	Blue Valley Creamery (Cedar Rapids Sheet Metal Co.)	
P	I	501 A Ave, NE	St. John the Baptist Greek Orthodox Church	
P	I	525 A Ave, NE	Grace Episcopal Church	
P	P	200 B Ave, NE	Quaker Oats - determination not complete	
U	U	707-711 B Ave, NW	Chandler Pump Company	
U	U	101 1st Street, SE	Federal Bldg	Mays Island District
U	U	1st Ave /Cedar River	Highwater Rock	Mays Island District
U	U	1st Ave Bridge	Bridge	Mays Island District
U	U	2nd Ave	City Hall	Mays Island District
U	U	3rd Ave	County Courthouse	Mays Island District
U	U	3rd Ave	County Jail	Mays Island District
I	I		Cedar River - River Wall	

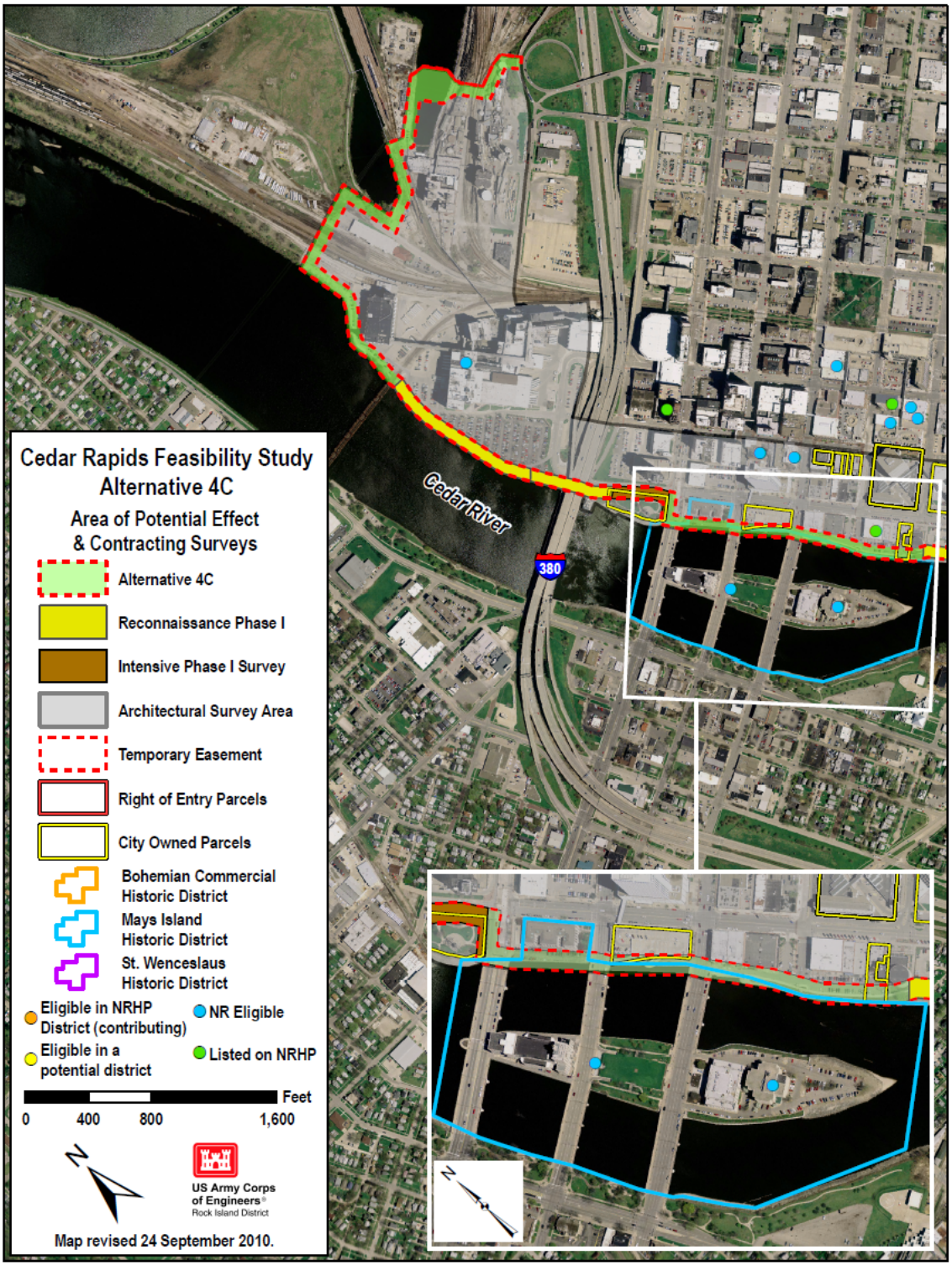


Figure 80. Location of Historic Districts Adjacent to Alternative 4C

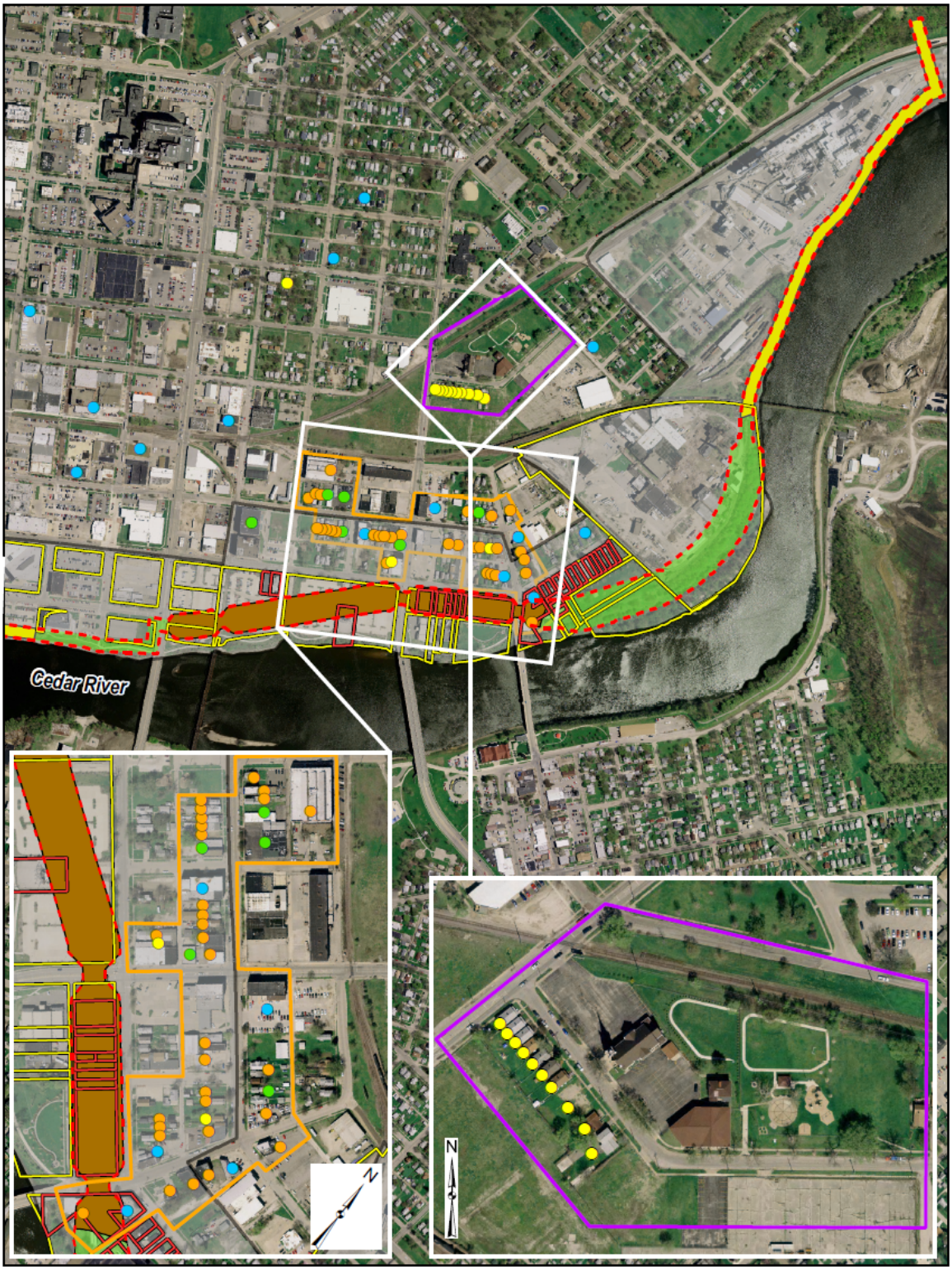


Figure 80. Location of Historic Districts Adjacent to Alternative 4C

5.1.9.2. Recommendations. To address the potential for archeological and architectural resources, the District conducted an archival background research and geomorphological investigations for the proposed flood proofing alternatives and the borrow areas. This information is contained in the Bear Creek Report. Final copies of this report are located at the District, as well as the permanent files of the State Historical Society of Iowa (SHSI).

A major component of the Report is the delineation of areas/landforms/reaches of no, low, medium, and high potential for containing archeological properties. The Report focuses on those areas where the flood proofing measures and construction borrow were considered. These investigations were conducted to complement the extensive architectural documentation of the area by the City and FEMA (Department of Homeland Security). Historic and prehistoric site probabilities are mapped on an ordinal scale of "no-low, medium, and high" within all of the Study areas. .

Of the 24 recommendations listed within the Bear Creek Report (report pages 114 to 121) for conducting Phase I survey investigations within all alternatives and borrow areas studied, 14 pertain to the APE of Alternatives 4C and 10, and within the Cedar Rapids Airport borrow area. The District proposes to implement the following 14 recommendations for the Phase I investigations:

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 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 Fire Insurance 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, the Sinclair plant, and the 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 7 Sanborn Fire Insurance maps should be used during the field survey where no historic structure 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 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 10 While located at one of the most heavily constructed and reconstructed intersections in Cedar Rapids, geomorphic drilling found evidence for intact deposits within 2 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- and 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 City.

Recommendation 11 The depressions at the possible early cabin along 2nd Street SE suggest that intact historic deposits, potentially from the mid-19th 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 15 The Terrace 3 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.

Recommendation 16 "No–low" probability zones in the Study area include the youngest alluvial units (Terrace 1 and Terrace 2) and zones where historic disturbances have completely destroyed or modified the natural landscape (e.g., Mays Island). No Phase I surveys are required.

Recommendation 17 Zones of "medium" probability are located within the Terrace 3 channelbelt, where prehistoric habitations may occur, but mitigating factors reduce the likelihood of finding intact sites. For example, the Terrace 3 channelbelt 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 the 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 three parts of Riverfront Park on both sides of the river in downtown Cedar Rapids, the Bohemian Commercial District, and the high terrace around St. Wenceslaus Church. Intensive Phase I archeological survey zones cover 41 percent (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 surveys, 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 percent (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 (Terrace 1 and Terrace 2), 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 percent [126 ac (51 ha)] of the Cedar River.

Recommendation 23 The Eastern Iowa Airport 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).

The SHSI concurred with the recommendations within the draft report by letter dated March 22, 2010 (Appendix L). As plan formulation continues with refinements to Alternative 4C or Alternative 10E, potential impacts to historic properties will be investigated in much greater detail with the development of avoidance plans to mitigate those effects (figures 80 and 81). Phase I and Phase II archeological investigations are planned within the APE for the Recommended Plan and any borrow. Cultural resources discovered within the Study area rate from *no potential* to *high potential* in terms of containing architectural and archeological sites that are NRHP eligible or listed. Phase I and II survey investigations and NRHP eligibility determinations will be conducted prior to construction activities. Phase III mitigation is expected since the area contains a rich heritage of settlement and occupation in which avoidance cannot occur, due to the construction and operational costs.

Figure 80 indicates that the APE includes the Mays Island, Bohemian Commercial and Commercial and Industrial Development of Cedar Rapids, Iowa Multiple Property Historic Districts. Direct impacts to contributing properties of the Bohemian Commercial and Mays Island Historic Districts are shown. Phase I and II surveys will be performed to document significant archeological and architectural properties, necessary since changing condition have result in building deterioration and removal, resulting in changes in status of building contribution to historic districts and possible changes in district boundaries. Based upon the 14 recommendation that pertain to the APE of Alternatives 4C and 10, and within the Cedar Rapids Airport borrow area (figures 80 and 81) Phase I architectural and archeological surveys are identified. Upon completion and reporting of these surveys, identification of significant historic properties and subsequent determination of effect can be made with assurance documenting existing conditions, which can be formally coordinated under the NHPA.

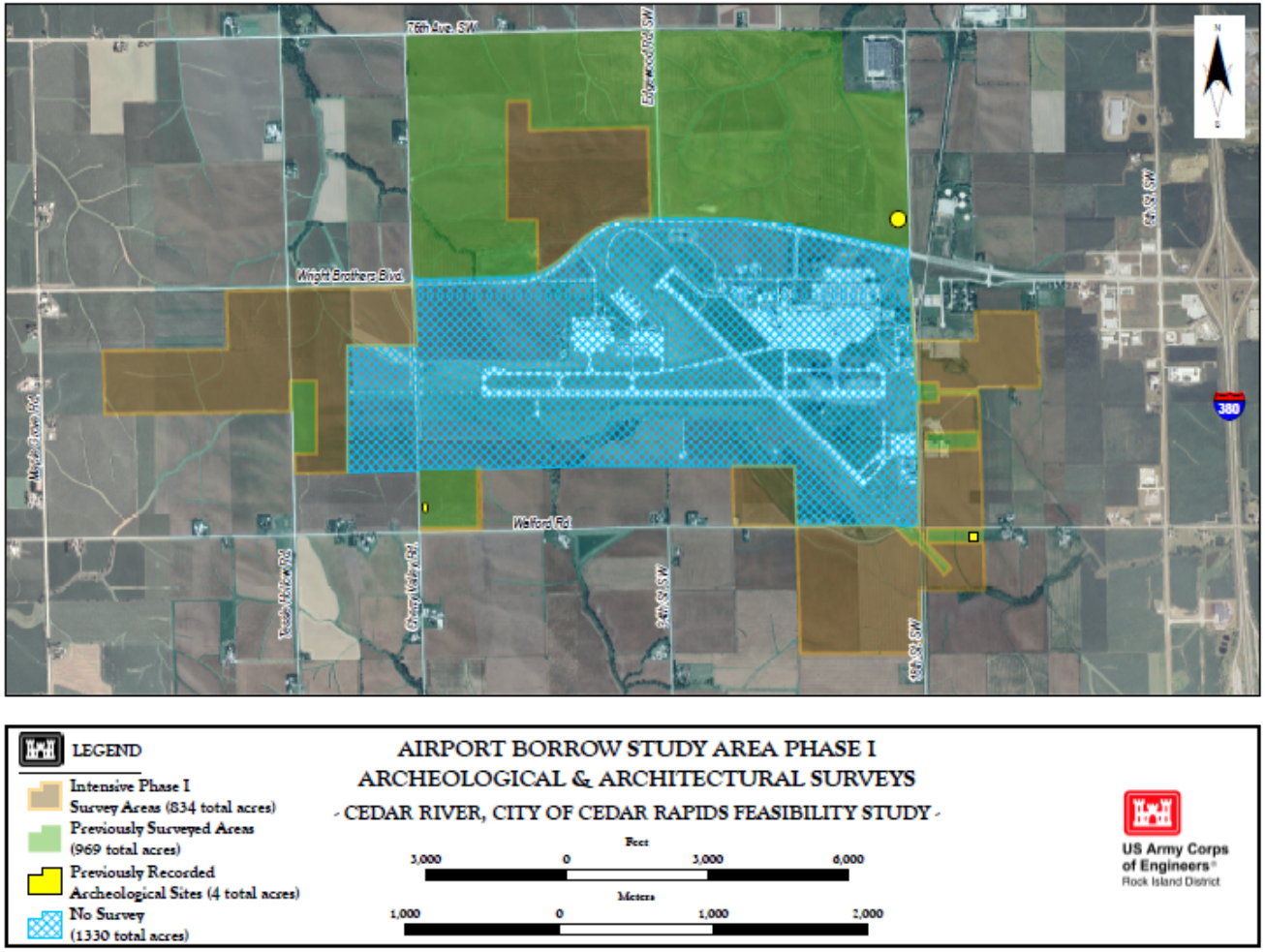


Figure 81. Airport Borrow Study Area – Phase I

The District and the City have initiated a Phase I archeological and architectural survey and have an executed PA in place for the conduct of any necessary Phase II assessments needed to identify archeological and architectural sites within the APE and to assess effects upon those identified as NRHP eligible or listed properties. Both of these phased surveys will be completed using costs included as part of the planning and PED phase of the Project. Based on best available information we have estimated historic properties mitigation at $687,000 which is 1 percent of construction costs. (fully funded estimate $706). This includes a 21 percent contingency which resulted from the cost risk assessment of which cultural resource considerations were a part. The estimate is based on an extensive literature review and geomorphic assessment as well as the district's experience in conducting urban cultural resources assessments.

Based upon recommendations from the literature review and geomorphic assessment nearly 30 percent of the project area has been eliminated from the Phase I investigations. Following the Phase I recommendation, a Phase II will be implemented to identify which archeological and architectural sites are listed on, or eligible for, the NRHP. The result of the Phase II investigations will include avoidance strategies to reduce or eliminate adverse effects, as promulgated under the NHPA. Based on best available information the study team is quite confident that the mitigation costs will not exceed $687,000.

If after the Phase II assessment mitigations costs are estimated to exceed 1 percent of construction costs a waiver will be sought from USACE HQ and the National Park Service to allow for the necessary mitigation. In the unlikely event that a waiver is required, the City will provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project.

5.1.10. Cumulative Impacts. The Council on Environmental Quality's regulations for implementing the NEPA define cumulative effects/impacts as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR Section 1508.7).

Actions that were considered when evaluating cumulative impacts on natural resources, flood heights, cultural/historical resources, and human communities include:

- FEMA Voluntary Acquisitions
- HUD Voluntary Acquisitions
- City Voluntary Acquisitions
- City's Stance of No Services to Residences Riverward of the New Levee
- Timecheck Levee Rehabilitation
- Five-in-One Dam Construction
- C Street Dam Construction
- New levee System
- Rubber Dam
- Channelizing and diverting lower McLoud Run

Natural Resources. It appears that past actions (e.g. Five-in-One Dam construction replacing the F Avenue Dam and Powerhouse; original Timecheck levee construction; I-380 Bridge

construction; C Street Dam construction; and channelizing and diverting McLoud Run) had no lasting significant adverse impact on song birds/neotropical migrants, bald eagles, migratory waterfowl, wading birds, mussels or fish, wetlands, or threatened and endangered species. Implementation of the Clean Water Act (1972) has done much to improve water quality throughout the United States which aided mussels, fish, shorebirds, wading birds, eagles etc. The Cedar River in Cedar Rapids is currently of high enough habitat quality to serve as mussel expansions location efforts for Higgins' Eye pearly mussel and contains a self sustaining varied fishery (see U.S. Fish and Wildlife Service CAR, Appendix D). The presence of breeding bald eagles within the City of Cedar Rapids also is testimony that past actions have not resulted in significant adverse impacts to natural resources.

Cedar Lake provides a sport fishery, dominated by common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), freshwater drum (*Aplodinotus grunniens*) and buffalo species (*Ictiobus sp.*). Largemouth bass and sunfish are also present. While the river fishery is consistent with other Iowa River fish populations, the Five-in-One 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, or migratory, 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 critical spawning habitat for these species. Tagged shovelnose sturgeon have been recaptured as far downstream as Pools 17 and 18 of the Mississippi River.

Additionally, in 2009 an adult lake sturgeon was also sampled near Palisades-Kepler State Park. This area has also been the site of Higgins' Eye mussel releases, although none have been relocated during sampling in 2009. Iowa DNR staff report that most shovelnose sturgeon recaptures in this area are from Pool 18, and that 33-46 percent of the fish handled during spring sampling are gravid females, indicating that this area is critical for sturgeon recruitment to populations in the Mississippi River. Iowa DNR staff 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.

The island complex and McLoud 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*).

Some increase in flood heights has been realized from construction of the Five-in-One Dam, the I-380 Bridge and the C Street Dam. This increase in flood heights resulting from construction in the floodway would also rise from any new levee construction.

Implementation of the preferred alternative would not result in any significant changes to the project area. It is not anticipated that the preferred alternative would contribute negatively to cumulative impacts on land use and infrastructure, cultural/historical resources, human communities, or natural resources. Most impacts would be minor and short term and would result in little to no negative addition to cumulative impacts. There are no foreseeable long-term additions to cumulative impacts that would necessarily lead to significant impacts.

It is the District's determination that the proposed project would have no effect on any listed threatened or endangered species.

5.1.11. Socioeconomic Impacts of Alternatives. Sections 5.1.11.1 through 5.1.11.11 describe the impacts or effects of each of the final four alternatives on

- Community and Regional Growth
- Community Cohesion
- Displacement of People
- Property Values and Tax Revenues
- Public Facilities and Services
- Life, Health and Safety
- Business and Industrial Growth
- Employment and Labor Force
- Farm Displacement
- Noise Levels
- Aesthetics

The following paragraphs about Alternatives 1C, 1A-C, 4C and 10E describe in human, non-economic terms the relative pros and cons of each alternative:

5.1.11.1. Community and Regional Growth. The ***No Action Alternative*** would not support community and regional growth in the Cedar Rapids area. No action means that residents struggling to rebuild and businesses fighting to survive would lose their hope for flood recovery. No action means losses to the visual and performing arts and the cultural spirit of the community, adversely affecting the quality of life that is important to the people of Cedar Rapids. No action certainly means that dreams die, hopelessness lingers, and perhaps the ability of the community and the region to rebound and grow is forever lost.

Alternatives 1C and 1A-C reduce flood risk for both the east and west sides of the river, including the downtown area, and would enable the City to revitalize and redevelop this area and would contribute to the growth of the community and the Cedar Rapids region. To "revitalize an area is to imbue it with new life and vitality

Alternative 4C reduces flood risk for the east side of the City only. This FRM plan would protect the downtown business area and enable the City to revitalize and redevelop this area for community and regional growth. It does not offer flood risk management and future growth opportunities for the west side of the river.

Alternative 10E reduces flood risk for the Cargill corn facility on the east side of the river. This may provide for community or regional growth associated with this facility only, but does not offer growth

opportunities for the entire City. Alternative 10E also provides flood damage reduction for Quaker Oats, Cargill and Alliant Energy's power plant on the east side of the river. Flood risk management could provide opportunities for community or regional growth for these facilities only. This alternative does not provide flood risk reduction to the west and east side neighborhoods or the downtown.

5.1.11.2. Community Cohesion. The ***No Action Alternative*** would inhibit reestablishment of some of the core neighborhoods of the City that were severely impacted by the 2008 flood. This would mean the continued loss of the social and cultural networks that are the fabric of the community. Without flood risk management, some of the more socially vulnerable populations in the City would remain at risk.

Alternatives 1C and 1A-C reduce flood risk for both sides of the river and would help the downtown and residential neighborhoods achieve their shared vision for recovery and reinvestment in the flood-impacted area. Connecting friends and family, and social sustainability are clearly part of that recovery vision. Flood risk reduction along both sides of the river ensures that no group is disproportionately affected by future flood events.

Alternative 4C offers flood risk reduction to specific areas only and does not promote maintaining the social and cultural networks of the community. Protecting only the river's east side would likely be socially and politically unacceptable, especially to those living and working on the river's west side. Providing flood risk management to only one side of the river divides the community. Future flood events could create feelings of isolation and detachment for some of the City's more vulnerable populations.

Alternative 10E would offer flood risk reduction to specific areas only and does not promote maintaining the social and cultural networks of the community.

5.1.11.3. Displacement of People. A ***No Action Alternative*** would not eliminate the relocation or displacement of Cedar Rapids residents as a result of flooding. As in the 2008 flood event, approximately 25,000 residents were displaced. No-action leaves the City vulnerable to future flooding with the potential for displacement or relocation of residents.

Alternatives 1C, 1A-C, 4C, and 10E would require removal of some buildings/ structures to allow for construction. Based upon assumptions used in the Study's NED benefit analysis, structures assumed no longer present under the With Project Condition for these alternatives are presented in table 57.

The estimated structures to be removed are based on preliminary information available, and estimates could change depending on the final plan and levee height selected. However, displacement can be both economically and socially injurious. The adversities are speculative but could include a breakdown of community cohesion and the loss of community institutions.

Table 57. Estimated Number of Structures Removed

Alternative	Descending Bank	Residential	Commercial	Public	Total
1C	Left	7	5	0	12
	Right	105	14	6	125
	Both	112	19	6	137
1A-C	Left	7	5	0	12
	Right	105	14	6	125
	Both	112	19	6	137
4C	Left	7	5	0	12
	Right	0	0	0	0
	Both	7	5	0	12
10E	Left	4	0	1	5
	Right	0	0	0	0
	Both	4	0	1	5

5.1.11.4. Property Values and Tax Revenues. The ***No Action Alternative*** would adversely impact property values and tax revenues. Removal of existing flooded structures and the lack of new residential, commercial or industrial properties being built would have a detrimental impact on the property tax base that generates tax revenues for the City. In addition, sales tax revenues would be lost following the closure of businesses in the Downtown District.

Alternatives 1C and 1A-C would offer future flood damage reduction for the City and the Downtown District and would be expected to result in development plans that would generate increased tax revenue and income to local and state governments. The potential value of property in the project vicinity could increase, especially in areas available for business and industrial development.

Alternatives 4C offers flood damage reduction to the east side of the City only. The resulting impacts on property values and tax revenues would be less positive than those created by Alternatives 1C and 1A-C.

Alternative 10E offers flood damage reduction, but in more localized sections of the City. The resulting impacts on property values and tax revenues would be less positive than those created by Alternatives 1C and 1A-C.

5.1.11.5. Public Facilities and Services. The ***No Action Alternative*** would allow future impacts on public facilities and services similar to those that occurred during the 2008 event. Major City services would face the possibility of being interrupted, flooded, damaged, or displaced. Major transportation routes could be closed or compromised, creating significant difficulties for citizens, workers, emergency, City and school vehicles, freight connections, as well as businesses and industries.
Alternatives 1C and 1A-C offer a level of flood damage reduction on both sides of the river that would be recognized as sufficient to keep the City operating and providing services at the optimum level for its citizens.

Alternatives 4C offers flood damage reduction to the east side of the City, and essential City services could not be guaranteed for the west side during a flood event.

Alternative 10E offers flood damage reduction only to localized areas and essential City services could not be guaranteed to be available during a flood event.

5.1.11.6. Life, Health, and Safety. The ***No Action Alternative*** would present negative impacts for the City and its residents. No Action contributes to the ongoing threat of flooding which represents a key health stressor for the citizens of Cedar Rapids. Without flood risk management, access to health care, medical facilities, and emergency response systems such as ambulance, police, and fire services could be severely impacted. Utilities such as electric, gas, water, and sewer would continue to be at risk.

Alternatives 1C and 1A-C offer a significant level of flood risk reduction for maintaining the sense of security and safety that is important to those who live and work in Cedar Rapids.

Alternatives 4C would provide flood damage reduction to the east side of the City, but would leave other areas vulnerable to flooding and risk.

Alternative 10E would provide flood damage reduction to portions of the City, but would leave other areas vulnerable to flooding and risk.

5.1.11.7. Business and Industrial Growth. The ***No Action Alternative*** negatively impacts the potential for business and industrial growth in Cedar Rapids. Downtown business owners and investors would be cautious about building or developing in an area that is at risk for future flooding. Some may go out of business or relocate, having serious effects on the City's economic viability.

Alternatives 1C and 1A-C provide a significant level of flood risk reduction to both the east and west sides of the river, including the downtown area, and would enable the City to revitalize and redevelop. Future flood risk management could instill investor confidence and positively contribute to opportunities for expansion of businesses and industries in the Cedar Rapids region.

Alternative 4C provides a significant level of flood risk reduction to the east side of the City only. This FRM plan would protect the downtown business area and enable the City to revitalize and redevelop this area for business growth. It does not offer flood risk management and future growth opportunities for the west side of the river.

Alternative 10E would provide flood damage reduction for the Cargill corn facility on the east side of the river. This may provide for community or regional growth associated with this facility only, but does not offer growth opportunities for the entire City. Alternative 10E also provides flood damage reduction for Quaker Oats, Cargill and Alliant Energy's power plant on the east side of the river. Flood risk management could provide opportunities for community or regional growth for these facilities only. This alternative does not provide flood damage reduction to the west and east side neighborhoods or the downtown.

5.1.11.8. Employment and Labor Force. The ***No Action Alternative*** could have a significant impact on employment and labor force in the Cedar Rapids area. Without future flood risk management, businesses may be unwilling to commit to investing in the Downtown District. Business

closures and loss of employment would be detrimental to the City's ability to remain competitive and attract a capable qualified workforce. No action also means the loss of economic and social well-being for its citizens.

The infusion of substantial construction into the community created by ***Alternative 1C or 1A-C*** would create additional jobs within the project area and positively impact employment and labor force in the Cedar Rapids Metropolitan Area. Both short-term construction jobs and long-term permanent jobs would be an expected outcome. Construction of either Alternative would create construction expenditures and support construction employment during a multi-year development period.

Alternative 4C would offer similar positive impacts to employment and labor force in the Cedar Rapids Metropolitan Area. However, the smaller size of the project would mean a reduction in the number of additional jobs created and the amount of construction expenditures purchased through the local economy.

Alternative 10E would offer similar positive impacts to employment and labor force in the Cedar Rapids Metropolitan Area. However, the smaller size of the projects would mean a reduction in the number of additional jobs created and the amount of construction expenditures purchased through the local economy.

5.1.11.9. Farm Displacement. No farm displacement would occur with the ***No Action Alternative***. All project alternatives are located in an entirely urban setting. However, the proposed project could result in the conversion of prime farmland to non-agricultural uses if ***Alternatives 1C, 1A-C, 4C, and 10E*** were implemented in the future. Some of the borrow sites needed for project construction are/or contain prime farmlands.

5.1.11.10. Noise Levels. Implementation of the ***No Action Alternative*** would have no impact on noise levels.

Alternatives 1C, 1A-C, 4C, and 10E would result in adverse impacts of increased noise and traffic associated with construction equipment. Elevated noise levels associated with construction activities would occur during the construction phase of the project. These activities would likely be of short duration and spread over a period of several years. This increase would have the potential to disturb persons visiting, working or living along the riverfront.

5.1.11.11. Aesthetics. The ***No Action Alternative*** would not encourage cleanup and redevelopment within the City. Flood blighted properties that remain following the 2008 event would diminish the aesthetic quality of the neighborhoods and the downtown, inhibiting community events, visitor experience and growth.

The project areas for ***Alternatives 1C and 1A-C*** are a mix of industrial, commercial and residential properties, and construction activities would be within the viewscape of neighboring properties and users of the existing riverfront. Project plans would include landscaping and new vegetation along both sides of the river which would be aesthetically pleasing.

Aesthetic impacts for ***Alternative 4C and 10E*** would be similar to 1C and 1A-C, but would be lesser in scale as they would be localized within the smaller project area.

5.1.12. Airport Borrow Area. Some impact to the borrow areas is unavoidable if the NED Plan were to be implemented. The primary borrow area, around the airport, is currently made up of agricultural fields containing no wetlands. In the with-project scenario, the amount of borrow material needed for the NED Plan (Alternative 4C) is estimated at 132,000 cubic yards. This equates to roughly 10 acres at a depth of 8 feet. The overall area where borrow material may be excavated is over 2,100 acres. No borrow site within the overall borrow area would be excavated to a depth such that wetland or aquatic habitat would develop. Given the proximity to the airport, habitats that would attract migratory waterfowl would be highly undesirable. The existing upland habitat (agricultural fields) of the borrow area would be maintained following removal of material for levee construction. Drainage of the borrow areas following construction would be established to maintain upland status, much as it is now. These areas, post-construction, would be similar to pre-construction conditions, but simply several feet lower in elevation.

Following completion of the construction of Alternative 4C, the most likely land use scenario for the borrow area around the airport would be that it would return to agricultural production. Given the proximity of the borrow area to the airport, it is unlikely that any vegetative cover that would grow after removal of borrow material, would have substantial value to wildlife. The habitat value of the borrow area following construction should remain somewhat similar to what it is now.

Hazardous, toxic, and radioactive waste soil sampling was completed for the Cedar Rapids Airport potential borrow area. Three soil sample locations indicate chemical or metal concentrations above the Iowa DNR Statewide Standards for soil. No soil from these three locations would be used for borrow material.

With the implementation of the NED Plan/Alternative 4C, the primary proposed borrow area around the airport would most likely return to agricultural land, resulting in no significant adverse direct, indirect or cumulative impacts.

5.2. Compliance with Environmental Quality Statutes *

Endangered Species Act of 1973, as amended. The proposed action has been coordinated with the USFWS, the IDNR, and other state and Federal agencies, and other interested conservation groups. The Districts initial coordination letters, presented in Appendix L, *Pertinent Correspondence*, show the organizations and individuals contacted. None of the alternatives, including No Action, should result in any significant impact to any listed species. If implemented, the project, as proposed, would be in full compliance.

National Historic Preservation Act (NHPA) of 1966, as amended . The proposed actions would be in full compliance with this Act. The NHPA of 1966 established a program for the preservation of additional historic properties throughout the Nation, and for other purposes, approved October 15, 1966 (Public Law 89-665; 16 U.S.C. 470 et seq.). Section 106 of the NHPA, as amended and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties," establishes the primary policy, authority for preservation activities, and compliance procedures. The NHPA ensures early consideration of historic properties preservation in Federal undertakings and the integration of these values in to each agency's mission.

The District and the City have determined that implementation of the Study may have an effect upon properties listed on, or eligible for listing on, the NRHP. The District and the City have initiated

consultation with the Advisory Council and the Iowa SHPO pursuant to Section 800.14(b) of the regulations (36 CFR Part 800) implementing Section 106 of the NHPA (16 U.S.C. 470(f)), and Section 110(f) of the same Act (16 U.S.C. 470h-2[f]) assure that interested and consulting parties, have been and will continue to 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. 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 NEPA of 1969 Act (42 U.S.C. 4321-4327), the District and the City have developed an Interested and Consulting Parties List (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 August 5, 2009). The District will comply with any requests to be removed from, or added to, the List. The development and maintenance of the 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 Study and to participate in the review of the Draft PA. Response will allow the District and the City to provide those on the List access to all environmental reports;

- 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 Study identifies a preferred plan; and

- is integral to the development of the Public Development Plan, as follows: In consort with the 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 Study will include developing and maintaining a mailing list of interested publics consisting of over 900 names, which includes those on the 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; 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 District and the City will be taken into account when finalizing plans for the Study, as promulgated by the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the Study. Although the Study presently lies entirely within the State of Iowa, consulting parties from elsewhere in the United States are given equal and due consideration. Since the District 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 District requests any information concerning our Federal trust responsibilities**.** The District's NEPA document will be included within the report, contain a draft of this PA, and be made available to all on the District's 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 (Draft PA is located in Appendix C); and 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 Study, the public will be invited to be included on the List. Those on the 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).

Although THPOS, Tribes and Parties are included on the 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 Study will be implemented in compliance with EO 13007.

Interested and consulting parties have been, and will continue to 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 List may not get all of the enclosures, since specific locations of historic and archaeological properties are subject to protection through nondisclosure under Section 304 of the NHPA. This information is not to be released in order to protect the resources at the sites.

By letters dated June 23, 2009 and August 31, 2009 (Appendix L, *Pertinent Correspondence*), the District and the City provided Interested and Consulting Parties with a preliminary description of the Study area, maps of alternatives studied, and a draft PA. The District and the City have coordinated with the SHPO; local and other government agencies; the Advisory Council; and with tribes and other consulting parties, concerning the draft PA, as well as sacred sites and traditional cultural properties.

On October 10, 2009, the District held a telephone conference call which focused on the follow-up issue resolution, with participants from the SHPO and the Advisory Council. All comments were incorporated into the draft PA. Although the District correspondence and meeting generated a plethora of emails and telephone conversations, only three formal responses were received and they are from the University of Iowa Office of the State Archaeologist (July 1, 2009); the National Trust for Historic Preservation (July 29, 2009); and the SHPO (October 4, 2009); (Appendix L).

By letter dated October 20, 2009 (Appendix L, *Pertinent Correspondence*), the District invited all consulting parties to a meeting in Cedar Rapids to discuss FRM measures with a tour of the potential locations for alternatives. The meeting was held on October 29, 2009 and the agenda included a PowerPoint presentation of the various FRM alternatives under study, and cultural resources status relevant to Section 106 of the NHPA procedures and the proposed draft PA. The meeting included a bus tour of the areas under study.

By District letter dated February 16, 2010 (Appendix L), the District forwarded the revised third draft of the PA to the Iowa SHPO with proposed flood proofing measures. By letter dated March 17, 2010, the Iowa SHPO requested review of the final alternative when the District established an undertaking and proposed a revised Draft of the PA (Appendix C) (R&C#: 090657190, Appendix L). The District plans to conduct a Phase I and II archeological and architectural survey to assess potential effects of planning and designing the Recommended Plan, Alternative 4C, and the proposed borrow area. Future archeological investigations shall be guided by the geomorphological assessment and landform stability model developed by the Bear Creek Report.

The PA affords protection to historic properties and assures that the District will comply with the NHPA and that no significant historic properties will be affected by any flood proofing measures; if any undocumented historic properties are identified or encountered during the undertaking, the District would discontinue all activities in order to evaluate the significance of the historic property and determine potential effects under Section 106 of the NHPA of 1966 and 36 CFR Part 800. The PA also allows for the development of a phased approach to the identification and evaluation of historic properties promulgated under the NHPA [36 CFR 800.4(b)(2)] and through additional coordination using the NEPA process [36 CFR 800.8].

Although the District's PA assures compliance with the NHPA, if any construction activities and ancillary actions result in the discovery or potentially affect potentially significant historic properties, the District would discontinue the undertaking and resume coordination with the Iowa State Historic Preservation Office, tribes, agencies, and other consulting parties to evaluate the significance of the historic property and assess potential effects. All consulting parties must be aware that the specific locations of historic and archaeological properties are subject to protection through nondisclosure under Section 304 of the NHPA. 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.

The District 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 any proposed construction associated with the *Iowa Flood Risk Management Feasibility Study*. Presently, the District is unaware of any traditional cultural properties or sacred sites within this reach of the Cedar Rapids watershed or surrounding urban development. Those on the List were asked to provide any concerns about traditional cultural properties or potential effects. To facilitate tribal coordination, the District requested those on the Consulting Parties List to refer to the National Park Service NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties.* Consulting Parties were provided with a blank Traditional Cultural Property and Sacred Site Form for completion and submittal to the District. Traditional Cultural Property location and ancillary information may not be disclosed to the public. Pursuant to Section 304 of the NHPA, archeological site locations cannot be disclosed and the District will secure this information from the general public.

In accordance with 36 CFR Section 800.13, if previously undetected or undocumented historic properties were to be discovered during project construction activities, the District would 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 human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected, the District would comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains would be made recognizing the rights of lineal descendants, Tribes, and other Native American Indians and under consultation with the SHPO/THPO(s) and the other consulting parties, designated Tribal Coordinator, and/or other appropriate legal authority for future and expedient disposition or curation.

Upon execution of the PA and implementation of its terms, the District would be in full compliance with the NHPA, as amended. By review of the draft Study, all consulting and interested parties would have the opportunity to comment on the coordination and the draft PA (Appendix C). All comments concerning the draft PA would be considered for inclusion in the final PA.

Federal Water Project Recreation Act. Full consideration has been given to the opportunities which this project affords for outdoor recreation and for fish and wildlife enhancement. It has been determined this project cannot reasonably incorporate these opportunities into the FRM construction. This project would be in full compliance.

Fish and Wildlife Coordination Act. Project plans have been coordinated with the USFWS and the IDNR. Coordination responses are presented in Appendix L, *Pertinent Correspondence*. The Coordination Act Report from the USFWS is presented in Appendix D, *USFWS Draft Coordination Act Report*. If implemented, the project, as proposed, would be in full compliance.

Wild and Scenic Rivers Act of 1968, as amended. The Linn County section of the Cedar River is not listed on the National Rivers Inventory. The National Rivers Inventory is used to identify rivers that may be designated by Congress to be component rivers in the National Wild and Scenic Rivers Systems. If any of the alternatives were to be implemented, the project, as proposed, would be in full compliance.

Executive Order 11988 (Floodplain Management). This EO requires Federal agencies to recognize the significant values of floodplains and to consider the public benefits that would be realized from restoring and preserving floodplains. The objective of this EO is to avoid, to the extent possible, long- and short-term adverse impacts associated with the occupancy and modification of the base floodplain and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative. Under this EO, the Corps is required to provide leadership and take action to:

1. avoid development in the base floodplain unless it is the only practicable alternative;
2. reduce the hazard and risk associated with floods;
3. minimize the impact of floods on human safety, health and welfare; and
4. restore and preserve the natural and beneficial values of the base floodplain.

The following are the general procedures to be followed for implementing EO 11988. These procedures are the "decision making process." The general procedures are to be incorporated in the planning, design and construction of civil works projects.

1. Determine if the proposed action is in the base floodplain.
2. If the action is in the base floodplain, identify and evaluate practicable alternatives to the action or to location of the action in the base floodplain describing advantages and disadvantages based on many factors.
3. If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.
4. Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial floodplain values. Where actions proposed to be located outside the base floodplain will affect the base floodplain, impacts resulting from these actions should also be identified.
5. If the action is likely to induce development in the base floodplain, determine if a practicable non-floodplain alternative for the development exists.
6. As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for

which there is no practicable alternative and methods to restore and preserve the natural and beneficial floodplain values.

7. If the final determination is made that no practicable alternative exists to locating the action in the floodplain, advise the general public in the affected area of the findings.
8. Recommend the plan most responsive to the planning objectives established by the Study and consistent with the requirements of the EO.

District determination of compliance with procedures of this EO is based on:

1. The action is located in the base floodplain.
2. No practicable alternative has been identified and evaluated to locating the action outside the base floodplain.
3. The general public will be advised/informed of the proposed action through public meetings, newsletters, distribution of this Study for public review, and through a Public Notice. To date, the public and environmental agencies have been coordinated with via letter, newsletters, public meetings, open houses, and through the District website. These comments will be considered and summarized in a Statement of Findings.
4. Beneficial impacts if this project were to be implemented would be reduced flood damages. Adverse impacts would be slight increase in flood heights. There are no expected losses of natural and beneficial floodplain values, as the floodplain is heavily urbanized.
5. Since the project area is the large urban area of Cedar Rapids, and already fully developed, neither large scale new development, nor significant improvements to existing developments are anticipated behind the proposed levee/floodwall system. No practicable non-floodplain alternative has been identified.
6. No viable methods to minimize the slight increase in future flood heights that would result from construction of Alternative 4C have been identified.
7. The general public will be advised that no practicable alternative to locating the proposed action in the floodplain exists, as indicated in Item No. 3 above.
8. The Recommended Plan, Alternative 4C, is the plan most responsive to the planning objectives established by the Study and consistent with this EO. The proposed project would be in full compliance with EO 11988.

Executive Order 11990 (Protection of Wetlands). Executive Order 11990 (Protection of Wetlands): The No Action Alternative would not impact wetlands. Although Alternatives 1C, 1A-C, 4C and 10 would result in placing dredged or fill material in the waters of the United States, subject to Clean Water Act 404 regulations, only Alternative 1C would result in impacts to jurisdictional wetlands. This project would be in full compliance if the NED plan (Alternative 4C) were to be implemented.

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). This EO requires the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. Fair treatment means that no group of people, including a racial, ethnic, or a socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial,

municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Meaningful involvement means that: 1) potentially affected community residents have an appropriate opportunity to participate in decision making about a proposed activity that could affect their environment and/or health; 2) the public's contribution can influence the regulatory agency's decision; 3) the concerns of all participants involved will be considered in the decision making process; and 4) the decision makers seek out and facilitate the involvement of those potentially affected.

A variety of public participation methods were used to comply with the provisions of the EO. When the flood hit, the City mobilized and embarked on multiple phases of community engagement, providing citizens the opportunity to learn about and provide feedback on future flood risk management 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, and interdisciplinary consultant team, and numerous agencies ranging from the local to the Federal level such as the Federal Emergency Management Agency (FEMA), US Department of Housing and Urban Development (HUD), the Downtown District, the Chamber of Commerce, Linn County, and multiple departments of the State of Iowa.

Phase I sought to establish the framework for reinvestment and revitalization of Cedar Rapids. Between June and October 2008, a series of three Open Houses engaged over 2,680 residents in evaluating several options for flood management and community revitalization. The Phase I public process resulted in a RCRP, and a public process to develop the Parks and Recreation Master Plan.

Phase II of the community engagement process involved more than 1,400 citizens, 5,900 hours of planning time and eight public meetings. This collaboration effort resulted in the development of a Framework for Neighborhood Reinvestment in the City's nine flood-affected neighborhoods.

In April 2009 a public open house was held to explain the Corps' Feasibility Study process and answer questions related to the Study initiative. Representatives from the District and the City were on hand to provide information and answer questions on a one-to-one basis. Concerns expressed by the members of the public focused on future FRM measures, voluntary acquisition programs, and the Study timeline.

Throughout these processes all residents were engaged 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 public open house events. The Cedar Rapids website and the Corps study newsletters were used to provide information on plan development, as well as solicit and receive comments and suggestions. Other opportunities for involvement and participation were available through District coordination and the NEPA review process.

Regarding this EO, concerns about perceived inequities of protecting one side of the river and not the other were expressed during the public participation process. Social characteristics of the Study area, by reach (table 31) were used to assess the social equity of plan alternatives. While both sides of the river were considered for protection in the Study, only the east side of the river could be economically justified.

In the year 2000, there were 120,758 people, 49,820 households, and 30,824 families residing in Cedar Rapids. Although the population has grown about 4 percent since then, other characteristics are believed to be approximately the same as those reported at the 2000 Census. The minority population was at 8 percent. Median household income and the percent of the City population with income below the poverty level were lower than that for the State of Iowa.

An overview of major socioeconomic characteristics for the City and the designated Study area provide a context from which to assess impacts. The 2000 census data was used for this assessment as that data set has corresponding census block data from which to draw demographic characteristics of the Study area.

Making a determination of whether affected areas with a high proportion of minorities or low-income populations have been disproportionately impacted involves comparing the magnitude of impacts within and outside these areas. There are approximately 14,526 people living in the census block groups within the flood impacted Study area, which is about 12 percent of the City population. The racial makeup of the Study area is 89.6 percent white, 4.3 percent black, 2.7 percent Asian and 2.3 percent Hispanic or Latino. Total minority population in the Study area is 10 percent, while it is 8 percent for the City. In contrast to the City as a whole, the Study area has an equal percentage of elderly residents, and it has a much higher percentage of people that are disabled, are in poverty, and/or are female head-of-households. About 41 percent of the housing units in the Study area are renter occupied, the median household income here is about 25 percent less, and about one-third of the households in this area are living on Social Security income.

In table 58, the demographic characteristics of the City are contrasted with those of the Study area. Data for the specific blocks and block groups were aggregated to represent the Study area.

Table 58. Comparison of Demographic Characteristics

	Cedar Rapids	Study Area
Population	120,758	14,526
White	110,931	13,016
Minority-total	9,827	1,510
% Minority	8%	10%
Black	4,481	637
Asian	2,135	399
Hispanic	2,065	339
American Indian	306	53
Hawaiian	78	22
Other	670	73
2+ Races	2,157	326
Female	61,925	7,366
Male	58,833	7,160
Children < 5 yrs	8,625	827
Children 5-18 yrs	21,540	1,980
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
Median Household Income	$43,704	$33,653
Households with Social Security Income	12,524	1,625
% Households with Social Security Income	25%	31%
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

The IEPR of the Study yielded concern that Environmental Justice was not presented in enough detail in the feasibility report. The Environmental Justice EO 12898 directs Federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law. The order is also intended to promote nondiscrimination in Federal programs that affect human health and the environment, as well as provide minority and low-income communities' access to public information and public participation.

Environmental justice encompasses more than looking at the total number of people protected, or not protected, by a proposed project. According to EO 12898, an environmental justice assessment identifies high and adverse human health or environmental effects of a program, policy and activity on minority populations and low-income populations. Low income is identified using Bureau of Census poverty thresholds; minority population groups include Black, American Indian, Asian, and Hispanic, and such populations must not exceed 50 percent of the population in the affected area. Disproportionately high and adverse human health effects are determined significant if they are above generally accepted norms, if the risk to a minority or low-income population appreciably exceeds the risk to the general population, and whether the effects would occur for such populations by cumulative or multiple adverse exposures from environmental hazards.

Referencing the data from the 2000 census presented in the report, none of these criteria have been exceeded to indicate a significant environmental justice impact from the proposed project. This data may not reflect current conditions because a number of residents have moved out after the 2008 flood event. The minority populations do not exceed 50 percent of the total population in any of the reaches; the percent of the population below the poverty level is higher for reaches on the east side of the river; and the number of children under the age of 16 is 21 percent of the east side population and 22 percent of the west side population. The January 2009 Census Bureau poverty guidelines have an income threshold of $14,750 for a family of two and $18,310 for a family of three. The average family size on the west side of the river is three and the median household income is $35,926. The average family size on the east side of the river is two and the median household income is $29,109.

Executive 12898 also requires that minority and low-income communities are provided access to public information and public participation. All residents were invited to participate in all public meetings, and the public review and participation process for this Study was more than adequate to accommodate this EO.

Although life and safety are a concern, this Study found there is ample warning time for evacuation of residents from the area at risk. Cedar Rapids has about three days warning on flooding. For the 2008 Flood, it took approximately 12 to 15 hours for initial evacuations and then another 24 to 36 hours of boat-based operations to evacuate the flood impact area.

The impact of induced flooding was analyzed during the formulation and evaluation of alternatives. Where induced damages would occur within the damage reaches they were calculated and factored into the economic analysis using the certified HEC-FDA models; and utilized for evaluation and comparison of alternatives. Once the recommended plan was identified, the induced damages/stages were analyzed again to determine if they were significant enough to require mitigation. Under the recommended plan, certified HEC-RAS hydraulic models indicate the increase during a 1 percent chance event would be less than ¼ foot. For a 0.2 percent chance event the modeled average increase for the west bank would still remain less than 1 foot. It was determined that the increase was not

significant and did not require mitigation. No mitigation measures were explored. The State of Iowa code (Iowa Administrative Code Section 567 Chapter 71) specifies how much the overbanks of a stream can be restricted or encroached. In Iowa the water surface elevation of the .01 exceedance probability flood cannot be increased more than 1 foot.

Non-structural measures such as floodproofing were analyzed and found to be not cost effective. The City is pursuing flood mitigation measures for the west side utilizing the FEMA HGMP Property Acquisition Program. The properties that are being targeted by this program were identified and utilized in the economic analysis.

Figure 52 includes a map of the west bank FEMA target HGMP property acquisition area (aka greenway acquisition area). Under the assumptions from October 2009 listed in Section III of Appendix B, *Economics*, 134 residential structures, 8 commercial/industrial structures, and 2 public structures on the west bank were in the target area for the FEMA HGMP Property Acquisition program and were removed from the structure inventory because they would not be re-built. The number of structures assumed to be acquired by category and bank is listed in table B-11.

Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds). Implementation of the No Action Alternative, to the extent appropriate and practicable, would promote the conservation of migratory birds. This project is not likely to have a measurable negative impact on migratory bird populations. The implementation of Alternatives 1, 1A, 4C, and 10 would also promote conservation of migratory birds. This project would be in full compliance.

Clean Water Act (Sections 401 and 404), as amended. The No Action Alternative would not require any action on the Districts part to be in compliance with any section of the Clean Water Act (CWA). A CWA 404(b)(1) Evaluation is included in this report as Appendix N. The signing of the Findings of Compliance will constitute full compliance with the CWA. Clean Water Act 401 Certification would be acquired prior to construction.

For Alternatives 1C, 1A-C, 4C and 10E the use of construction materials would not require the imposition of any controls to ensure that receiving water maintains compliance with water quality standards. Land based staging and construction areas would be controlled by employing traditional erosion prevention techniques. Certification under Section 401 of this Act from Iowa would be received before construction of this project would begin. No significant adverse impacts to water quality would result from the construction of the aforementioned alternatives for this project. If, in the future, Alternatives 1C, 1A-C, 4C and 10E were to be recommended, the completion of a CWA Section 404(b)(1) Evaluation and the signing of the Findings of Compliance would constitute compliance with Section 404.

Clean Air Act, as amended. The No Action Alternative would not impact this Act. It is not anticipated that any of the levee construction alternatives (1C, 1A-C, 4C and 10E) proposed for the levee/flood damage reduction project, would result in either short- or long-term violations to air quality standards. It is not anticipated that the outdoor atmosphere would be exposed to contaminants/pollutants in such quantities and of such duration as may be or tend to be injurious to human, plant, or property, or which unreasonably interferes with the comfortable enjoyment of life, or property, or the conduct of business. If implemented, the proposed project would be in full compliance.

Farmland Protection Policy Act of 1981. The No Action Alternative would not impact any farmland, prime, unique or of statewide importance.

The proposed project could result in the conversion of prime farmland to nonagricultural uses if Alternatives 1C, 1A-C, 4C and 10E were to be implemented in the future. Some of the proposed borrow areas are/or contain prime farmlands. The proposed project has identified and taken into account the adverse effects; considered alternative actions or borrow sites that could lessen such adverse effects, and is, to the extent practicable, compatible with State, local government units, and private programs and policies to protect farmland.

The District and the Natural Resource Conservation Service completed AD 1006 Farmland Impact Conversion ratings for the proposed borrow sites. The borrow area with the highest rated farmland was the Eastern Iowa Airport area, followed by Tuma Parkland parcels, then the Oeschger parcel, and lastly the Phillip Trucking site. The Phillip Trucking area is the only borrow area evaluated for this project with no prime farmland and should be utilized for borrow material first if at all possible. Every effort will be made to utilize the lowest rated prime, unique, statewide or local farmland for borrow sites. If implemented, the project, as proposed, would be in full compliance.

National Environmental Policy Act of 1969, as amended. Following the public review period, the signing of the Finding of No Significant Impact (FONSI) for the EA aspect of this report would constitute NEPA compliance.

National Economic Development (NED) Plan. The NED Plan is the plan which best satisfies the Federal planning objectives of increasing the Nation's output of goods and services and produces the most improvement to the national economic efficiency. The proposed project would be consistent with the NED objective. If implemented, the project, as proposed, would be in full compliance.

Migratory Bird Treaty Act of 1918, as amended. The purpose of this Act is to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the take and harvest of migratory birds. The USFWS will be provided this report for review and will work with the District for compliance with this Act.

Executive Order 13112 Invasive Species. This project does not authorize or carry out any actions that are likely to promote invasive species proliferation. Any subsequent occurrence of any invasive species in the project vicinity should not solely be the result of the implementation of this project. This project is in full compliance.

Bald and Golden Eagle Protection Act of 1940. This law provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds, including eagle parts, eggs, and nests. Active nests of the previously federally-threatened bald eagle (*Haliaeetus leucocephalus*) are located near Cedar Lake. The bald eagle has been de-listed from the List of Threatened and Endangered Species due to recovery.

No longer federally endangered, the bald eagle remains protected under the Migratory Bird Treaty Act and the more robust Bald and Golden Eagle Protection Act (BGEPA). The latter was recently amended to include two new regulations in section § 22. These regulations allow for the issuance of "take" permits to qualified applicants.

The regulation set forth in section § 22.26 governs the issuance of permits to take bald eagles and golden eagles, where the taking is associated with, but not the purpose of the activity, and cannot practicably be avoided. Most take authorized under this section will be in the form of disturbance; however, permits may authorize non-purposeful take that may result in mortality.

The regulation at section § 22.27 establishes the issuance of permits for removing eagle nests where 1) necessary to alleviate a safety emergency to people or eagles, 2) necessary to ensure public health and safety, 3) the nest prevents the use of a human-engineered structure, or 4) the activity or mitigation for the activity will provide a net benefit to eagles. Only inactive nests may be taken except in the case of safety emergencies.

The two regulations share the following characteristics:

- both address golden eagles and bald eagles;
- provide that take will only be authorized where it is compatible with the preservation of either of the eagle species and consistent with the goal of stable or increasing breeding populations;
- a permit will be issued only when the take cannot practicably be avoided; and
- are prioritized by; safety emergencies, Native American religious use, activities that ensure public health, and resource development or recovery operations

The new permit program has the potential to provide significant benefits to eagles because it requires permittees to conduct advanced conservation practices, unlike the Endangered Species Act. The new regulations provide greater flexibility for relevant activities or projects, and authorize human activities that would otherwise be curtailed if the BGEPA were to remain unchanged.

The bald eagle will continue to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. This project would be in full compliance.

Executive Order 13045 (Protection of Children from Environmental Health Risks and Safety Risks). The District has made it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. It is not anticipated that this FRM project, either during construction or after construction is complete, would result in increased risk to children from products or substances that a child would likely come in contact with or ingest (such as air, food, water, or soil). This project is in full compliance.

5.3. Probable Adverse Environmental Impacts Which Cannot Be Avoided. * The No Action Alternative would not result in any unavoidable adverse effects such as traffic, noise, and aesthetic impacts associated with construction equipment. The No Action Alternative would not result in any unavoidable impacts to any group of birds, mussels/fish, wetlands, threatened or endangered species or wetlands.

The levee/floodwall system associated with Alternatives 1C, 1A-C, 4C and 10E would increase the Cedar River water surface elevations due to confining the river by levee/floodwalls. Table 59 displays how much increase in water surface elevation each alternative would have for the 25 year flood event (0.04 exceedance probability event); the 50 year flood event (0.02 exceedance probability event); the 100-year flood event (0.01 exceedance probability event); the 200 year flood event (0.005 exceedance probability event); and the 500 year flood event (0.002 exceedance probability event).

Some loss of wetland habitat could be expected from construction of the levee for Alternatives 1C, 1A-C, 4C and 10E. The levee footprint and associated construction impact footprint encroach into wetlands adjacent to the railroad embankment on the east side of the river for Alternative 1C. Wetland mitigation would be required to replace lost wetland functions if Alternative 1C were to be implemented. For Alternatives 1A-C, 4C and 10E levee fill would encroach into a small portion of Cedar Lake. Some clearing of vegetation (trees/shrubs) in the levee alignment footprints and construction zone for Alternatives 1C, 1A-C, 4C and 10E are unavoidable. Alternatives 1C, 1A-C, 4C and 10E would result in unavoidable adverse effects such as traffic, noise, and aesthetic impacts associated with construction equipment. Wetland mitigation would not be required if Alternatives 1A-C, 4C or 10E were to be implemented, since no wetland function would be lost. Cedar Lake functions as a cooling water source for the power plant, but water would be pumped around the levee portion during construction. After construction is complete, gated pipes through the Cedar Lake levee segment would allow water to circulate similar to the condition prior to construction.

Table 59. Water Surface Increase Above Existing Condition (without project) for Various Alternatives

Alternative	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)
1C & 1A-C	Average Increase	0.01	0.06	0.27	1.20	2.35
1C & 1A-C	Maximum Increase	0.03	0.09	0.32	1.95	3.61
4C	Average Increase	0.01	0.07	0.23	0.34	0.63
4C	Maximum Increase	0.02	0.22	0.43	0.62	1.17
10E	Average Increase	Insignificant	0.01	0.08	0.16	0.19
10E	Maximum Increase	Insignificant	0.01	0.10	0.28	0.41

It is unavoidable that some number of buildings/structures (residences, businesses, garages, etc) would require demolition/removal to allow for construction of the new levee alternatives, either in the footprint of the proposed levee alignments or the adjacent construction zone. The No Action Alternative would not require removal of any structures. Alternative 1C would require removal of approximately 137 structures; Alternative 1A-C removal of approximately 137 structures; and Alternative 4C removal of approximately 12 structures.

Some temporary disruption of recreational facilities/usage (e.g. parks, greenspace, trails, etc) is unavoidable if Alternatives 1C, 1A-C, 4C and 10E were to be implemented. This impact would be temporary until construction of the new levee alternative is complete. See Appendix M for more information on recreational facilities for this project.

5.4. Relationship Between Short-Term Use and Long-Term Productivity. * The local short-term impacts of the proposed action and the use of resources for it are consistent with the maintenance and enhancement of long-term productivity for the City, local area, region, and Nation. Implementation of the project would support growth and development of employment and population in the region.

The long-term productivity of the City could be altered if greenspace ultimately replaces the residences and businesses impacted from the 2008 flood. Productivity may not suffer/decline as recreational opportunities (either in greenspace without any new levee or greenspace created by the levee and riverward of it) would be greatly enhanced over existing conditions. Net primary production (photosynthesis from green plants) should increase with increased greenspace.

5.5. Irreversible or Irretrievable Commitments of Resources. * The No Action Alternative would not require any irreversible or irretrievable commitments of resources.

The implementation of Alternatives 1C, 1A-C, 4C and 10E would require the expenditure of human and fiscal resources and the potential modification of natural resources. Construction would require the expenditure of materials that are generally not retrievable. Considerable amounts of fossil fuels, labor, and construction materials such as earth, cement, aggregate, iron, and gravel would be expended and large amounts of labor and natural resources would be necessary in the fabrication and preparation of construction materials. However, although these materials are generally not retrievable, they are not in short supply and their use would not have an adverse effect upon continued availability of these resources. In addition, construction would also require large, one-time investment of Federal funds that are not retrievable.

The commitment of these resources is based on the concept that residents both within the project area, as well as the region and nationally, would benefit by improvements in the flood damage reduction potential in the area. The facilities should provide a positive influence on the economy of the local area, region, and Nation and the livelihood of its citizens.

No irreversible or irretrievable commitment has occurred which would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative. No commitment of resources has occurred that would prejudice the selection of any alternative before making a final decision on this project.

5.6. Relationship of the Proposed Project to Land-Use Plans. * The City's land-use planning efforts have concentrated on flood recovery since the June 2008 record flood event. The City, County,

residents, and businesses are all currently implementing nonstructural measures throughout the Study area. These measures include raising structures, elevating new structures with fill, floodproofing buildings, removing buildings through voluntary acquisition programs, raising important utilities.

Floodplain Management Plan. A floodplain management plan (FPMP) is required of the Corps' non-Federal Sponsor. If there is a Federal FRM project, the non-Federal Sponsor must prepare a 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 management 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 non-Federal Sponsor from not only the cost share perspective, but also from the holistic FRM perspective. This latter perspective makes sense for the Corps as well. By integrating an 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 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 FIRM Map 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 of Cedar Rapids is currently undergoing 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 flood plan management plan is part of the Recommended Plan.

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 and 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 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 International Building Code (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. Since the revision of building codes contributes to reducing flood damages, they are carried forward into more detailed formulation.

Community Rating System. The NFIP's 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 maintaining and improving a community's floodplain management program over the years.

5.7. Agency Correspondence. * The Cedar Wapsie Group of the Sierra Club responded by letter dated August 17, 2009. A wide variety of concerns were expressed. Their letter can be found in Appendix L, *Pertinent Correspondence*.

The IDNR, Conservation and Recreation Division responded by letter dated August 24, 2009. The letter can be found in Appendix L. They inform the District that the proposed alignments may require a Sovereign Lands construction Permit from the IDNR as the alignments appear to directly abut the

Cedar River. They have 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 the project. If listed species or rare communities are found during the planning or construction phases, additional studies and/or mitigation may be required. Any construction activity that bares the soil of any area greater than or equal to 1 acre including clearing, grading or excavation may require a stormwater discharge permit from the IDNR. 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.

The USFWS responded by letter dated September 8, 2009. This letter can be found in Appendix L. Federally listed species for Linn County, Iowa are the threatened western prairie fringed orchid and the prairie bush clover. It appears that the proposed activities occur either 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. Project planning must consider the proximity of proposed construction activities to bald eagle nests and include a search for other bald eagle nesting activity near construction alignments.

The USFWS provided the District the Draft Coordination Act Report (Appendix D), by letter dated May 18, 2010.

The IDNR responded by letter dated November 5, 2008 concerning borrow areas for the proposed project. Their concerns were about avoiding impacts to wetlands, mitigation for unavoidable impacts, control of erosion during project construct, try and construct during periods of low flow, and seed all disturbed areas with native grass and other appropriate erosion control measures to reduce negative impacts to waters of the United States.

The IDNR, Conservation and Recreation Division responded by letter dated November 6, 2009 concerning the borrow areas. They recommend that no borrow is removed in Dry Creek to avoid impacting aquatic resources. They find no specific records of rare and significant natural communities in the proposed borrow areas. If listed or rare species/communities are found during planning or construction phases, additional consultation/coordination may be required. Any construction activities that bares the soil of an area larger than or equal to 1 acre including clearing, grading or excavation may require a storm water discharge permit from the IDNR.

The Office of the State Archeologist (OSA) responded by letter dated July 1, 2009. The OSA recommended several modifications to the PA to better reflect compliance with the Code of Iowa regarding ancient remains. Their letter can be found in Appendix L, *Pertinent Correspondence*.

The National Trust for Historic Preservation responded by letter dated July 29, 2009. They provided comments on the draft PA. As a consulting party to the PA, they also requested the opportunity to review draft versions of the Study and to provide comments on the various alternatives prior to the finalization of the NEPA document. Their letter can be found in Appendix L, *Pertinent Correspondence*.

The Iowa SHPO responded by letter dated October 4, 2009 that can be found in Appendix L, *Pertinent Correspondence*. They provided comments on the draft PA and recommend that the Corps organize a meeting or series of meetings with all of the consulting parties, and any other party that expresses an interest in the Study and its associated undertakings to discuss the PA.

The Iowa SHPO provided a letter dated March 17, 2010. They commented on the revised draft PA and requested more definite parameters regarding the scope and location of the undertaking. The SHPO provided example documentation that could serve as the framework for revising the PA and suggested that the details regarding the actual implementation of alternative procedures could be included as an appendix to the agreement document. They stated that they will resume 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. Once this has been completed the SHPO will be prepared to execute the finalized agreement. Their letter can be found in Appendix L, *Pertinent Correspondence*.

The Iowa SHPO provided a letter dated July 20, 2010. They commented on the revised draft PA and requested that the Corps consider recommendations 2, 7, 8, 9, 20, and 23 found in the Bear Creek Report. Their letter can be found in Appendix L, *Pertinent Correspondence.*

5.8. Additional Required Coordination. * Coordination for the project has been and will be maintained with the following state and Federal agencies and other interested publics:

USFWS
USEPA, Region 7
IADNR
Iowa Department of Agricultural and Land Stewardship
Sac & Fox Nation of Oklahoma
Sac and Fox of Missouri
Sac and Fox of Iowa
Iowa Tribe of Kansas and Nebraska
Iowa of Oklahoma
Ho Chunk Nation of Wisconsin
Menominee
Winnebago
Otoe-Missouria Tribe of Oklahoma
Yankton Sioux
Linn County Conservation Board
City of Cedar Rapids
Sierra Club, Iowa Chapter
Sierra Club, Cedar Rapids Chapter
The Nature Conservancy, Iowa Field Office
Izaak Walton League, Linn County Chapter
Audubon Society, Iowa Chapter
Audubon Society, Cedar Rapids Chapter
State Historical Society of Iowa
National Park Service Eastern Office of Project Review
Community Development Division Iowa Department of Economic Development
General Services Administration
US Department of Homeland Security FEMA, Iowa Recovery Center
Midwest Office National Trust for Historic Preservation
Iowa Office of the State Archaeologist
National Czech & Slovak Museum & Library
Executive Director of the Czech Village/ New Bohemia Main Street District

African American Museum of Iowa
Silos & Smokestacks
Iowa Historic Preservation Alliance
FEMA Region VII
National Park Service
Midwest Office, National Trust for Historic Preservation
Cedar-Wapsie Group of the Iowa Chapter the Sierra Club

6.0. PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION *

6.1. Goals and Objectives of Public Involvement. * In consort with the PDT, a Public Involvement Plan was designed and implemented to help meet NEPA scoping requirements and the requirements of ER 1105-2-100. The plan detailed how the PDT informs and involves the public throughout the Study. Public input was solicited on problems, issues, and potential solutions for flood damage reduction, environmental effects (economic, natural and cultural), and related purposes in Cedar Rapids, Iowa. Public involvement tasks throughout the Study included developing and maintaining a mailing list of interested publics, 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 writing Appendix J, *Public Involvement and Comments*.

6.2. Project Strategy. * The goals of a public involvement plan are to inform and educate the public and solicit feedback through open communication; and include in the plan formulation process all publics interested in and affected by the Study recommendations. The public involvement strategy included media relations, public meetings and outreach activities.

Media relation activities provided a flow of information to the news media about the project. The flow of information, however, increased and decreased as the project developed. The goal of the District was to focus media and public attention on the project at key times in the process.

Strategic techniques were used to get the most from media coverage. However, it is important to note that news departments have final editorial control over what is covered, written or said. Ethical public relations cannot guarantee news coverage.

Outreach activities for this project were designed to provide the public with important project information and keep them informed about project activities and milestones and receive feedback. Public feedback was provided to PDT members for consideration and use in the analysis of project alternatives. The Public Involvement (PI) team utilized several communication tools to provide the public With-Project information.

6.3. Tools and Techniques. * The communication tools and techniques used to carry out the project strategy included:

- Open Houses
- Public Meetings
- Press Releases
- Project Brochures
- Local radio, newspaper, television coverage (due to press release)

6.4. Public Open House and Meetings. * A series of meetings were held within the project area. The meetings allowed the PI team to show the public project alternatives and to discover any issues that needed to be addressed prior to the start of the project. The meetings were held in an informational format. An invitation noting the date, time and location of the meeting was distributed approximately 30 days prior to the meetings. News releases were sent out to area media. In addition, display boards were prepared to provide clear pictures of the selected alternatives. The PI team attended the meetings in order to address public comments and concerns. Comment forms were prepared and distributed at the meetings.

On July 29, 2008, September 11, 2008, and October 16, 2008, the City held several meetings in coordination with Sasaki consulting firm. These meetings were determined to be in line with what the District would conduct for public scoping and workshop meetings. Thus, the City will receive work-in-kind credit for conducting the meetings.

The District held an **open house** on April 28, 2009 to explain Study process and to answer any subsequent questions. Comments were collected to assure that the public understood the process.

The District held an **informational meeting** on June 23, 2010, following the development of project alternatives. The meeting was a formal presentation of the identified alternatives along with displays of the identified alternatives. A question and answer period was held after the presentation. Input collected from the public allowed the PDT the opportunity to address any issues prior to the selection of the Recommended Plan. The District presented its planning process, the alternatives evaluated, and the screening process used to arrive at the Recommended Plan for FRM. Attendees were given an opportunity to review display boards showing the information presented.

A **public meeting** was held on September 21, 2010 during the public review period of the Study. This meeting explained the District's Recommended Plan for FRM for Cedar Rapids. Comments were received on the draft report.

6.5. Press Releases. * Press releases were distributed before all meetings to announce the meeting date, location and time. The PI team determined the appropriate information needed for the press release and coordinated with the Corporate Communications Office for distribution to local media outlets.

6.6. Display Boards/Handouts. * The display boards and handouts included information about the project alternatives and any other information that was presented at the meetings.

6.7. Content Analysis Report. * A content analysis report was prepared after the public meetings to document the proceedings and public comments. Content analysis is necessary to identify the opinion, Study concerns, and potential controversy. It ensures that the public involvement plan is responsible to the level of interest and concern expressed by the public, and will assess the effectiveness of the public involvement techniques. Appendix K of Engineering Regulation 1105-2-100 states that the objectives of content analysis techniques are to "summarize and display public comment in such a way that maximum information is available to decision-makers and the public about what was said." The report described the dominant themes of the feedback and was considered by the PDT as the Study progressed.

6.8. Resources. * The resources available to the PI team for meeting the public involvement goals and objectives for this project were adequate.

The PI team includes one public involvement specialist and one social science analyst to assist project team in meeting the goals and objectives identified in this public involvement plan. The PI team was assisted by the PDT with all technical information related to the project.

6.9. Project Schedule. * Project construction is estimated to be complete in December 2015. The remaining milestones leading up to project completion are presented in the following schedule:

Milestone	Start Date	Finish Date
Review of Public Review Draft	Aug 2010	Sep 2010
Issue Public Notice for Permit	Aug 2010	Sep 2010
Review of Policy Review Draft	Sep 2010	Oct 2010
District Commander's Submittal	Oct 2010	----
Civil Works Review Board	Nov 2010	----
State and Agency Review	Nov 2010	Dec 2010
Execute Design Agreement	Dec 2010	----
Sign the Report of the Chief of Engineers	Jan 2011	----
Chief's Report sent to the ASA (CW)	Feb 2011	----
PED Phase	Jan 2010	Aug 2012
Real Estate Acquisition	Aug 2011	Aug 2012
Construction Contract Advertising and Award	Sep 2012	Dec 2012
Project Construction	Jan 2013	Dec 2015

6.10. Roles and Responsibilities. * Public involvement tasks were led by the District's Public Involvement Specialist with the assistance of the Social Science Analyst and the Project Manager. The District Corporate Communications Office was responsible for sending out media releases.

Other public involvement activities included assisting project team members with the following tasks: responding to inquiries from the general public, agencies, and congressional interests; preparing visual aids for briefing; and preparing briefings.

6.11. Evaluation. * The public involvement strategy for this project will evolve over time as the project develops. For this reason the public involvement strategy, tools and techniques will be evaluated through consultation with the Project Manager and the City throughout the project to determine whether they meet the goals and objectives of the project. This process will allow the project team to develop the next public involvement activity to better meet the goals of the project. The final evaluation will be determined after the public review.

6.12. Report Recipients. * Project information was disseminated to the stakeholders through the use of newspaper media coverage, brochures, press releases, display boards, and public open house meetings. A mailing list was developed from a stakeholder list. There are approximately 900 names on the current mailing list. Stakeholders include but are but not limited to:

- Congressional
- Federal
- State Offices
- Local Offices
- Commercial Interest

- Government Entities
- Education
- Groups and Organization
- Media
- Local Interested Parties
- Indian Tribes

7.0. LIST OF PREPARERS *

Primary PDT Members

Christopher Haring, P.G.	Project Planner	MVR-PD-F
Michael Zukowski, P.E.	Project Manager	MVR-PM-M
Kirk Sunderman, P.E.	Project Engineer	MVR-EC-DM
Steve Gustafson, P.G.	Environmental Specialist	MVR-EC-DN
George Staley, P.E.	Hydraulic Engineer	MVR-EC-HH
Padmakar Srivastava, Ph.D., P.E.	Geotechnical Engineer	MVR-EC-G
Ronald Williams	Supervisory Appraiser	MVR-RE-P
Lonn McGuire	Biologist	MVR-PD-E
Ron Deiss	Archeologist	MVR-PD-E
Kathryn Hatch	Economist	MVR-PD-E
Sharryn Jackson	Social Science Analyst	MVR-PD-E
Marsha Dolan	Public Involvement Specialist	MVR-PD-E
Stanley Consultants	Engineering Support	Contractor
Foth	HTRW Support	Contractor

Supporting PDT Members

Dennis Hamilton, P.E.	Chief of Project Management	MVR-PM-M
Camie Knollenberg, C.P.G.	Senior Planner	MVR-PD-F
John Carr	Supervisory Economist	MVR-PD-E
Daniel Fetes	National Economic Development Economist	MVR-PD-E
Keven Lovetro	Regional Economic Development Economist	MVN-PDE-FR
John B. Logan	Regional Economic Development Economist	MVN-PDE-FR
Kevin Bluhm	Economics Contract Coordinator	MVP-PD-F
Shirley Johnson	Hydrologist	MVR-EC-HH
Rowland Fraser	Hydrologic Technician	MVR-EC-HH
Steven Johnson	Project Manager	MVR-PM-M
Mary Rodkey	Technical Writer/Editor	MVR-PM-M
Robert Lazenby	Attorney	MVR-OC
Richard Eberts	Recreation Economist	MVR-PD-E
Michael Barndollar	Cost Estimator	MVR-TE
Charles Van Laarhoven	Cost Engineering, Supervisor	MVR-TE
URS Corporation	Economics	Contractor
Terracon Consultants	Geotechnical Exploration	Contractor
Bear Creek Archeology, Inc	Cultural, Archeological	Contractor

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

SUMMARY OF COMPREHENSIVE STUDY PLANNING

Since the devastating record flood in June 2008, the City has focused recovery efforts with community residents on the creation of the River Corridor Redevelopment Plan (RCRP) to provide the framework for recovery and reinvestment in the entire flood impacted area of Cedar Rapids. Residents participated through a series of public meetings, focus groups, and open houses. The development of the RCRP can be broken down into two phases. Phase One focused on flood risk management (FRM) strategies to maximize flood damage reduction from future flood losses, choosing a preliminary flood risk 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 risk management, housing, sustainable neighborhoods, business reinvestment, etc. Phase Two focused on neighborhood planning to directly involve the community in planning for reinvestment in the flood-damaged neighborhoods of Cedar Rapids. The resulting comprehensive RCRP guided decision-making, established reinvestment priorities, and provided clear roles and responsibilities for the community by addressing six key themes; housing and neighborhood character, transportation and connectivity, recreation and open space, arts and cultural opportunities, business reinvestment, and community services.

The RCRP planning process led the City to approve a Greenway Acquisition and Construction Area (figure 52 of the Main Report) for implementing a City-preferred FRM Plan. The City's FRM Plan includes structural and nonstructural measures for the east and west sides of the downtown corridor, as well as other study reaches. As part of the plan, the City estimates that a total of 7,198 properties throughout the City were impacted by the June 2008 flood. The City's recovery efforts include a voluntary property acquisition and residential demolition program for approximately 2,500 of the 7,198 properties. These programs are funded by two Federal sources and a Local Option Sales Tax (LOST). The City's cost estimate to acquire these properties is $200 million.

While taking into account the City's RCRP planning process and City-preferred FRM Plan, the District determined through the feasibility study process that there is a Federal interest in providing FRM measures to the east side of the downtown corridor (Alternative 4C - Reaches 4B, 5A, 5B, 5C). The study identified Alternative 4C as the Recommended Plan which consists of concrete floodwalls, earthen levees, closure structures, and pump stations. The Recommended Plan has a 91.24 percent chance of containing a 0.2 percent flood event and a 99.99 percent chance of containing a 1 percent flood event. Based on implementation of the Recommended Plan, the residual flood damage risk is reduced for the entire study area from $12.2 million to $6.1 million annually, an approximate 50 percent reduction in expected annual damages. Also for the Recommended Plan, the expected annual flood damages are reduced from $7.3 million to $1.2 million, an 84 percent reduction.

In addition to the Recommended Plan, the City, Linn County, and community residents are implementing non-structural measures using FEMA, HUD, and LOST program funding. This integrated approach allows each agency's programs to provide funding targeted at reducing the risk to the west side floodplain and other areas within the City which are not part of the District's Recommended Plan.

The final part of the overall comprehensive planning effort includes conducting further watershed studies through the Iowa-Cedar River Comprehensive Plan. This multi-agency watershed team will work to formulate a comprehensive watershed plan and process for interagency collaboration to address water resource and related land resource problems and opportunities within the watershed.

Potential funding sources with estimated amounts for recovery efforts from 2008 to 2013 (Jan 2011) are as follows:

	Potential Sources					
Study Reach	**City**	**County**	**Private**	**Corps**	**FEMA**	**HUD**
1	x		x		x	
2A, 2B, 2C, 2D	x	x	x		x	x
3			x			
4A	x		x		x	x
4B	x		x	x	x	x
5A, 5B, 5C	x	x	x	x	x	x
6	x		x		x	x
7	x				x	
8	x				x	
9	x	x			x	
	$345,000,000	**$8,000,000**	**?**	**$69,000,000**	**$323,000,000**	**$204,000,000**

Note: FEMA (HMGP) program funding includes voluntary property acquisition, demolition program, and implementation of nonstructural floodproofing measures throughout the study area. HUD (CDBG) programs are concentrating funding on property acquisition and housing and business recovery (Jumpstart Programs). The Corps funding is based on the feasibility study and estimated construction costs of Alternative 4C. The City is concentrating funding on all study reaches and includes LOST funding program. The County is concentrating efforts on nonstructural measures to their facilities. Many private property owners are implementing nonstructural measures on their own.

Actions taking place by Study Reach (as defined in figure 3) are as follows:

Reach 1: Actions in the Edgewood Neighborhood include voluntary property acquisition, structural refinements and floodproofing of the Morgan Creek Lift Station, and continued efforts by the City to fund the Edgewood Bridge Approach improvements (City priority), which will allow Edgewood Road to remain open during most flood events.

Reaches 2A, 2B, 2C, 2D: These reaches define the west side of the City's-preferred FRM Plan, which outlines plans for both structural and nonstructural FRM measures. Actions in these reaches include voluntary property acquisition; floodproofing of private properties and utilities, existing County and City administrative buildings, and the Czech-Slovak Museum & Library; moving the Central Fire Station out of the floodplain to the east side; and re-occupancy of Taylor School and the Public Works Building.

Reach 3: The Prairie Creek Generation Station has used private funding to mitigate much of the flooding damages in this reach.

Reach 4A: Actions in North Cedar Lake include voluntary property acquisition and floodproofing of private properties. This reach includes the City's Potable Water Treatment Plant which was not significantly impacted by flooding.

Reaches 4B, 5A, 5B, 5C: These reaches define the east side of the City's Preferred FRM Plan and the District's Recommended Plan. Actions include voluntary property acquisition and floodproofing of private properties; re-establishing a new City Hall (old Federal Courthouse building); floodproofing the new Federal Courthouse (parking on the lower level); and re-occupancy of the US Cellular Event Center, the Cedar Rapids Ground Transportation Center, the US Post Office, Mercy Medical Center, and other downtown facilities and businesses.

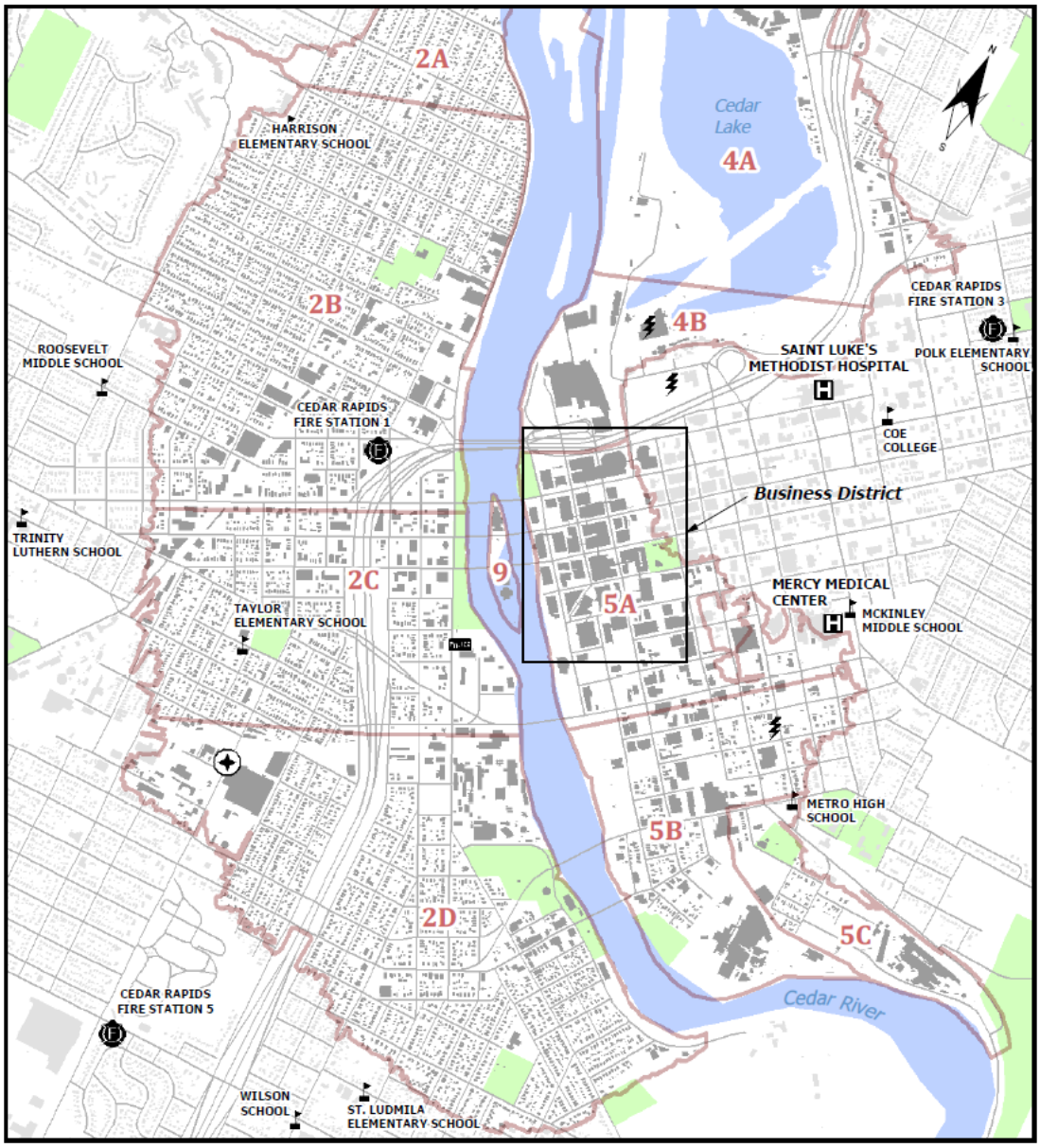
Reach 6: Actions taking place in the Cedar Valley (Rompot) Neighborhood include voluntary property acquisition and floodproofing by private individuals.

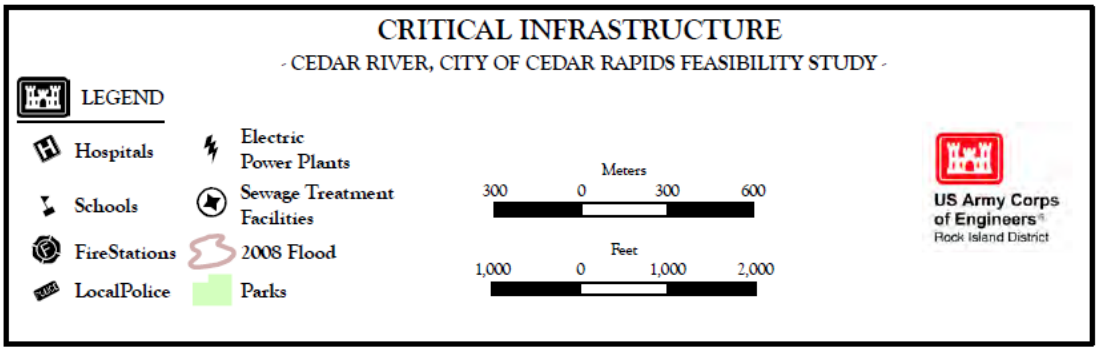
Reach 7: This reach includes the City's Water Pollution Control Facilities. Proposed actions include using City and FEMA funding to upgrade the facilities and provide structural FRM measures (levee/floodwall).

Reach 8: Floodproofing of 10 of the Fresh Water Intake Wells is complete, with future floodproofing planned for the entire well field using City and FEMA funding (Section 3.2.2.8, *Damage Reach 8*).

Reach 9: This reach is defined as Mays Island. Floodproofing is planned for the Linn County Courthouse and Corrections Facilities. Plans for Veteran's Memorial Building-City Hall include floodproofing by restricting usage on the lower floors.

Locations of the City's critical infrastructure for all Reaches are illustrated in Section 3.1; critical infrastructure for Reaches 2, 4, 5, and 9 are shown in the following figure:


2A
HARRISON ELEMENTARY SCHOOL
Cedar Lake
4A
2B
4B
CEDAR RAPIDS FIRE STATION 3
POLK ELEMENTARY SCHOOL
ROOSEVELT MIDDLE SCHOOL
SAINT LUKE'S METHODIST HOSPITAL
CEDAR RAPIDS FIRE STATION 1
COE COLLEGE
Business District
TRINITY LUTHERN SCHOOL
2C
9
5A
MERCY MEDICAL CENTER
MCKINLEY MIDDLE SCHOOL
TAYLOR ELEMENTARY SCHOOL
METRO HIGH SCHOOL
5B
2D
5C
CEDAR RAPIDS FIRE STATION 5
Cedar River
WILSON SCHOOL
ST. LUDMILA ELEMENTARY SCHOOL


CRITICAL INFRASTRUCTURE
- CEDAR RIVER, CITY OF CEDAR RAPIDS FEASIBILITY STUDY -
LEGEND
Hospitals
Schools
FireStations
LocalPolice
Electric Power Plants
Sewage Treatment Facilities
2008 Flood
Parks
Meters
300 0 300 600
Feet
1,000 0 1,000 2,000
US Army Corps of Engineers
Rock Island District

For the study area, the City maintains a Flood Response Manual that is updated on an annual and includes stage-related flood fighting efforts, updated flood fighting maps, and evacuation plans. Other major items contained within this manual include: emergency points of contact; Cedar River flood response tasks and maps; inundation maps; excavation route maps; flash flood response for local creeks; and supplemental flood fighting materials. This manual will be updated as appropriate after construction of the Recommended Plan (Section 4.6.1, *Flood Risk*). Other activities include review of design standards for new development within the floodplain (EO 11988) and adjacent watersheds and reviewing reports such as *Embracing the River: Smart Growth Strategies for Assisting in Cedar Rapids' Recovery* developed jointly by U.S. EPA, FEMA, the State of Iowa, and the City of Cedar Rapids. Further work on floodplain management has occurred through the City's planning efforts. The RCRP and the neighborhood planning initiatives have led the City to discuss plans for sustainable neighborhoods, businesses, and infrastructure (Section 5.6, *Relationship of the Proposed Project to Land-Use Plans*). Additional work is required to develop a more comprehensive floodplain management plan.

In addition to the Flood Response Manual, an Operation and Maintenance, Repair, Replacement and Rehabilitation Manual will be written specifically for the Recommended Plan based on the final as-built design of the project. All closure structures contained within the Recommended Plan are permanent in nature and can be erected and closed in advance of a coming flood on the Cedar River. The City will be required to execute periodic closure of all structures at least once every 3 years as part of the operation and maintenance schedule. Periodic installation exercises will ensure erection crews remain trained and are at appropriate numbers to assure closures can be made in a timely matter.

In summary, the planning and development of a collaborative approach to solving water resource problems engaged the City, Federal and state agencies, and community residents throughout the feasibility study process leading to the development of an Integrated Water Resources Management Plan (IWRMP). The IWRMP is defined by the integration of the Recommended Plan, the RCRP, the City's-preferred FRM Plan, FEMA-HUD Smart Growth strategies and future watershed studies (Section 3.2.3.8, *Iowa-Cedar River Comprehensive Plan*).

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CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

RECOMMENDATIONS

As District Engineer, I have considered the environmental, social, and economic effects; the engineering feasibility; and comments received from the other resource agencies, the City, and the public and have determined that the Recommended Plan presented in this report is in the overall public interest and is technically sound, environmentally acceptable, and economically feasible.

Alternative 4C is the Recommended Plan. The plan includes flood risk management features consisting of concrete floodwalls, earthen levees, closure structures, and pump stations and. Concrete floodwalls comprise approximately two thirds of the total alignment length totaling 2.17 miles. The remainder of the alignment length includes 0.75 mile of earthen levee and a total length of 0.23 mile for all closure structures. All major components were developed as utilitarian designs in order to minimize estimated construction cost. The Alternative 4C cost estimate that was used for evaluation and comparison of the alternatives was revised to reflect the results of the Cost Schedule Risk Analysis. The total estimated first costs of the Recommended Plan, based on October 2010 price levels, is $99,004,000 with the Federal and non-Federal shares of total first costs estimated at $64,352,600 and $34,651,400 respectively. The annualized operation, maintenance, and replacement costs are $18,000. The Recommended Plan has an overall BCR of 1.2 and has 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 (0.2 percent chance event).

These recommendations are made with the provision that, prior to implementation, the City will agree to comply with the following requirements:

Federal implementation of the Recommended Plan would be subject to the City agreeing to comply with applicable Federal laws and policies, including but not limited to:

A. Provide a minimum of 35 percent, but not to exceed 50 percent of total first costs further specified as follows:

1. Provide 25 percent of design costs allocated by the Federal Government to flood risk management in accordance with the terms of a design agreement entered into prior to commencement of design work for the flood risk management features;
2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Federal Government to flood risk management;
3. Provide, during construction, a contribution of funds equal to 5 percent of total flood risk management costs;

4. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Federal Government to be required or to be necessary for the construction, operation, and maintenance of the flood risk management features;
5. Provide, during construction, any additional funds necessary to make its total contribution for flood risk management equal to at least 35 percent of total flood risk management costs;

B. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the City obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

C. Not less than once each year, inform affected interests of the extent of flood damage reduction afforded by the flood risk management features;

D. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

E. Comply with Section 402 of the WRDA of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within 1 year after the date of signing a project cooperation agreement, and to implement such plan not later than 1 year after completion of construction of the flood risk management features;

F. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with degrees of flood risk management provided by the flood risk management features;

G. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the flood risk management features afford, hinder operation and maintenance of the project, or interfere with the project's proper function;

H. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

I. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the

Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and state laws and regulations and any specific directions prescribed by the Federal Government;

J. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the City owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

K. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

L. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations Section 33.20;

M. Comply with all applicable Federal and state laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

N. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under CERCLA, Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the City with prior specific written direction, in which case the City shall perform such investigations in accordance with such written direction;

O. Assume, as between the Federal Government and the City, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

P. Agree, as between the Federal Government and the City, that the City shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

Q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the WRDA of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the City has entered into a written agreement to furnish its required cooperation for the project or separable element.

The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding.

However, prior to transmittal to Congress, interested Federal agencies, the State of Iowa, the City, and other parties will be advised of any modifications and will be afforded the opportunity to comment further.

R. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project.

2 NOV 2010

Date

Shawn P. McGinley
Colonel, US Army
Commander & District Engineer

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

FINDING OF NO SIGNIFICANT IMPACT *

I have reviewed the information in this Feasibility Study, along with data obtained from Federal and state agencies having jurisdiction by law or special expertise, and from the interested public. Based on the summary of effects/impacts (as discussed in Chapter 5) and the following factors, I have determined that constructing a new levee system (Alternative 4C) for the Cedar River, Cedar Rapids, Iowa, would not significantly affect the quality of the human environment. For this reason, it is my determination that an Environmental Impact Statement is not required and will not be prepared. This determination will be reevaluated if warranted by later developments. This Finding of No Significant Impact is based on the following factors:

A. The project would have only minor and short-term impacts on fish, freshwater mussels, wildlife resources and water quality.

B. The project would have no significant impact to McLoud Run, which is the only urban trout stream in Iowa, or to the bald eagle nests adjacent to the stream.

C. No significant adverse social, economic, environmental impacts are anticipated as a result of the proposed action.

D. Implementation of the project, as proposed, would not result in increased costs or prices for consumers, individual industries, Federal, state, or local governmental agencies, nor would it impair in any way, the ability of the United States to compete with foreign-based enterprises in domestic or export markets.

E. Utilization of a properly placed levee system (Alternative 4C) should provide protection to the east side of the Cedar River, Cedar Rapids, Iowa from flooding damage up to the 500-year flood event (0.002 exceedance probability event).

F. To afford protection to known and unknown significant historic properties the Corps has executed the *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*

15 OCT 10

Date

Shawn P. McGinley
Colonel, US Army
Commander & District Engineer

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EXHIBIT A

LETTER FROM CITY OF CEDAR RAPIDS
RE: LOCAL BUSINESS FLOOD PROTECTION PLANS

CEDAR RAPIDS
City of Five Seasons

November 19, 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: Local Business Flood Protection Plans

Dear Colonel McGinley,

The City of Cedar Rapids recently (mid-October) became aware of a local business owner's intention to improve its flood management system. They have since assured us that, as a long-standing member of the Cedar Rapids community, they have no intentions of jeopardizing our community's goal of providing flood protection for the City and they are fully supportive of the USACE tentatively recommended Alternative 4C. Since the goals of the City of Cedar Rapids and the business owner are synonymous (i.e., reducing the risk of flooding to the City of Cedar Rapids including its citizens, businesses and industries), the City has been collaborating with the local business to determine how we can work in partnership to provide flood protection.

In addition, the City will formally request that they be allowed to enter into a Memorandum of Understanding with the Assistant Secretary of the Army (Civil Works) to allow the City to receive credit for any work performed by the City which is integral to Alternative 4C.

Thank you in advance for your assistance with this matter and please contact me with any questions.

Jeffrey 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

CEDAR RIVER
CEDAR RAPIDS, IOWA

FLOOD RISK MANAGEMENT PROJECT

FEASIBILITY STUDY REPORT
WITH
INTEGRATED ENVIRONMENTAL ASSESSMENT

PLATES

ALTERNATIVE 4C – RECOMMENDED PLAN

CEDAR RAPIDS, IOWA
GENERAL INVESTIGATION
FEASIBILITY STUDY

DOWNTOWN CEDAR RAPIDS
EAST SIDE - RIVER EDGE
ALIGNMENT ALTERNATIVE 4C
REACHES 4(PARTIAL), 5A, 5B
27-APRIL-2010

PRELIMINARY ISSUE
FOR REVIEW
NOT FOR CONSTRUCTION

27-APRIL-2010

auto_username
auto_sysdtme
auto_xref_design

US Army Corps of Engineers ®
Rock Island District

Revisions			
Symbol	Description	Date	Approved

Designed By: JLB	Date: 27-APRIL-2010		
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Reviewed By: MRH	Solicitation Number:		

U.S. ARMY ENGINEER DISTRICT
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ROCK ISLAND, ILLINOIS

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CEDAR RIVER
CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
COVER SHEET

Sheet Reference Number:
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C-103-4C	FP33-C-103-4C			ALTERNATIVE 4C - 0.2% PROBABILITY FLOOD LEVEL SHT 3
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C-108-4C	FP33-C-108-4C			ALTERNATIVE 4C - STANDARD DETAIL FLOODWALL
C-109-4C	FP33-C-109-4C			ALTERNATIVE 4C - STANDARD DETAIL REMOVABLE WALL
C-110-4C	FP33-C-110-4C			ALTERNATIVE 4C - TYPICAL ROLLING GATE DETAIL SHT 1
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C-113-4C	FP33-C-113-4C			ALTERNATIVE 4C - TYPICAL ROLLING GATE DETAIL SHT 4
C-114-4C	FP33-C-114-4C			ALTERNATIVE 4C - TYPICAL SWING GATE DETAILS SHT 1
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GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
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N

LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- RWRC — REMOVABLE WALL AT ROAD CROSSING

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GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
OVERALL SITE LOCATION PLAN

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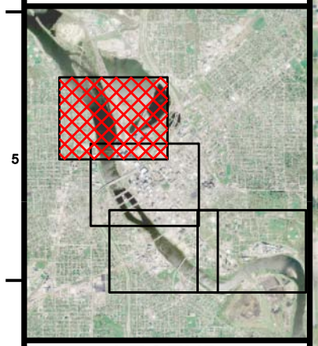

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- LEVEE
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- TEMPORARY EASEMENT
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- PUMP STATION
- RWRC — REMOVABLE WALL AT ROAD CROSSING

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GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
0.2 % PROBABILITY FLOOD LEVEL - SHT 1

Sheet Reference Number:
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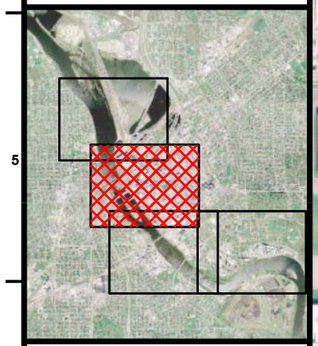

LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- RWRC — REMOVABLE WALL AT ROAD CROSSING

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GENERAL INVESTIGATION
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ALTERNATIVE 4C
0.2% PROBABILITY
FLOOD LEVEL SHT 2

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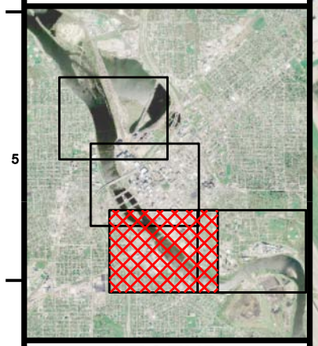

LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- RWRC — REMOVABLE WALL AT ROAD CROSSING

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GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
0.2% PROBABILITY
FLOOD LEVEL SHT 3

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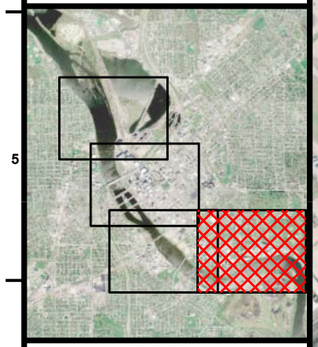

LEGEND

- LEVEE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- PARCEL BOUNDARY
- PUMP STATION
- RWRC — REMOVABLE WALL AT ROAD CROSSING

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200 0 200 400
SCALE IN FEET

STA 245+80.00
END LEVEE
BEGIN GATE - ROLLER

STA 247+20.00
END GATE - ROLLER
BEGIN LEVEE

500 GPM
STORMWATER

STA 266+60.00
END LEVEE
BEGIN FLOODWALL

9000 GPM
SANITARY

1500 GPM
STORMWATER

STA 293+75.00
END FLOODWALL
BEGIN GATE - SWING

STA 297+71.00
END GATE - SWING

245 250 255 260 265 270 275 280 285 290 295

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GENERAL INVESTIGATION
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ALTERNATIVE 4C
0.2% PROBABILITY
FLOOD LEVEL - SHT 4

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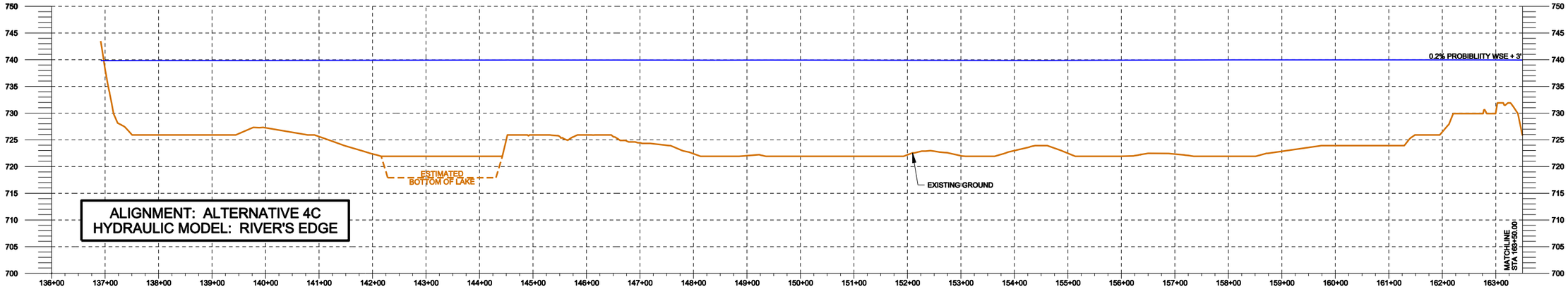

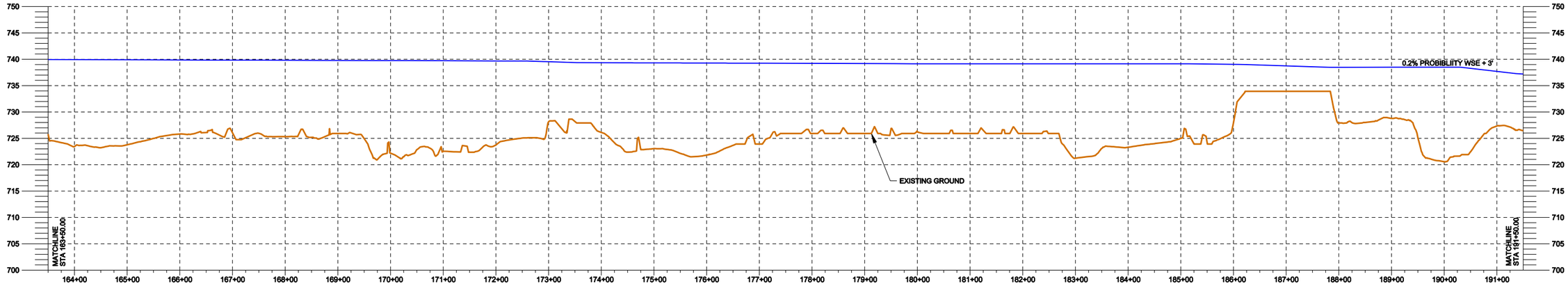

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ALTERNATIVE 4C PROFILE SHEET 1

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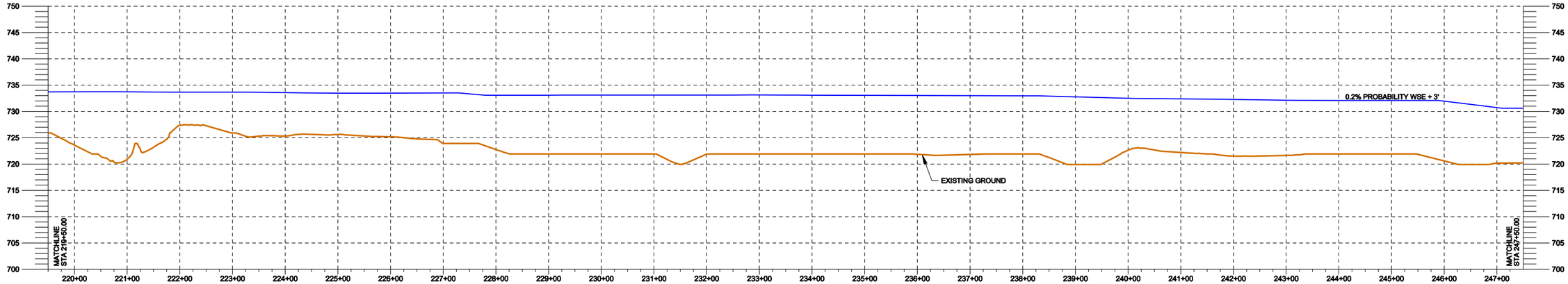

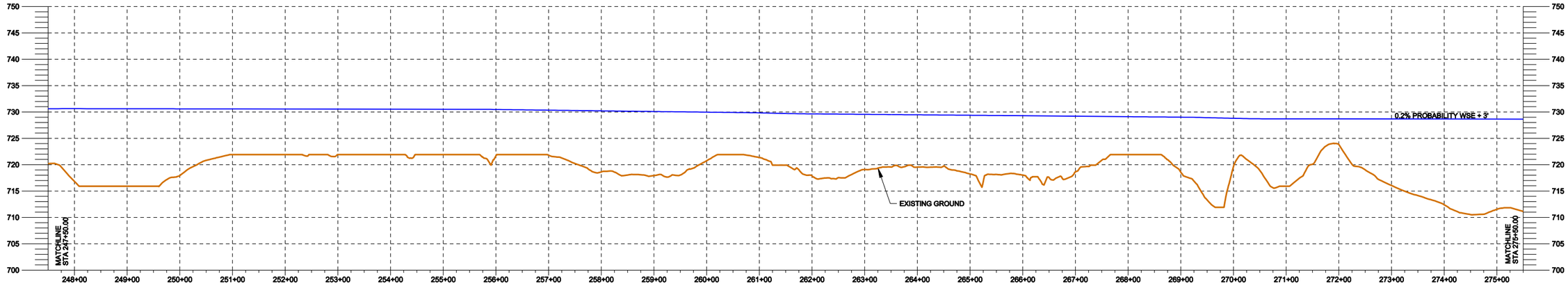

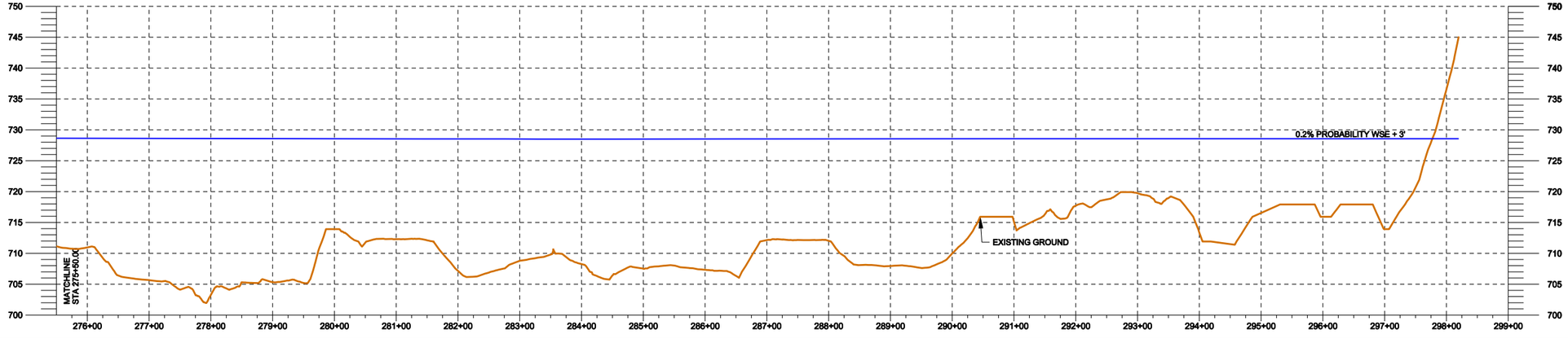

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GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C PROFILE SHEET 2

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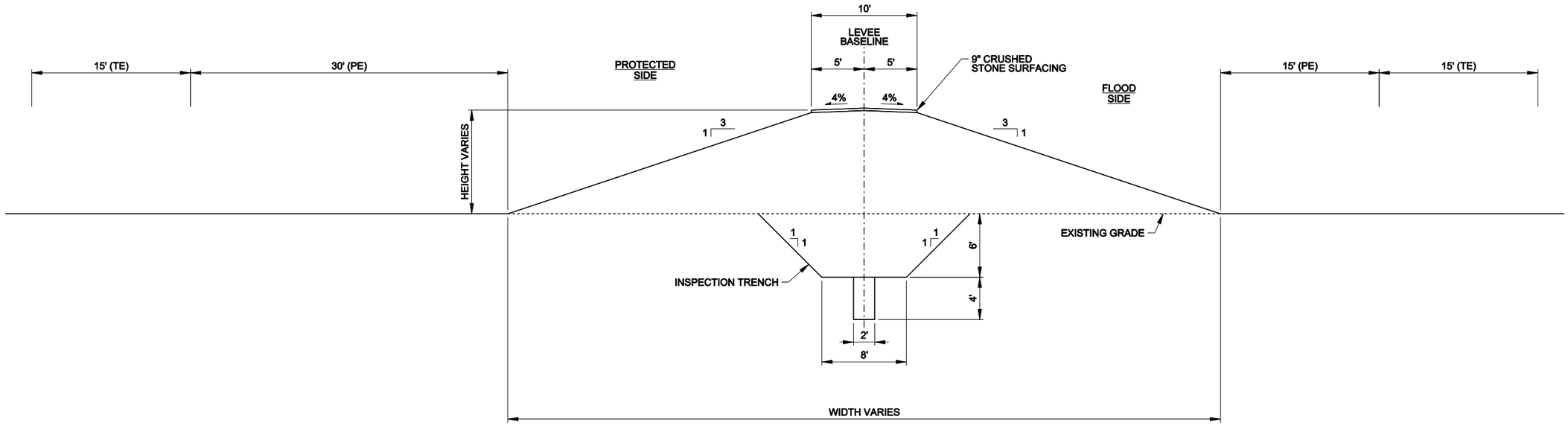

LEVEE SECTION

SCALE: NO SCALE

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ABBREVIATIONS

PE - PERMANENT EASEMENT
TE - TEMPORARY EASEMENT

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GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
STANDARD DETAIL
TYPICAL LEVEE

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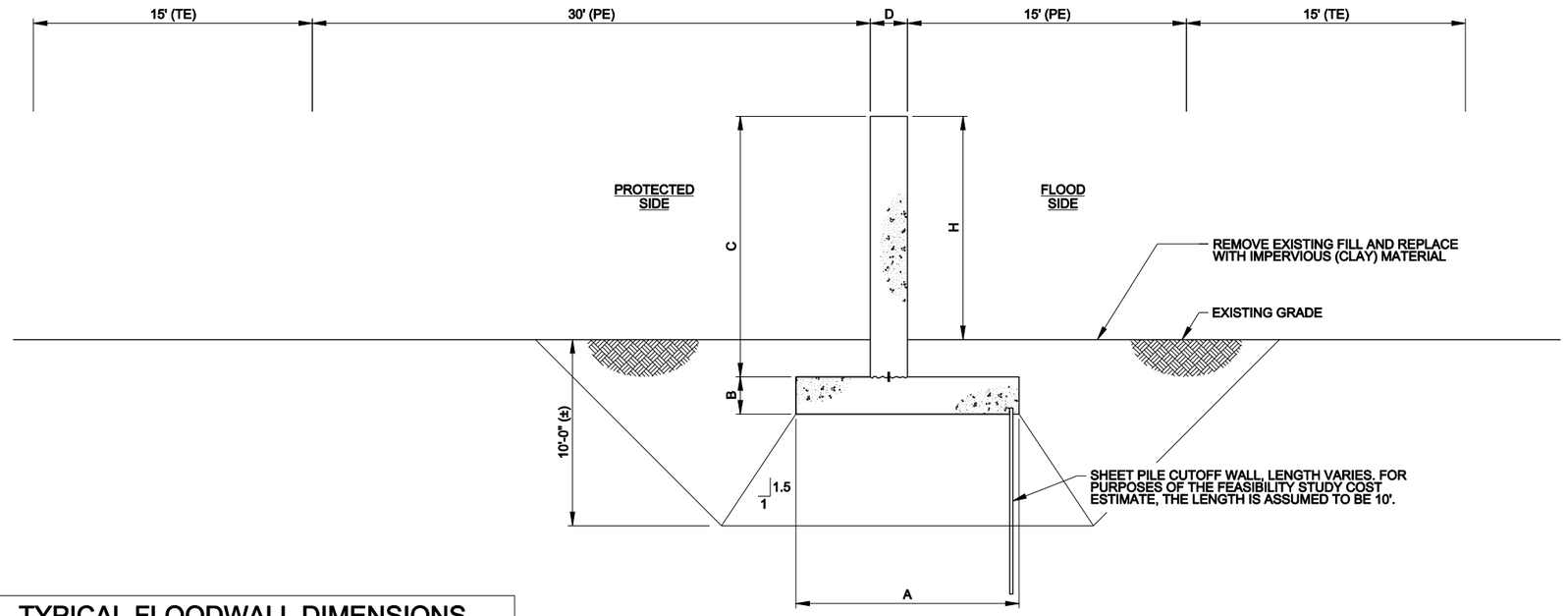

TYPICAL FLOODWALL DIMENSIONS

H	A	B	C	D
24'-0"	28'-0"	3'-0"	25'-0"	3'-0"
21'-0"	21'-0"	3'-0"	22'-0"	2'-6"
18'-0"	18'-0"	2'-6"	19'-6"	2'-0"
15'-0"	15'-0"	2'-0"	17'-0"	2'-0"
12'-0"	12'-0"	2'-0"	14'-0"	2'-0"
9'-0"	8'-0"	2'-0"	11'-0"	2'-0"
6'-0"	5'-0"	1'-6"	8'-6"	1'-6"
3'-0"	5'-0"	1'-6"	5'-6"	1'-6"

ABBREVIATIONS

PE - PERMANENT EASEMENT
TE - TEMPORARY EASEMENT

TYPICAL FLOODWALL SECTION

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ROCK ISLAND, ILLINOIS

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
STANDARD DETAIL
FLOODWALL

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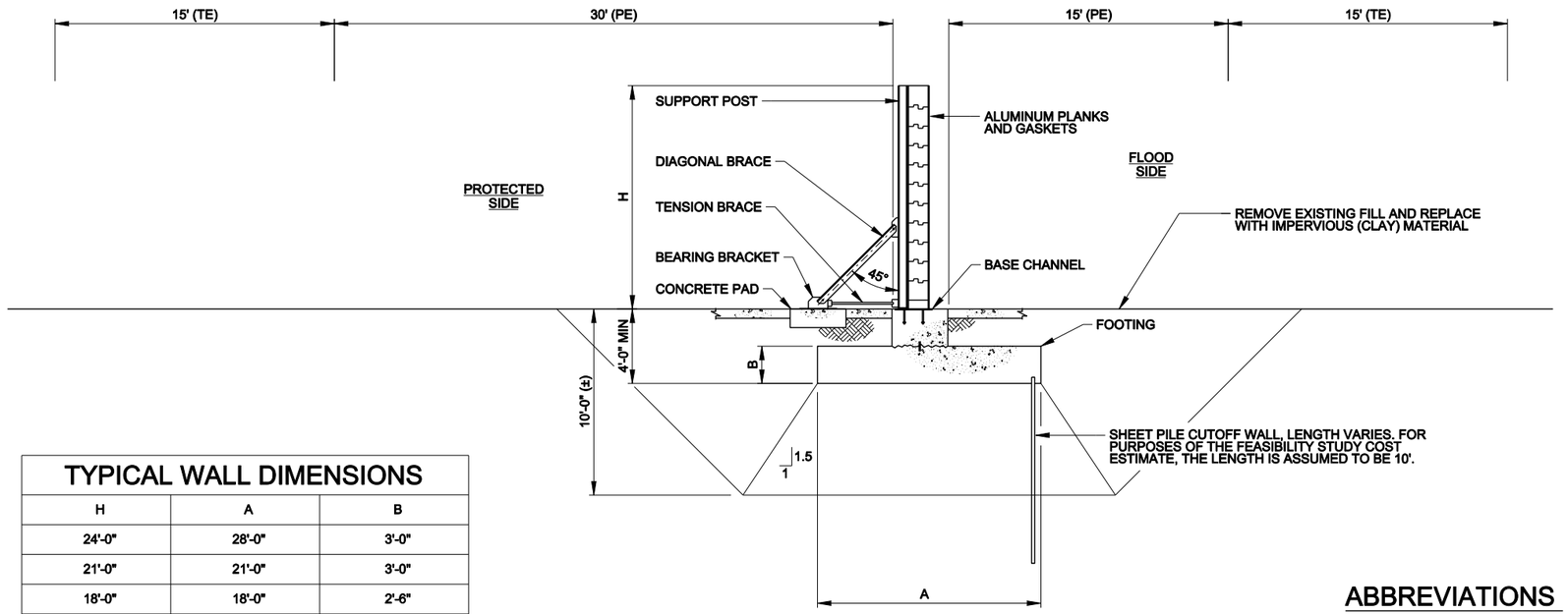

TYPICAL WALL DIMENSIONS

H	A	B
24'-0"	28'-0"	3'-0"
21'-0"	21'-0"	3'-0"
18'-0"	18'-0"	2'-6"
15'-0"	15'-0"	2'-0"
12'-0"	12'-0"	2'-0"
9'-0"	8'-0"	2'-0"
6'-0"	5'-0"	1'-6"
3'-0"	5'-0"	1'-6"

TYPICAL REMOVABLE WALL SECTION

SCALE: NO SCALE

ABBREVIATIONS

PE - PERMANENT EASEMENT
TE - TEMPORARY EASEMENT

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ROCK ISLAND, ILLINOIS

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
STANDARD DETAIL
REMOVABLE WALL

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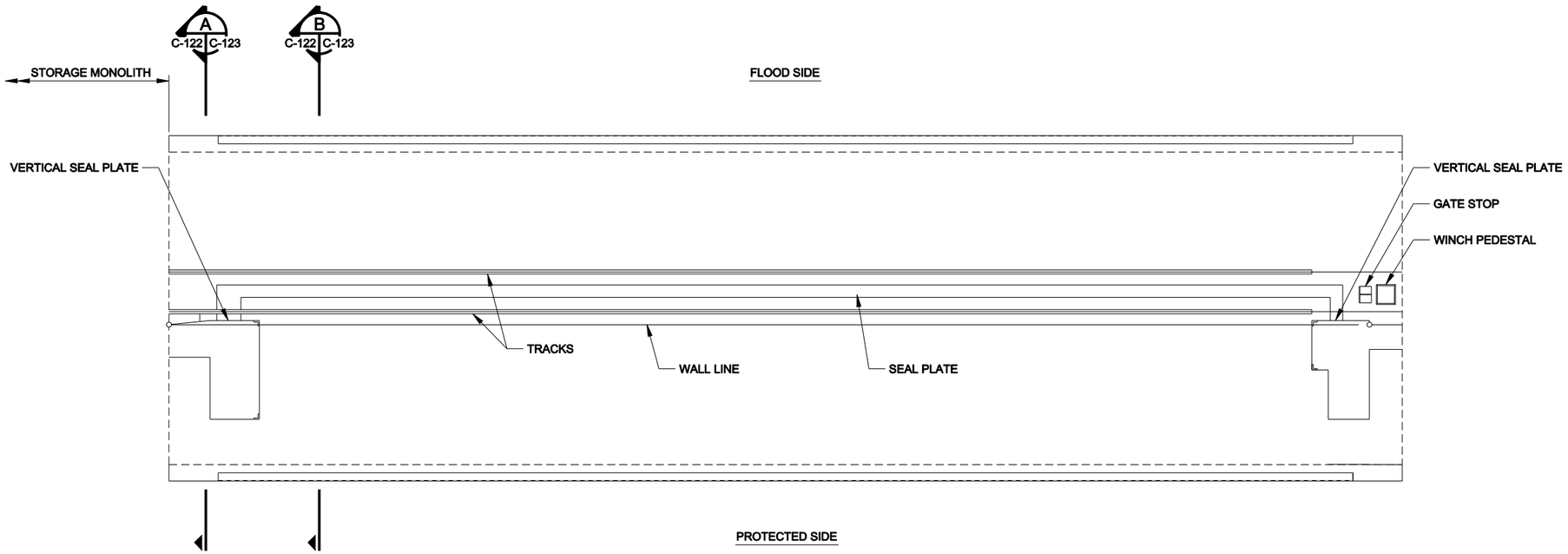

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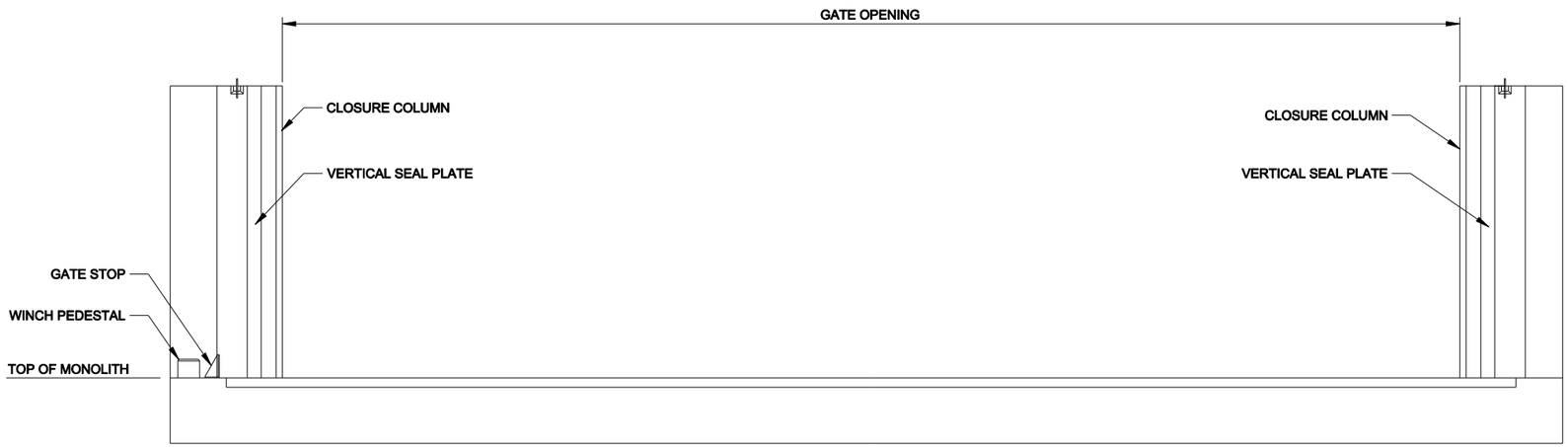

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ROCK ISLAND, ILLINOIS

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
TYPICAL ROLLING GATE DETAIL SHEET 1

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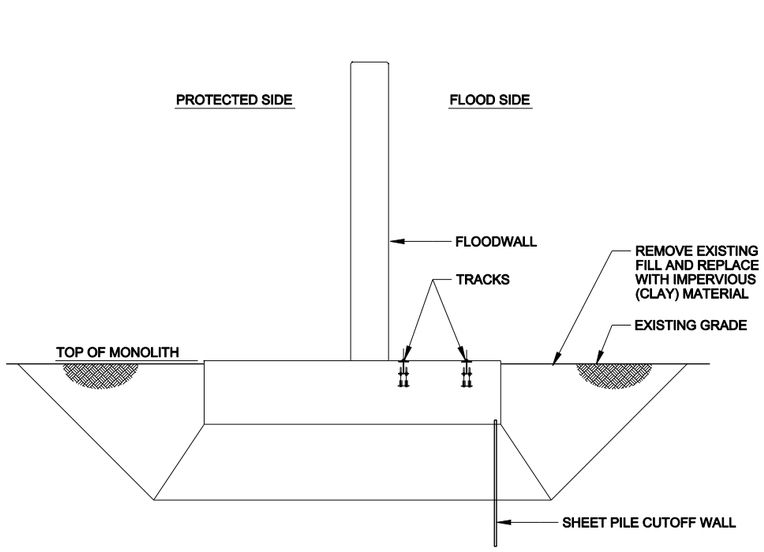

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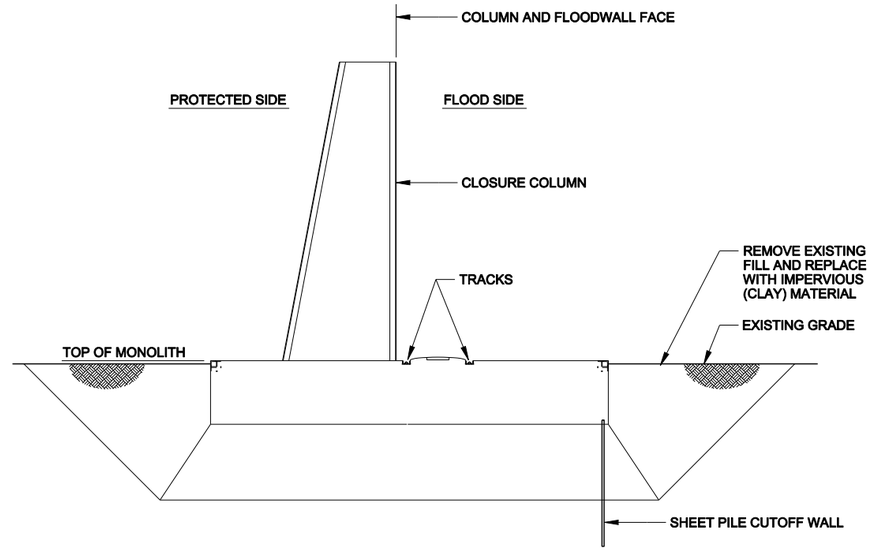

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FEASIBILITY STUDY

ALTERNATIVE 4C
TYPICAL ROLLING GATE DETAIL SHEET 2

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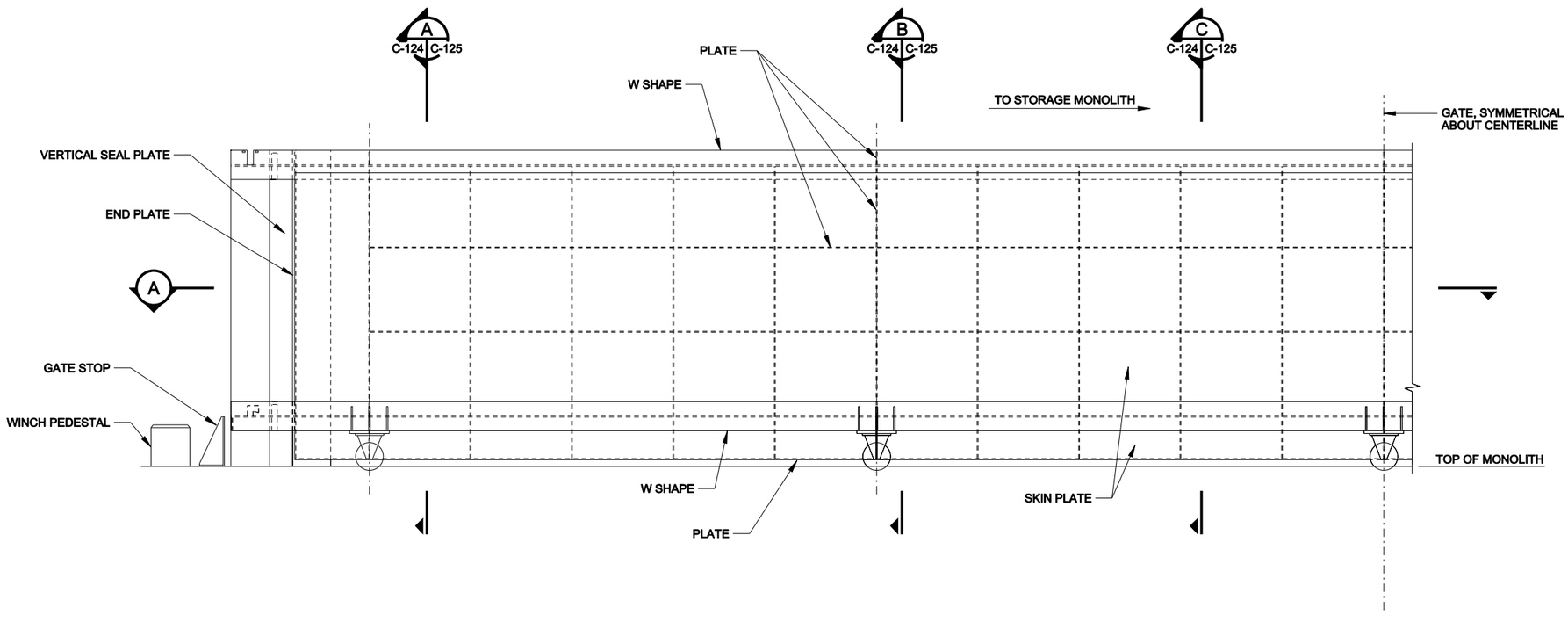

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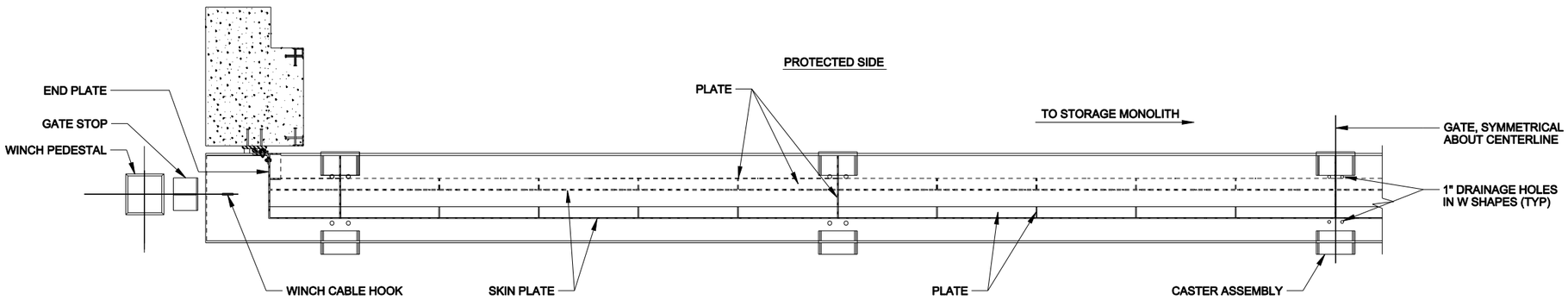

A SECTION

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CEDAR RAPIDS, IA
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ALTERNATIVE 4C
TYPICAL ROLLING GATE DETAIL SHEET 3

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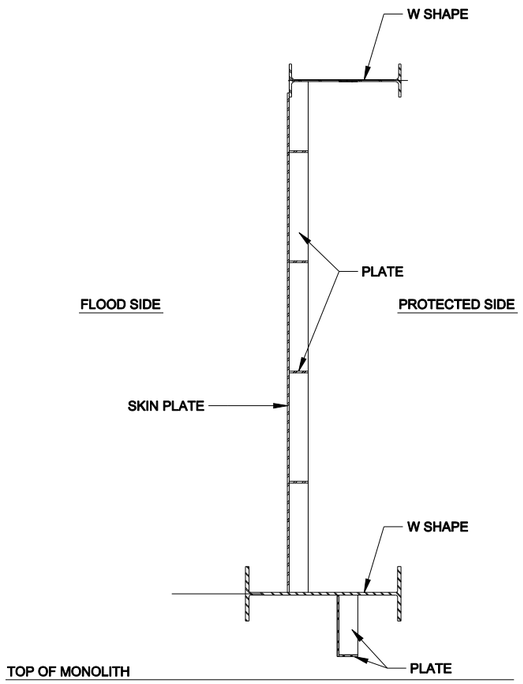

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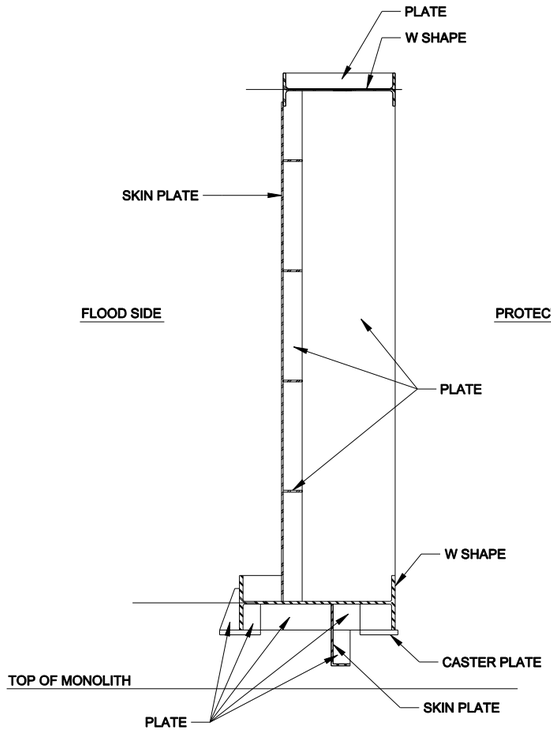

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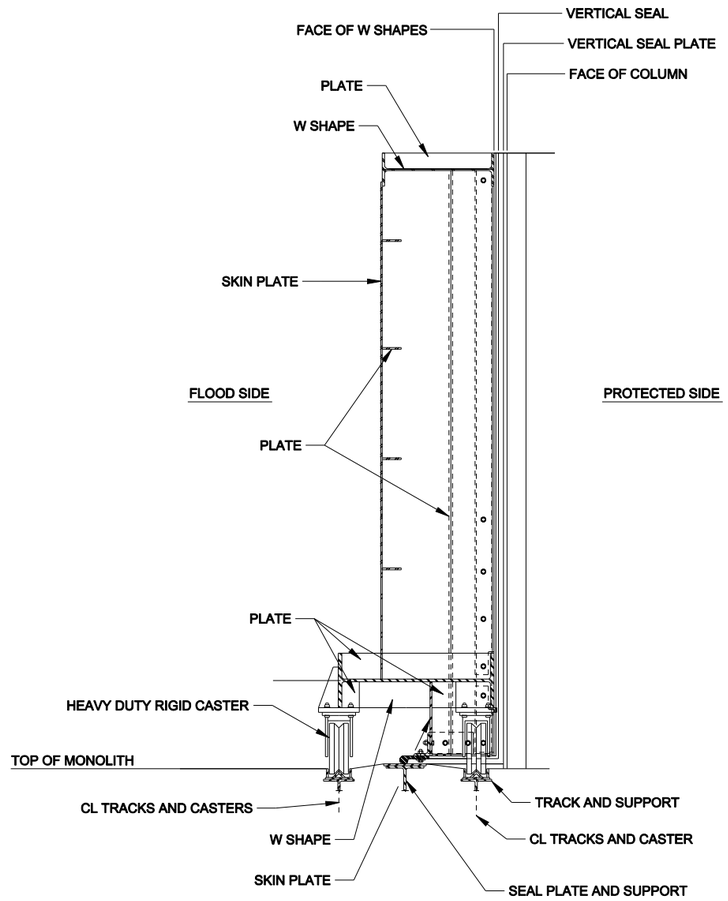

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PRELIMINARY ISSUE
FOR REVIEW
NOT FOR CONSTRUCTION
27-APRIL-2010

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Rock Island District

Symbol	Description	Date	Approved
	Revisions		

Designed By: DRD	Drawn By: JLB	Checked By: MRH	Reviewed By: MRH
Date: 27-APRIL-2010	Scale:	Project Code:	Solicitation Number:

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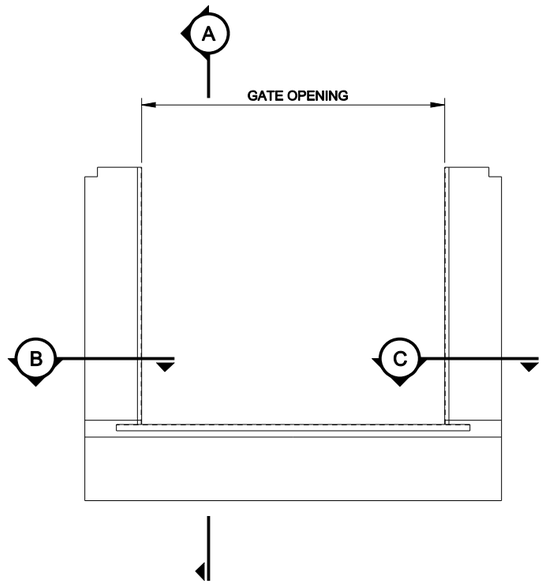
FEASIBILITY STUDY

ALTERNATIVE 4C
TYPICAL ROLLING GATE DETAIL SHEET 4

Sheet Reference Number:
C-113-4C
Sheet 16 of 18



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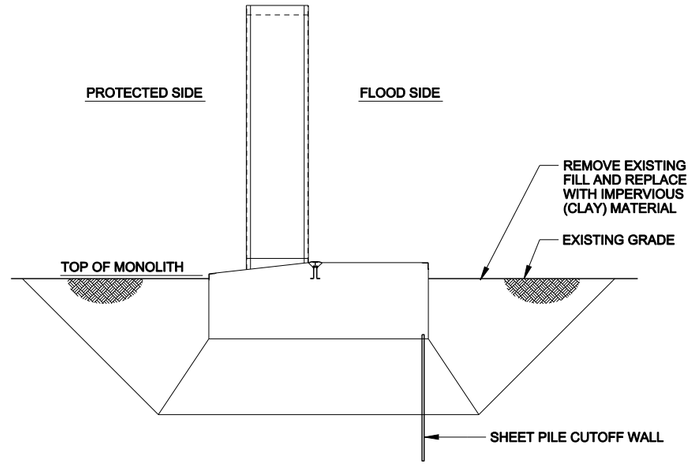

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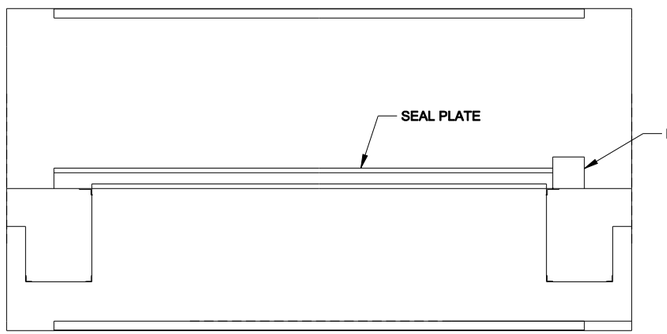
FLOOD SIDE

FLOOD SIDE



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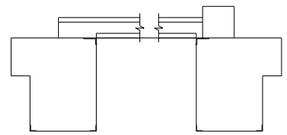

PROTECTED SIDE

B SECTION
NO SCALE

C SECTION
NO SCALE

PRELIMINARY ISSUE
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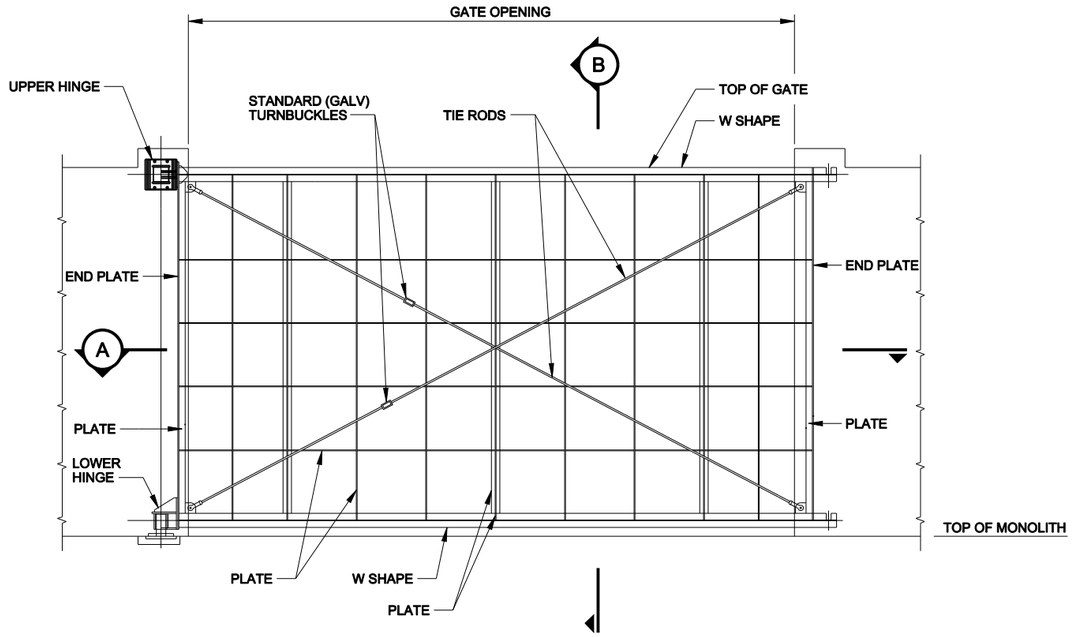
GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
TYPICAL SWING GATE
DETAILS SHEET 1

Sheet Reference Number:
C-114-4C
Sheet 17 of 18



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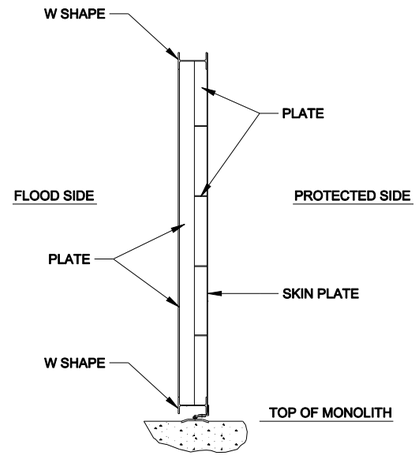

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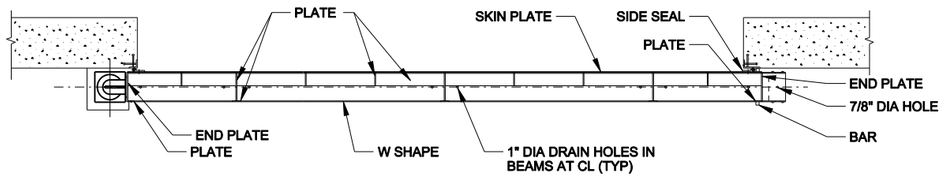

FLOOD SIDE

A SECTION
NO SCALE

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27-APRIL-2010

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Rock Island District

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CEDAR RAPIDS, IA
GENERAL INVESTIGATION
FEASIBILITY STUDY

ALTERNATIVE 4C
TYPICAL SWING GATE
DETAILS SHEET 2

Sheet Reference Number:
C-115-4C
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