CORALVILLE LAKE
WATER CONTROL UPDATE REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

CORALVILLE LAKE
IOWA CITY, IOWA

APPENDIX C

ECONOMICS

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ECONOMICS

I. FLOOD IMPACT ANALYSIS INPUT DATA

The Hydrologic Engineering Center-Flood Impact Analysis (HEC-FIA) model developed for the Iowa-Cedar River Basin Master Water Control Manual Study was based on HEC-FIA version 3.0.1. The HEC-FIA model required the pieces of input data shown in Table C-1.

Table C-1: Input Data Required by Hydrologic Engineering Center-Flood Impact Analysis

Data Input	Source
Stream Alignment	HEC-RAS
Cross Sections	HEC-RAS
Storage Areas	HEC-RAS
Depth, Duration, Arrival Grids	HEC-RAS
Terrain Grid	Same used for HEC-RAS development
Impact Areas	Hydraulics & Hydrologic Engineering Branch
Boundaries	Counties, Census Blocks, States
Agricultural Data	Grid from National Agricultural Statistics Service (NASS), Prices and yield from Purdue extension service crop budgets
Structure Data	HEC's National Structure Inventory (NSI)

II. FLOOD IMPACT ANALYSIS STRUCTURE INVENTORY

To estimate damages, HEC-FIA uses a point-based structure inventory. Hydraulic stage data are used to determine the flood depths at each structure, and structure depth-damage curves are used to estimate damages.

The structure inventory developed for the Iowa River Basin Master Water Control Manual Study was developed from nationwide National Structure Inventory (NSI) version 2.0. NSI 2.0 is comprised of data from the Census Bureau, FEMA, and other sources; geospatial structure locations are distributed across the developed and agricultural areas of Census Bureau blocks (based on National Land Cover Database land cover definitions). Structure locations were visually checked for accuracy and moved when placement was incorrect. The national data are based on HAZUS methodology but are modified so that structures are only placed on developed areas of each census block.

The structure values in the dataset are in 2019-dollar values and the population is based on year 2017 Census Bureau data and are generated without an uncertainty distribution. The dollar values were indexed up to 2019 using an index of 1.05 based on the Engineering News-Record Building Cost Index. Table C-2 shows foundation heights for each structure occupancy type pulled from the Modeling, Mapping, and Consequence standard operating procedures.

Table C-2. Structure Inventory Foundation Heights

Structure Occupancy Type Name	Foundation Height
REL1 (Churches)	3 feet
RES1 (Residential)	2 feet
RES2 (Mobile Home)	3 feet
All other (Commercial)	1 foot

III. FLOOD IMPACT STRUCTURAL ANALYSIS

To estimate structure damages, the HEC-FIA model relies on a structure inventory of georeferenced points that have ground surface elevation, foundation heights, and structure values. A depth grid is used to compute how high water will reach on each structure in the inventory. Based on the depth of flooding, HEC-FIA relies on depth-damage curves to compute damages. The depth-damage curves in HEC-FIA can be user-modified, but were left at the model defaults, which represent national averages for non-coastal riverine flooding and do not account for uncertainty. Further information about the structure inventory is found in Section II.

IV. FLOOD IMPACT AGRICULTURE ANALYSIS

To estimate agriculture damages, the HEC-FIA model extracts corn and soybean from a 2019 NASS land cover grid. The grid is a 30-meter resolution raster that has cells that represents each of the crop types. The agriculture compute in HEC-FIA requires three grids: depth, arrival, and duration. The depth grid computes how high water will reach on the crops, whereas the arrival grid determines how quickly (in hours) the flood depth reaches a threshold, in this case 2 feet. Finally, the duration grid determines how long (in hours) the depth of flooding exceeds a threshold, again 2 feet. The threshold of 2 feet was set as the point at which row crops would begin experiencing damages.

The crop budget in HEC-FIA was developed in support using the 2019 Purdue Crop Cost & Return Guide, which is published annually by the University of Purdue Agriculture Extension Service. The crop budget uses variable & fixed costs, crop yields, replanting rates, and duration damage curves by month that allow the model to determine damages by frequency.

V. FLOOD IMPACT ANALYSIS MODEL CALIBRATION

The HEC-FIA model utilized for the Iowa-Cedar River Basin Master Water Control Manual Study was sourced from the Rock Island District Corps Water Management System (CWMS) model. The CWMS model used was calibrated by evaluating damages caused by a 1/2 annual exceedance probability (AEP) flood event, which was determined by the hydraulic modeling to cause a bank full type of flow scenario that should not cause any actual structure flooding damages. This event was used to identify structures that were incorrectly placed too close to the river channel. Those structures were moved to more

reasonable locations based on aerial imagery until that bank full run resulted in no damages. Approximately 2 days were spent manually moving structure points to more accurate locations within each census block, concentrating the efforts on structures in the floodplain along the river. Despite the effort spent on spatially relocating structures, there were still residual structures located in erroneous locations. Consequently, the results for this study were further calibrated in GIS to ensure that damages began at an accurate flow/stage.

VI. FLOOD IMPACT ANALYSIS MODEL REACHES

The HEC-FIA model was split into the following five reaches:

1. Coralville Pool
2. Coralville
3. Iowa City
4. Lone Tree
5. Wapello

Each reach was modeled in HEC-FIA using depth, duration, and arrival grids generated by the Hydrology & Hydraulics engineer in HEC-RAS.

VII. FLOOD IMPACT ANALYSIS MODEL ALTERNATIVES

The HEC-FIA model was used to analyze the effects of four alternatives. for structure and agricultural damages. More detailed information about the differences between each of the alternatives can be found in the Main Report, Chapter III, *Formulation of Alternatives*. These four alternatives are:

1. Alternative 1 (Existing Conditions)
2. Alternative 2C
3. Alternative 5
4. Alternative 8

The structure inventory, agriculture data, and hydraulic grids for each of the three alternatives remained the same during each of the HEC-FIA model runs. The change in benefits (damages avoided) for each alternative was determined through the hydraulic frequency of each of the flows or stages occurring. Tables C-3, C-4, C- 5, and C-6, show the regulated 1-day flow and elevation frequencies for the four alternatives for the period of record 1917-2019. C-7, C-8, C-9, and C-10 show the regulated 1-day flow and elevation frequencies for the four alternatives for the period of record 1959-2019 which is a period of higher rainfall.

VIII. FLOOD IMPACT ANALYSIS MODEL RESULTS

The same array of flows and stages were run in HEC-FIA, but each alternative changed the frequency of the flows. As a result, the flow and stage frequencies were linearly interpolated to achieve consistent and comparable structure and agricultural benefits. Each of the economics results from the flow and stage runs were individually analyzed to determine spatial accuracy and ensure that damages begin at the correct flow or stage. The following tables and figures show the damage-frequency relationships for each of the alternatives and stages/flows.

Table C-3. Alternative 1 1917-2019 Existing Conditions Damage-Frequency Tables

Alt 1 - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.7	1.4143	-	0
0.9	1.1286	-	0
1.2	0.8429	-	0
1.3	0.7714	-	0
1.4	0.7000	-	0
1.7	0.6000	-	0
1.7	0.5750	-	0
2.0	0.5000	2,110	79
11.4	0.0875	4,760	1417
11.9	0.0844	30,730	55
12.3	0.0813	34,870	103
13.3	0.0750	254,980	906
14.5	0.0688	354,560	1905
16.0	0.0625	427,880	2445
17.8	0.0563	590,980	3184
20.0	0.0500	730,320	4129
22.2	0.0450	855,860	3965
25.0	0.0400	1,020,900	4692
54.8	0.0182	1,928,400	32080
102.7	0.0097	2,659,530	19519
311.7	0.0032	3,597,800	20427
559.2	0.0018	3,911,230	5330
1000.0	0.0010	4,339,570	3251
AVERAGE ANNUAL VALUE =		103,488	103,488

Alt 1 - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.2043	-	0
1.0	1.0250	1,590	143
1.2	0.8349	6,710	789
1.3	0.7874	9,200	378
1.4	0.7399	11,180	484
1.7	0.5911	36,810	3571
1.8	0.5565	49,350	1492
3.9	0.2549	95,220	21798
11.2	0.0895	188,000	23421
11.6	0.0862	207,120	658
12.1	0.0829	297,880	841
13.1	0.0762	479,400	2588
14.4	0.0695	660,920	3797
15.9	0.0629	842,440	5006
17.8	0.0562	1,023,960	6215
20.1	0.0497	1,202,241	7281
22.3	0.0448	1,335,746	6216
25.1	0.0399	1,469,251	6870
56.0	0.0179	2,306,770	41545
99.1	0.0101	3,379,180	22102
292.0	0.0034	66,623,270	233453
530.2	0.0019	208,121,510	211302
1453.6	0.0007	419,726,330	376167
AVERAGE ANNUAL VALUE =		976,116	976,116

Alt 1 - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1750	-	0
1.0	0.9880	1,660	155
1.4	0.7217	95,850	12983
1.5	0.6523	159,770	8867
1.7	0.5816	196,840	12613
2.8	0.3558	478,010	76205
3.3	0.3022	550,860	27546
5.4	0.1851	709,670	73834
13.7	0.0729	1,131,200	103232
13.9	0.0720	1,134,520	1023
14.1	0.0711	1,137,840	1026
14.4	0.0693	1,144,480	2062
14.8	0.0675	1,151,120	2074
15.2	0.0657	1,157,760	2086
15.7	0.0639	1,161,970	2096
16.1	0.0621	1,169,940	2107
16.6	0.0603	1,173,490	2117
17.1	0.0584	1,179,790	2126
33.1	0.0302	1,540,170	38452
96.9	0.0103	2,107,640	36217
338.9	0.0030	2,863,700	18314
632.9	0.0016	3,161,450	4128
5102.0	0.0002	3,670,480	4728
AVERAGE ANNUAL VALUE =		433,989	433,989

Alt 1 - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1009	-	0
1.3	0.7827	1,530	243
2.1	0.4862	397,970	59231
2.2	0.4503	574,070	17421
2.5	0.4062	600,430	25922
3.3	0.3016	782,830	72330
3.8	0.2628	793,550	30577
6.2	0.1610	1,195,720	101280
20.4	0.0491	2,299,830	195631
21.0	0.0477	4,110,330	4244
21.5	0.0464	4,392,480	5630
22.9	0.0438	4,692,360	12031
24.3	0.0411	4,992,240	12825
26.0	0.0385	5,292,120	13819
27.9	0.0358	5,592,000	14413
30.2	0.0332	7,535,660	17384
32.8	0.0305	8,238,500	20889
35.9	0.0279	8,768,060	22521
62.5	0.0160	9,516,940	108599
110.5	0.0090	13,943,600	81404
341.0	0.0029	19,766,400	103086
601.6	0.0017	34,340,300	34365
2316.2	0.0004	39,118,060	45197
AVERAGE ANNUAL VALUE =		998,841	998,841

Alt 1 - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.1	6.7000	-	0
3.0	0.3362	43,040	138949
3.4	0.2967	63,980	2112
5.1	0.1962	182,190	12377
11.3	0.0886	421,500	32454
22.0	0.0455	651,530	23143
88.2	0.0113	1,318,840	33660
295.5	0.0034	6,151,240	29689
1000.0	0.0010	17,749,110	28497
100000.0	0.0000	71,079,770	43970
AVERAGE ANNUAL VALUE =		270,385	270,385

Table C-4. Alternative 2C 1917-2019 Damage-Frequency Tables

Alt 2C - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0895	-	0
1.0	0.9842	-	0
1.1	0.8789	-	0
1.2	0.8526	-	0
1.2	0.8263	-	0
1.4	0.7211	-	0
1.5	0.6875	-	0
2.0	0.5000	2,110	198
10.0	0.1000	4,760	1374
20.7	0.0483	30,730	918
21.5	0.0465	34,870	57
23.2	0.0430	254,980	506
25.3	0.0395	354,560	1063
27.7	0.0360	427,880	1365
30.7	0.0326	590,980	1777
34.4	0.0291	730,320	2305
39.1	0.0256	855,860	2767
45.3	0.0221	1,020,900	3273
76.8	0.0130	1,928,400	13386
132.0	0.0076	2,659,530	12474
379.5	0.0026	3,597,800	15464
622.0	0.0016	3,911,230	3858
1987.8	0.0005	4,339,570	4557
AVERAGE ANNUAL VALUE =		65,342	65,342

Alt 2C - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0795	-	0
1.0	0.9737	1,590	84
1.2	0.8616	6,710	465
1.2	0.8336	9,200	223
1.2	0.8056	11,180	286
1.5	0.6896	36,810	2782
1.6	0.6265	49,350	2720
2.3	0.4302	95,220	14189
6.3	0.1586	188,000	38463
7.3	0.1375	207,120	4167
8.6	0.1164	297,880	5325
13.1	0.0762	479,400	15622
20.6	0.0485	660,920	15766
22.7	0.0441	842,440	3357
25.2	0.0396	1,023,960	4168
28.5	0.0351	1,202,241	4971
32.6	0.0307	1,335,746	5667
38.2	0.0262	1,469,251	6264
73.6	0.0136	2,306,770	23838
122.1	0.0082	3,379,180	15334
344.8	0.0029	66,623,270	185091
581.2	0.0017	208,121,510	162059
1619.5	0.0006	419,726,330	346313
AVERAGE ANNUAL VALUE =		857,154	857,154

Alt 2C - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1750	-	0
1.0	0.9880	1,660	155
1.4	0.7217	95,850	12983
1.5	0.6653	159,770	7206
1.6	0.6139	196,840	9173
2.3	0.4411	478,010	58310
2.5	0.4016	550,860	20297
3.5	0.2833	709,670	74602
12.2	0.0818	1,131,200	185461
12.3	0.0810	1,134,520	855
12.5	0.0803	1,137,840	857
12.7	0.0787	1,144,480	1722
12.9	0.0772	1,151,120	1732
13.2	0.0757	1,157,760	1742
13.5	0.0742	1,161,970	1750
13.8	0.0727	1,169,940	1759
14.0	0.0712	1,173,490	1768
14.3	0.0697	1,179,790	1775
34.3	0.0292	1,540,170	55104
110.6	0.0090	2,107,640	36727
396.7	0.0025	2,863,700	16201
713.6	0.0014	3,161,450	3373
28148.1	0.0000	3,670,480	4665
AVERAGE ANNUAL VALUE =		498,218	498,218

Alt 2C - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0920	-	0
1.3	0.7879	1,530	233
2.0	0.5000	397,570	57498
2.2	0.4636	574,070	17701
2.4	0.4188	600,430	26327
3.2	0.3126	782,830	73460
3.7	0.2732	793,550	31055
6.0	0.1660	1,195,720	106600
20.9	0.0478	2,299,830	206642
21.5	0.0464	4,110,330	4267
22.2	0.0451	4,392,480	5660
23.6	0.0424	4,692,360	12095
25.1	0.0398	4,992,240	12894
26.9	0.0371	5,292,120	13692
29.0	0.0344	5,592,000	14490
31.5	0.0318	7,535,660	17477
34.3	0.0291	8,238,500	21001
37.8	0.0265	8,768,060	22642
66.8	0.0150	9,516,940	105158
116.8	0.0086	13,943,600	75065
364.8	0.0027	19,766,400	98077
631.5	0.0016	34,340,300	31313
2721.4	0.0004	39,118,060	44662
AVERAGE ANNUAL VALUE =		998,009	998,009

Alt 2C - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.4	2.7000	-	0
3.5	0.2873	43,040	51921
3.9	0.2556	63,980	1699
8.9	0.1118	182,190	17698
22.4	0.0446	421,500	20260
43.1	0.0232	651,530	11497
121.7	0.0082	1,318,840	14778
933.3	0.0011	6,151,240	26679
10000.0	0.0001	17,749,110	11609
100000.0	0.0000	71,079,770	3997
AVERAGE ANNUAL VALUE =		160138	160,138

Table C-5. Alternative 5 1917-2019 Damage-Frequency Tables

Alt 5 - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1118	-	0
1.0	0.9941	-	0
1.1	0.8765	-	0
1.2	0.8471	-	0
1.2	0.8176	-	0
1.4	0.7000	-	0
1.5	0.6706	-	0
5.0	0.2000	2,110	496
10.0	0.1000	4,760	344
11.4	0.0875	30,730	222
13.3	0.0750	34,870	410
20.0	0.0500	254,980	3623
21.7	0.0461	354,560	1203
23.8	0.0421	427,880	1544
26.2	0.0382	590,980	2011
29.2	0.0342	730,320	2608
33.0	0.0303	855,860	3131
38.0	0.0263	1,020,900	3704
69.3	0.0144	1,928,400	17533
122.8	0.0081	2,659,530	14409
361.2	0.0028	3,597,800	16822
608.7	0.0016	3,911,230	4225
1987.4	0.0005	4,339,570	4702
AVERAGE ANNUAL VALUE =		76,987	76,987

Alt 5 - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1059	-	0
1.0	0.9846	1,590	96
1.2	0.8560	6,710	534
1.2	0.8238	9,200	256
1.3	0.7917	11,180	328
1.6	0.6412	36,810	3612
1.7	0.5875	49,350	2312
2.5	0.3997	95,220	13573
7.4	0.1353	188,000	37449
9.1	0.1100	207,120	5000
10.5	0.0949	297,880	3808
12.8	0.0780	479,400	6557
16.4	0.0611	660,920	9620
20.7	0.0484	842,440	9607
23.0	0.0435	1,023,960	4499
25.8	0.0387	1,202,241	5366
29.5	0.0339	1,335,746	6117
34.4	0.0291	1,469,251	6761
69.9	0.0143	2,306,770	27892
117.8	0.0085	3,379,180	16551
334.9	0.0030	66,623,270	192546
572.0	0.0017	208,121,510	169949
1593.8	0.0006	419,726,330	351899
AVERAGE ANNUAL VALUE =		874,330	874,330

Alt 5 - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1750	-	0
1.0	0.9880	1,660	155
1.4	0.7217	95,850	12983
1.5	0.6637	159,770	7417
1.6	0.6098	196,840	9610
2.3	0.4357	478,010	58734
2.5	0.3978	550,860	19527
3.5	0.2839	709,670	71769
12.6	0.0795	1,131,200	188119
12.7	0.0787	1,134,520	960
12.9	0.0778	1,137,840	963
13.1	0.0761	1,144,480	1934
13.4	0.0744	1,151,120	1946
13.7	0.0727	1,157,760	1957
14.1	0.0710	1,161,970	1966
14.4	0.0693	1,169,940	1977
14.8	0.0676	1,173,490	1986
15.2	0.0660	1,179,790	1995
33.8	0.0296	1,540,170	49404
105.3	0.0095	2,107,640	36720
373.5	0.0027	2,863,700	16939
681.6	0.0015	3,161,450	3647
9870.1	0.0001	3,670,480	4665
AVERAGE ANNUAL VALUE =		495,372	495,372

Alt 5 - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0973	-	0
1.3	0.7848	1,530	239
2.0	0.5000	397,970	56888
2.2	0.4629	574,070	18052
2.4	0.4172	600,430	26851
3.2	0.3088	782,830	74924
3.7	0.2687	793,550	31673
6.0	0.1658	1,195,720	102293
19.2	0.0521	2,299,830	198691
20.4	0.0490	4,110,330	9939
21.0	0.0476	4,392,480	6049
22.3	0.0448	4,692,360	12927
23.9	0.0419	4,992,240	13780
25.6	0.0391	5,292,120	14634
27.6	0.0362	5,592,000	15487
30.0	0.0334	7,535,660	18679
32.8	0.0305	8,238,500	22445
36.1	0.0277	8,768,060	24199
64.8	0.0154	9,516,940	111969
114.2	0.0088	13,943,600	78283
355.7	0.0028	19,766,400	100234
621.7	0.0016	34,340,300	32548
2646.6	0.0004	39,118,060	45197
AVERAGE ANNUAL VALUE =		1,015,982	1,015,982

Alt 5 - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.4	2.7000	-	0
3.3	0.3012	43,040	51623
3.8	0.2649	63,980	1941
7.3	0.1373	182,190	15711
22.3	0.0449	421,500	27871
35.9	0.0278	651,530	9158
112.1	0.0089	1,318,840	18652
346.4	0.0029	6,151,240	22523
10000.0	0.0001	17,749,110	33302
100000.0	0.0000	71,079,770	3997
AVERAGE ANNUAL VALUE =		184,778	184778

Table C-6. Alternative 8 1917-2019 Damage-Frequency Tables

Alt 8 - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0895	-	0
1.0	0.9842	-	0
1.1	0.8789	-	0
1.2	0.8526	-	0
1.2	0.8263	-	0
1.4	0.7211	-	0
1.5	0.6833	-	0
5.0	0.2000	2,110	510
10.0	0.1000	4,760	344
20.7	0.0484	30,730	917
21.4	0.0467	34,870	54
23.0	0.0434	254,980	478
24.9	0.0401	354,560	1005
27.2	0.0368	427,880	1290
29.8	0.0335	590,980	1679
33.1	0.0302	730,320	2178
37.1	0.0269	855,860	2615
42.3	0.0236	1,020,900	3094
72.9	0.0137	1,928,400	14624
128.4	0.0078	2,659,530	13587
386.8	0.0026	3,597,800	16274
639.6	0.0016	3,911,230	3837
2359.6	0.0004	4,339,570	4702
AVERAGE ANNUAL VALUE =		67,184	67,184

Alt 8 - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0795	-	0
1.0	0.9737	1,590	84
1.2	0.8616	6,710	465
1.2	0.8336	9,200	223
1.2	0.8056	11,180	286
1.5	0.6882	36,810	2816
1.6	0.6167	49,350	3083
2.6	0.3897	95,220	16406
7.3	0.1377	188,000	35682
8.6	0.1166	207,120	4167
10.3	0.0973	297,880	4876
13.9	0.0720	479,400	9836
20.2	0.0494	660,920	12878
22.2	0.0451	842,440	3261
24.5	0.0408	1,023,960	4049
27.5	0.0364	1,202,241	4829
31.2	0.0321	1,335,746	5505
36.0	0.0277	1,469,251	6085
70.7	0.0141	2,306,770	25683
119.4	0.0084	3,379,180	16386
346.6	0.0029	66,623,270	192253
589.9	0.0017	208,121,510	163510
1799.4	0.0006	419,726,330	357667
AVERAGE ANNUAL VALUE =		870,028	870,028

Alt 8 - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1750	-	0
1.0	0.9880	1,660	155
1.4	0.7217	95,850	12983
1.5	0.6637	159,770	7417
1.6	0.6098	196,840	9610
2.3	0.4349	478,010	59012
2.5	0.3965	550,860	19777
3.6	0.2811	709,670	72689
12.3	0.0811	1,131,200	184125
12.4	0.0803	1,134,520	836
12.6	0.0796	1,137,840	839
12.8	0.0781	1,144,480	1685
13.0	0.0767	1,151,120	1695
13.3	0.0752	1,157,760	1704
13.6	0.0737	1,161,970	1712
13.8	0.0722	1,169,940	1721
14.1	0.0707	1,173,490	1730
14.4	0.0693	1,179,790	1737
34.0	0.0294	1,540,170	54256
109.2	0.0092	2,107,640	36872
388.3	0.0026	2,863,700	16365
700.5	0.0014	3,161,450	3457
16170.2	0.0001	3,670,480	4665
AVERAGE ANNUAL VALUE =		495,044	495,044

Alt 8 - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0920	-	0
1.3	0.7879	1,530	233
2.0	0.4977	397,970	57966
2.2	0.4616	574,070	17556
2.4	0.4171	600,430	26123
3.2	0.3117	782,830	72891
3.7	0.2726	793,550	30814
6.1	0.1647	1,195,720	107277
20.9	0.0478	2,299,830	204410
21.5	0.0465	4,110,330	4211
22.1	0.0452	4,392,480	5585
23.5	0.0425	4,692,360	11935
0.0	0.0399	4,992,240	12723
26.8	0.0373	5,292,120	13511
28.9	0.0347	5,592,000	14299
31.2	0.0320	7,535,660	17246
34.0	0.0294	8,238,500	20723
37.4	0.0268	8,768,060	22342
65.7	0.0152	9,516,940	105586
115.3	0.0087	13,943,600	76879
360.9	0.0028	19,766,400	99419
628.8	0.0016	34,340,300	31942
2778.7	0.0004	39,118,060	45197
AVERAGE ANNUAL VALUE =		998,867	998,867

Alt 8 - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.4	2.7000	-	0
3.4	0.2900	38,950	46934
3.9	0.2580	57,900	1554
7.9	0.1272	165,030	14578
20.7	0.0484	381,210	21518
36.9	0.0271	594,900	10394
117.5	0.0085	1,234,140	16985
367.2	0.0027	6,049,840	21069
10000.0	0.0001	17,608,330	31032
100000.0	0.0000	70,857,040	3981
AVERAGE ANNUAL VALUE =		168,045	168,045

Table C-7. Alternative 1 1959-2019 Damage-Frequency Tables

Alt 1 - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.7	1.4125	-	0
0.9	1.1625	-	0
1.1	0.9125	-	0
1.2	0.8500	-	0
1.3	0.7875	-	0
1.6	0.6212	-	0
1.7	0.5909	-	0
2.0	0.5000	2,110	96
10.0	0.1000	4,760	1374
10.3	0.0972	30,730	49
10.6	0.0944	34,870	91
11.3	0.0889	254,980	805
12.0	0.0833	354,560	1693
12.9	0.0778	427,880	2173
13.8	0.0722	590,980	2830
15.0	0.0667	730,320	3670
16.4	0.0611	855,860	4406
18.0	0.0556	1,020,900	5213
28.1	0.0355	1,928,400	29513
53.2	0.0188	2,659,530	38375
172.7	0.0058	3,597,800	40748
277.7	0.0036	3,911,230	8215
707.9	0.0014	4,339,570	9029

Alt 1 - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.2000	-	0
0.9	1.0527	1,590	117
1.1	0.8966	6,710	648
1.2	0.8575	9,200	311
1.2	0.8185	11,180	398
1.5	0.6556	36,810	3908
1.6	0.6068	49,350	2102
2.8	0.3549	95,220	18210
7.7	0.1305	188,000	31782
8.7	0.1151	207,120	3030
10.0	0.1000	297,880	3832
10.7	0.0938	479,400	2399
11.4	0.0876	660,920	3519
12.3	0.0814	842,440	4640
13.3	0.0753	1,023,960	5760
14.5	0.0691	1,202,241	6871
15.9	0.0629	1,335,746	7833
17.6	0.0568	1,469,251	8657
27.8	0.0360	2,306,770	39272
47.2	0.0212	3,379,180	41993
143.9	0.0069	66,623,270	498066
237.8	0.0042	208,121,510	376905
581.3	0.0017	419,726,330	780112

Alt 1 - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1415	-	0
1.0	1.0062	1,660	112
1.2	0.8136	95,850	9392
1.3	0.7654	159,770	6155
1.4	0.7173	196,840	8587
2.0	0.4880	478,010	77366
2.2	0.4469	550,860	21131
3.1	0.3237	709,670	77668
8.7	0.1149	1,131,200	192158
8.8	0.1133	1,134,520	1809
9.0	0.1117	1,137,840	1814
9.2	0.1085	1,144,480	3644
9.5	0.1053	1,151,120	3665
9.8	0.1021	1,157,760	3686
10.0	0.0997	1,161,970	2839
10.1	0.0987	1,169,940	1127
10.2	0.0977	1,173,490	1133
10.3	0.0968	1,179,790	1138
17.0	0.0590	1,540,170	51402
44.6	0.0224	2,107,640	66682
144.4	0.0069	2,863,700	38509
238.6	0.0042	3,161,450	8242
570.7	0.0018	3,670,480	8328

Alt 1 - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.2776	-	0
1.2	0.8254	1,530	346
1.8	0.5471	397,970	55595
2.0	0.4971	574,070	24269
2.2	0.4614	600,430	20996
2.7	0.3767	782,830	58585
2.9	0.3453	793,550	24766
4.0	0.2510	1,195,720	93760
11.7	0.0851	2,299,830	289923
12.2	0.0816	4,110,330	11146
12.8	0.0782	4,392,480	14784
14.0	0.0712	4,662,360	31593
15.6	0.0643	4,992,240	33678
17.5	0.0573	5,292,120	35764
19.9	0.0503	5,592,000	37850
21.1	0.0474	7,535,660	19018
22.3	0.0448	8,238,500	21171
23.8	0.0421	8,768,060	22825
35.0	0.0286	9,516,940	123448
53.8	0.0186	13,943,600	117030
144.9	0.0069	19,766,400	197177
228.1	0.0044	34,340,300	68156
496.8	0.0020	39,118,060	87091
AVERAGE ANNUAL VALUE =		1,388,972	1,388,972

Alt 1 - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0811	-	0
2.3	0.4326	43,040	13957
2.7	0.3754	63,980	3058
4.3	0.2325	182,190	17586
7.3	0.1364	421,500	29012
14.5	0.0690	651,530	36148
45.4	0.0220	1,318,840	46311
162.0	0.0062	6,151,240	59266
10000.0	0.0001	17,749,110	72573
100000.0	0.0000	71,079,770	3997
AVERAGE ANNUAL VALUE =		281,908	281,908

Table C-8. Alternative 2C 1959-2019 Damage-Frequency Tables

Alt 2C - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0750	-	0
1.0	0.9917	-	0
1.1	0.9083	-	0
1.1	0.8875	-	0
1.2	0.8667	-	0
1.3	0.7833	-	0
1.3	0.7625	-	0
2.0	0.5000	2,110	277
5.0	0.2000	4,760	1031
10.7	0.0938	30,730	1885
11.4	0.0875	34,870	205
13.3	0.0750	254,980	1812
16.0	0.0625	354,560	3810
20.0	0.0500	427,880	4890
21.2	0.0471	590,980	1456
22.6	0.0443	730,320	1888
24.1	0.0414	855,860	2266
25.9	0.0386	1,020,900	2681
41.2	0.0243	1,928,400	21066
68.4	0.0146	2,659,530	22183
209.2	0.0048	3,597,800	30770
394.8	0.0025	3,911,230	8439
737.6	0.0014	4,339,570	4856
AVERAGE ANNUAL VALUE =		109,514	109,514

Alt 2C - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0680	-	0
1.0	0.9855	1,590	66
1.1	0.8981	6,710	363
1.1	0.8762	9,200	174
1.2	0.8544	11,180	223
1.3	0.7685	36,810	2061
1.3	0.7470	49,350	925
1.8	0.5549	95,220	13886
3.9	0.2568	188,000	42218
4.8	0.2093	207,120	9375
5.6	0.1786	297,880	7759
8.0	0.1253	479,400	20707
11.9	0.0844	660,920	23343
18.3	0.0546	842,440	22380
20.9	0.0478	1,023,960	6339
22.1	0.0452	1,202,241	2889
23.5	0.0426	1,335,746	3294
25.0	0.0400	1,469,251	3640
37.9	0.0264	2,306,770	25764
59.0	0.0170	3,379,180	26761
171.2	0.0058	66,623,270	389106
262.1	0.0038	208,121,510	278455
606.7	0.0016	419,726,330	680168
AVERAGE ANNUAL VALUE =		1,559,895	1,559,895

Alt 2C - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1179	-	0
1.0	0.9980	1,660	100
1.2	0.8271	95,850	8329
1.3	0.7844	159,770	5459
1.3	0.7417	196,840	7615
1.7	0.5769	478,010	55611
1.9	0.5344	550,860	21881
2.3	0.4270	709,670	67692
6.6	0.1524	1,131,200	252683
6.6	0.1506	1,134,520	2102
6.7	0.1487	1,137,840	2108
6.9	0.1450	1,144,480	4235
7.1	0.1413	1,151,120	4260
7.3	0.1376	1,157,760	4284
7.5	0.1339	1,161,970	4304
7.7	0.1302	1,169,940	4327
7.9	0.1265	1,173,490	4348
8.1	0.1228	1,179,790	4367
17.2	0.0581	1,540,170	87932
52.7	0.0190	2,107,640	71343
164.8	0.0061	2,863,700	32112
261.2	0.0038	3,161,450	6744
621.0	0.0016	3,670,480	7579
AVERAGE ANNUAL VALUE =		659,414	659,414

Alt 2C - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.1814	-	0
1.2	0.8444	1,530	258
1.7	0.5850	397,970	51823
1.9	0.5300	574,070	26722
2.1	0.4782	600,430	30428
2.6	0.3854	782,830	64184
2.8	0.3510	793,550	27133
4.0	0.2477	1,195,720	102720
11.5	0.0872	2,299,830	280453
11.9	0.0837	4,110,330	11146
12.5	0.0803	4,392,480	14784
13.6	0.0733	4,692,360	31593
15.1	0.0664	4,992,240	33678
16.8	0.0594	5,292,120	35764
19.1	0.0524	5,592,000	37850
20.8	0.0482	7,535,660	28138
22.1	0.0453	8,238,500	22381
23.5	0.0425	8,768,060	24129
35.4	0.0282	9,516,940	130503
55.6	0.0180	13,943,600	119763
152.5	0.0066	19,766,400	192884
234.3	0.0043	34,340,300	61940
511.4	0.0020	39,118,060	84953
AVERAGE ANNUAL VALUE =		1,413,226	1,413,226

Alt 2C - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
1.3	0.7735	-	0
2.8	0.3632	43,040	8829
3.2	0.3164	63,980	2506
5.0	0.2000	182,190	14328
16.9	0.0592	421,500	42485
26.1	0.0383	651,530	11216
62.8	0.0159	1,318,840	22098
200.0	0.0050	6,151,240	40767
10000.0	0.0001	17,749,110	58556
100000.0	0.0000	71,079,770	3997
AVERAGE ANNUAL VALUE =		204,782	204,782

Table C-9. Alternative 5 1959-2019 Damage-Frequency Tables

Alt 5 - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.2000	-	0
0.9	1.0571	-	0
1.1	0.9143	-	0
1.1	0.8786	-	0
1.2	0.8429	-	0
1.4	0.7000	-	0
1.5	0.6500	-	0
2.0	0.5000	2,110	158
5.0	0.2000	4,760	1031
10.4	0.0958	30,730	1848
10.9	0.0917	34,870	137
12.0	0.0833	254,980	1208
13.3	0.0750	354,560	2540
15.0	0.0667	427,880	3260
17.1	0.0583	590,980	4245
20.0	0.0500	730,320	5505
21.4	0.0468	855,860	2558
23.0	0.0435	1,020,900	3027
36.5	0.0274	1,928,400	23785
77.5	0.0129	2,659,530	33299
203.1	0.0049	3,597,800	24964
305.6	0.0033	3,911,230	6202
746.5	0.0013	4,339,570	7972
AVERAGE ANNUAL VALUE =		121,740	121,740

Alt 5 - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1211	-	0
1.0	1.0125	1,590	86
1.1	0.8975	6,710	477
1.2	0.8687	9,200	229
1.2	0.8399	11,180	293
1.4	0.7269	36,810	2712
1.4	0.6969	49,350	1295
2.0	0.4961	95,220	14515
5.2	0.1937	188,000	42819
6.3	0.1600	207,120	6666
7.9	0.1262	297,880	8520
10.7	0.0934	479,400	12748
12.1	0.0826	660,920	6140
13.9	0.0719	842,440	8095
16.4	0.0611	1,023,960	10050
19.9	0.0503	1,202,241	11987
21.2	0.0471	1,335,746	4088
22.7	0.0441	1,469,251	4176
35.1	0.0285	2,306,770	29553
57.0	0.0175	3,379,180	31101
166.2	0.0060	66,623,270	403518
258.0	0.0039	208,121,510	294105
602.7	0.0017	419,726,330	695852
AVERAGE ANNUAL VALUE =		1,589,028	1,589,028

Alt 5 - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1179	-	0
1.0	0.9980	1,660	100
1.2	0.8271	95,850	8329
1.3	0.7844	159,770	5459
1.3	0.7417	196,840	7615
1.9	0.5192	478,010	75080
2.1	0.4800	550,860	20154
2.5	0.3935	709,670	54517
9.5	0.1048	1,131,200	265792
9.9	0.1012	1,134,520	4094
10.0	0.0996	1,137,840	1816
10.2	0.0982	1,144,480	1492
10.3	0.0969	1,151,120	1501
10.5	0.0956	1,157,760	1510
10.6	0.0943	1,161,970	1517
10.8	0.0930	1,169,940	1525
10.9	0.0917	1,173,490	1532
11.1	0.0904	1,179,790	1539
22.1	0.0452	1,540,170	61409
50.5	0.0198	2,107,640	46398
156.9	0.0064	2,863,700	33391
252.5	0.0040	3,161,450	7271
602.7	0.0017	3,670,480	7861
AVERAGE ANNUAL VALUE =		609,900	609,900

Alt 5 - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.2189	-	0
1.2	0.8370	1,530	292
1.8	0.5695	397,970	53432
1.9	0.5169	574,070	25590
2.1	0.4716	600,430	26582
2.6	0.3807	782,830	62896
2.9	0.3469	793,550	26589
4.1	0.2457	1,195,720	100658
11.2	0.0891	2,299,830	273814
11.6	0.0861	4,110,330	9542
12.0	0.0831	4,392,480	12657
13.0	0.0772	4,692,360	27047
14.0	0.0712	4,992,240	28833
15.3	0.0652	5,292,120	30618
16.9	0.0593	5,592,000	32404
18.7	0.0533	7,535,660	39083
20.6	0.0486	8,238,500	37421
22.0	0.0454	8,768,060	27243
34.2	0.0293	9,516,940	147342
55.2	0.0181	13,943,600	131020
150.6	0.0066	19,766,400	193185
232.8	0.0043	34,340,300	63425
497.0	0.0020	39,118,060	83865
AVERAGE ANNUAL VALUE =		1,433,538	1,433,538

Alt 5 - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.4	2.4063	-	0
2.5	0.4012	43,040	43149
2.9	0.3455	63,980	2978
4.8	0.2064	182,190	17127
12.8	0.0784	421,500	38647
22.0	0.0454	651,530	17666
58.4	0.0171	1,318,840	27884
200.0	0.0050	6,151,240	45286
10000.0	0.0001	17,749,110	58556
100000.0	0.0000	71,079,770	3997
AVERAGE ANNUAL VALUE =		255,291	255,291

Table C-10. Alternative 8 1959-2019 Damage-Frequency Tables

Alt 8 - Coralville			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1545	-	0
1.0	1.0333	-	0
1.1	0.9121	-	0
1.1	0.8818	-	0
1.2	0.8515	-	0
1.3	0.7667	-	0
1.4	0.7000	-	0
2.0	0.5000	2,110	211
5.0	0.2000	4,760	1031
10.4	0.0958	30,730	1848
10.9	0.0917	34,870	137
12.0	0.0833	254,980	1208
13.3	0.0750	354,560	2540
15.0	0.0667	427,880	3260
17.1	0.0583	590,980	4245
20.0	0.0500	730,320	5505
21.5	0.0466	855,860	2704
23.2	0.0432	1,020,900	3199
38.3	0.0261	1,928,400	25136
80.0	0.0125	2,659,530	31281
211.2	0.0047	3,597,800	24297
324.4	0.0031	3,911,230	6202
789.8	0.0013	4,339,570	7492
AVERAGE ANNUAL VALUE =		120,296	120,296

Alt 8 - Iowa City			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.0826	-	0
1.0	0.9929	1,590	71
1.1	0.8979	6,710	394
1.1	0.8741	9,200	189
1.2	0.8504	11,180	242
1.3	0.7570	36,810	2240
1.4	0.7337	49,350	1005
2.0	0.4963	95,220	17157
4.7	0.2109	188,000	40419
5.6	0.1777	207,120	6554
6.7	0.1496	297,880	7100
10.1	0.0985	479,400	19851
11.6	0.0862	660,920	7039
13.5	0.0739	842,440	9280
16.3	0.0615	1,023,960	11521
20.1	0.0498	1,202,241	13038
21.4	0.0468	1,335,746	3778
22.8	0.0438	1,469,251	4176
35.5	0.0282	2,306,770	29553
57.7	0.0173	3,379,180	30836
172.8	0.0058	66,623,270	404511
266.9	0.0037	208,121,510	280445
634.0	0.0016	419,726,330	680889
AVERAGE ANNUAL VALUE =		1,570,289	1,570,289

Alt 8 - Lone Tree			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.9	1.1179	-	0
1.0	0.9980	1,660	100
1.2	0.8271	95,850	8329
1.3	0.7844	159,770	5459
1.3	0.7417	196,840	7615
1.8	0.5685	478,010	58443
1.9	0.5231	550,860	23373
2.6	0.3868	709,670	85906
7.0	0.1436	1,131,200	223825
7.0	0.1421	1,134,520	1748
7.1	0.1405	1,137,840	1753
7.3	0.1374	1,144,480	3521
7.4	0.1344	1,151,120	3542
7.6	0.1313	1,157,760	3562
7.8	0.1282	1,161,970	3579
8.0	0.1251	1,169,940	3598
8.2	0.1220	1,173,490	3615
8.4	0.1189	1,179,790	3631
16.7	0.0600	1,540,170	80195
52.0	0.0192	2,107,640	74295
161.7	0.0062	2,863,700	32408
257.6	0.0039	3,161,450	6935
614.0	0.0016	3,670,480	7696
AVERAGE ANNUAL VALUE =		643,125	643,125

Alt 8 - Wapello			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
0.8	1.2053	-	0
1.2	0.8397	1,530	280
1.7	0.5794	397,970	52001
1.9	0.5280	574,070	24955
2.1	0.4781	600,430	29307
2.6	0.3850	782,830	64404
2.9	0.3504	793,550	27226
4.1	0.2468	1,195,720	103071
11.4	0.0877	2,299,830	278043
11.8	0.0844	4,110,330	10696
12.3	0.0811	4,392,480	14188
13.4	0.0744	4,692,360	30319
14.8	0.0677	4,992,240	32320
16.4	0.0610	5,292,120	34322
18.4	0.0544	5,592,000	36324
20.4	0.0490	7,535,660	35287
21.7	0.0461	8,238,500	23039
23.2	0.0431	8,768,060	24839
35.1	0.0285	9,516,940	134341
55.2	0.0181	13,943,600	121424
150.6	0.0066	19,786,400	193185
234.3	0.0043	34,340,300	64158
511.4	0.0020	39,118,060	84953
AVERAGE ANNUAL VALUE =		1,418,683	1,418,683

Alt 8 - Coralville Pool			
YEAR	FREQUENCY	EVENT DAMAGES	AVERAGE ANNUAL DAMAGES
	-	0	
1.1	0.9100	-	0
2.7	0.3696	43,040	11629
3.1	0.3209	63,980	2804
5.0	0.2000	182,190	14886
17.7	0.0564	421,500	43340
26.5	0.0378	651,530	10008
61.2	0.0164	1,318,840	21094
200.0	0.0050	6,151,240	42393
10000.0	0.0001	17,749,110	58556
100000.0	0.0000	71,079,770	3997
AVERAGE ANNUAL VALUE =		208,508	208,508

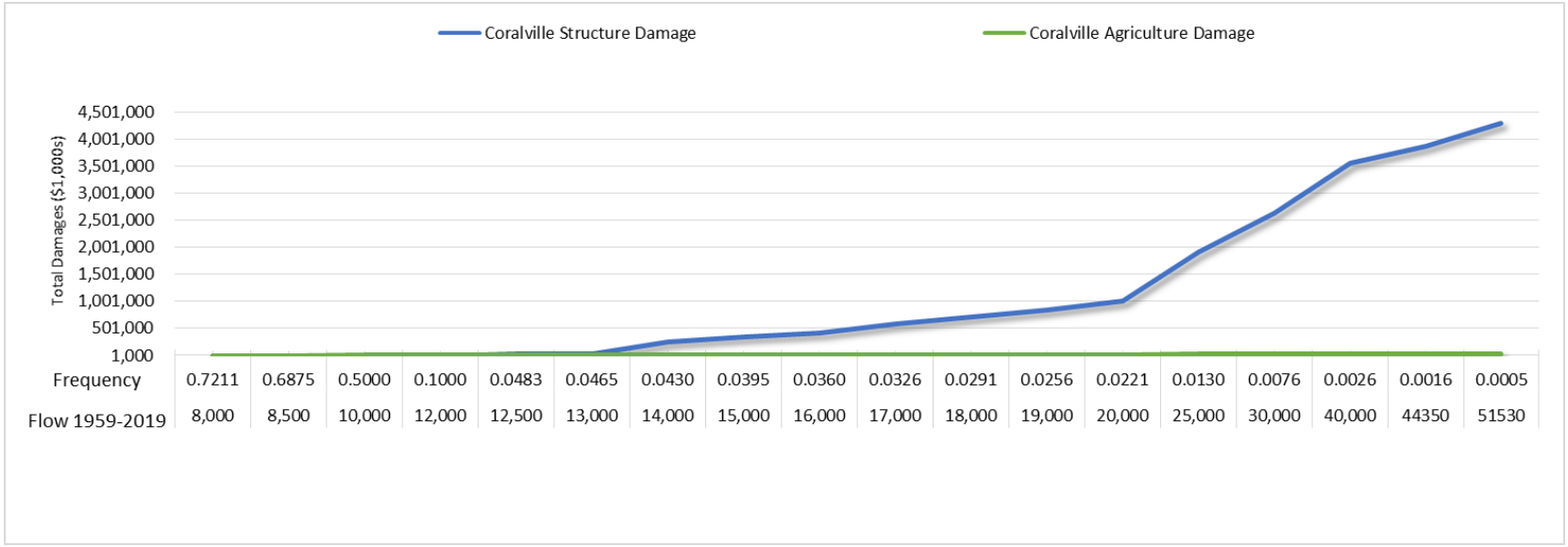

Figure C-1. Alternative 2C 1917-2019 Coralville Reach Damage-Frequency

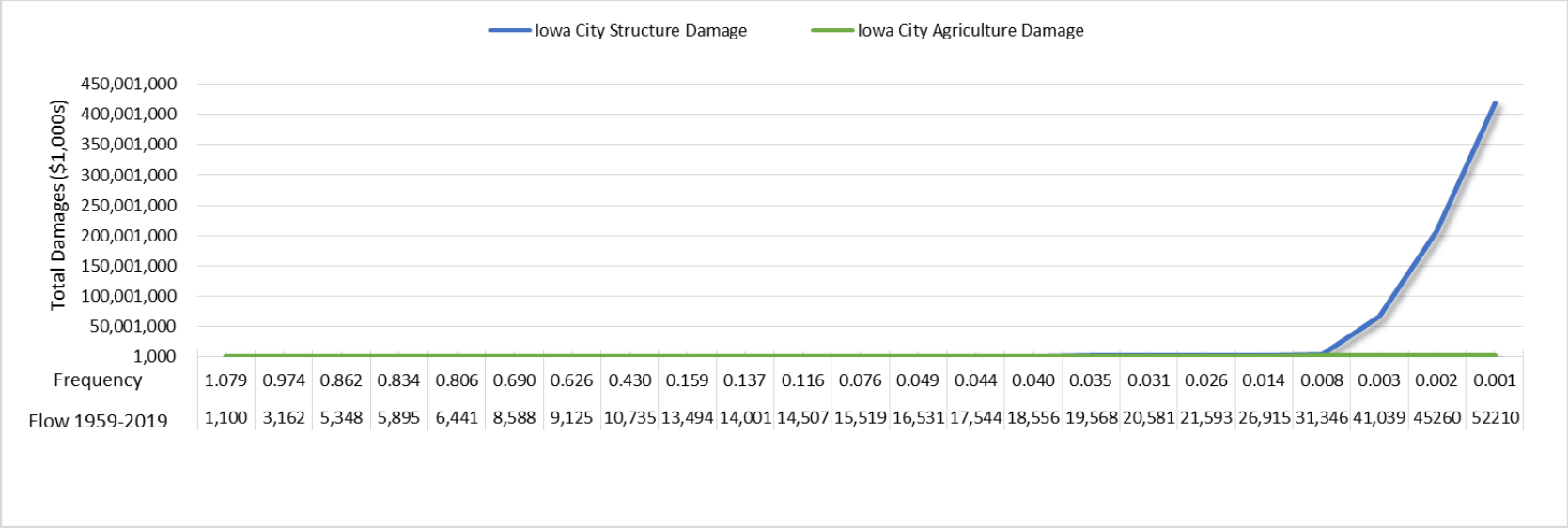

Figure C-2. Alternative 2C 1917-2019 Iowa City Reach Damage-Frequency

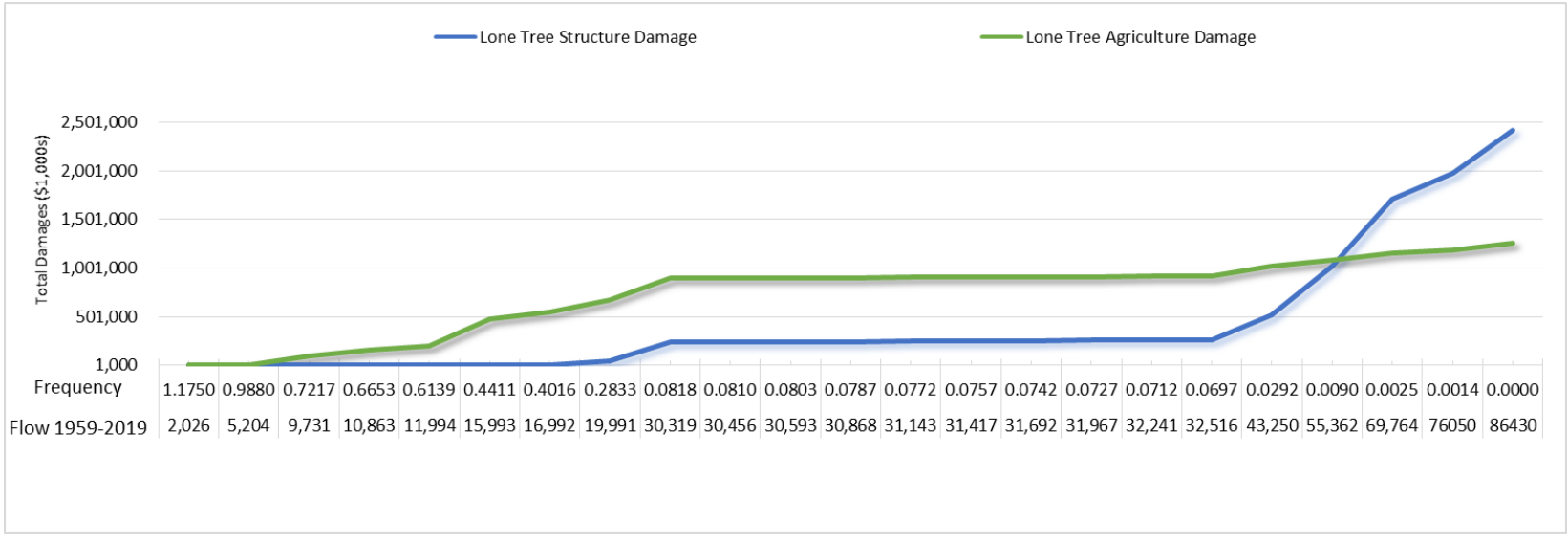

Figure C-3. Alternative 2C 1917-2019 Lone Tree Reach Damage-Frequency

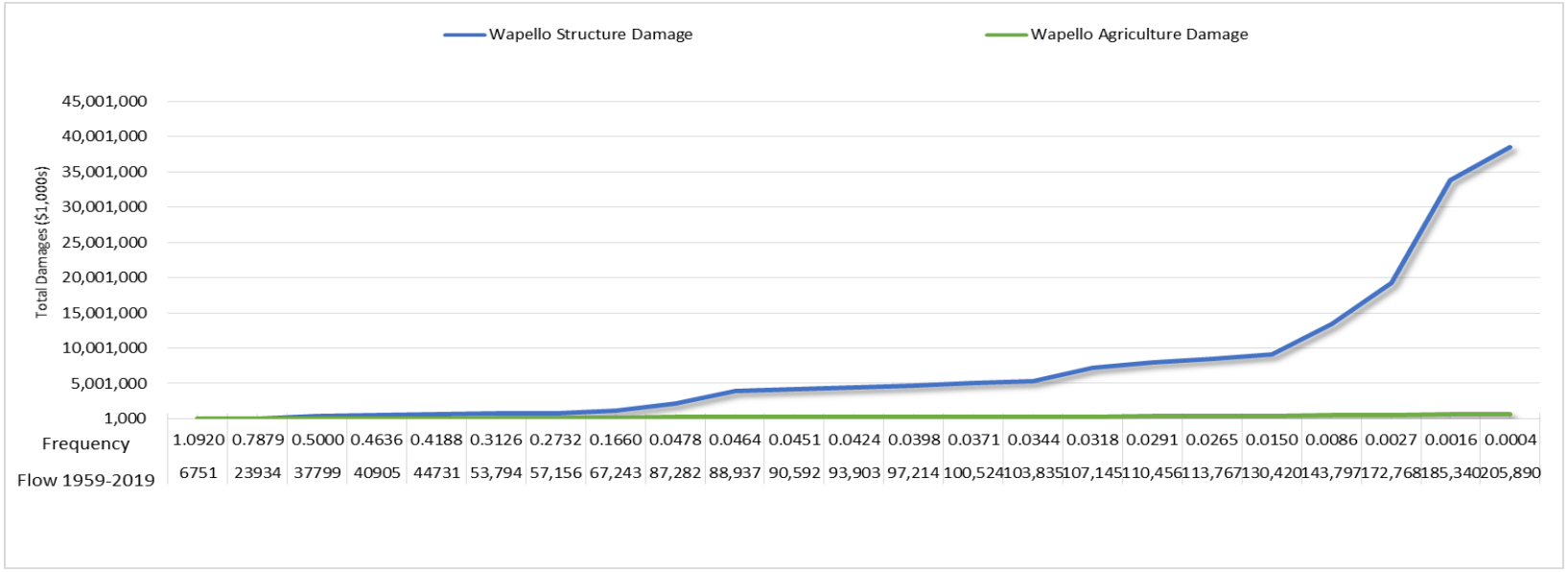

Figure C-4. Alternative 2C 1917-2019 Wapello Reach Damage-Frequency

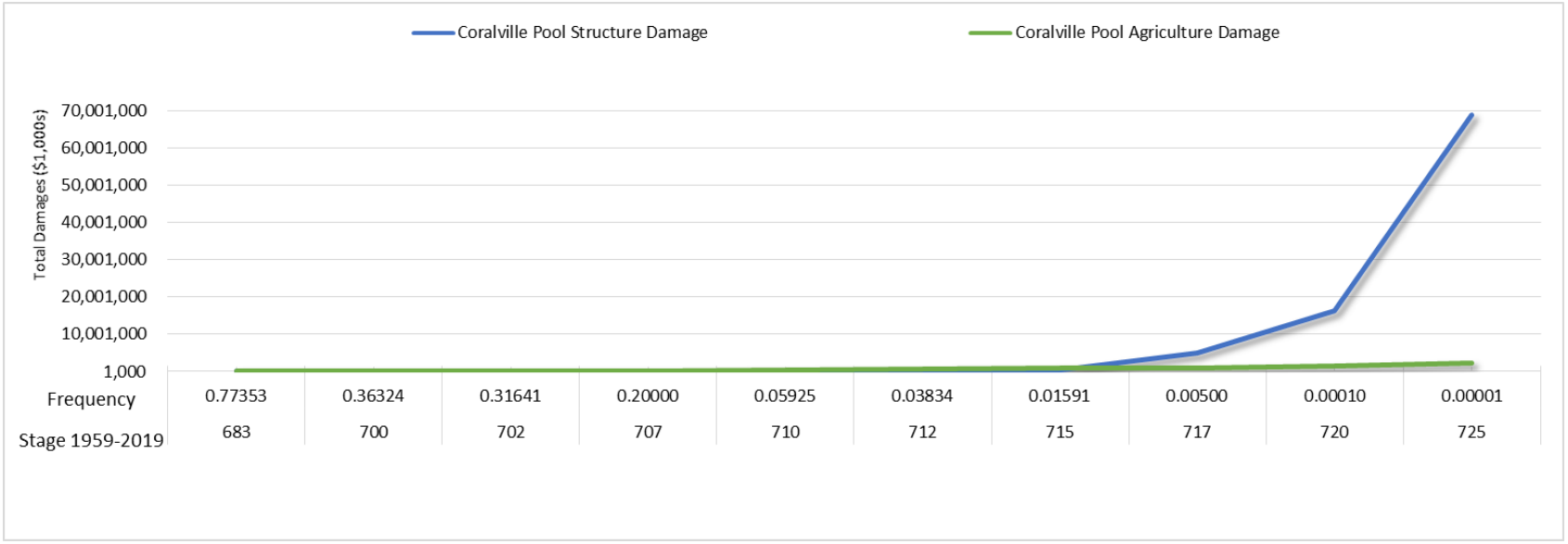

Figure C-5. Alternative 2C 1917-2019 Coralville Pool Reach Damage-Frequency

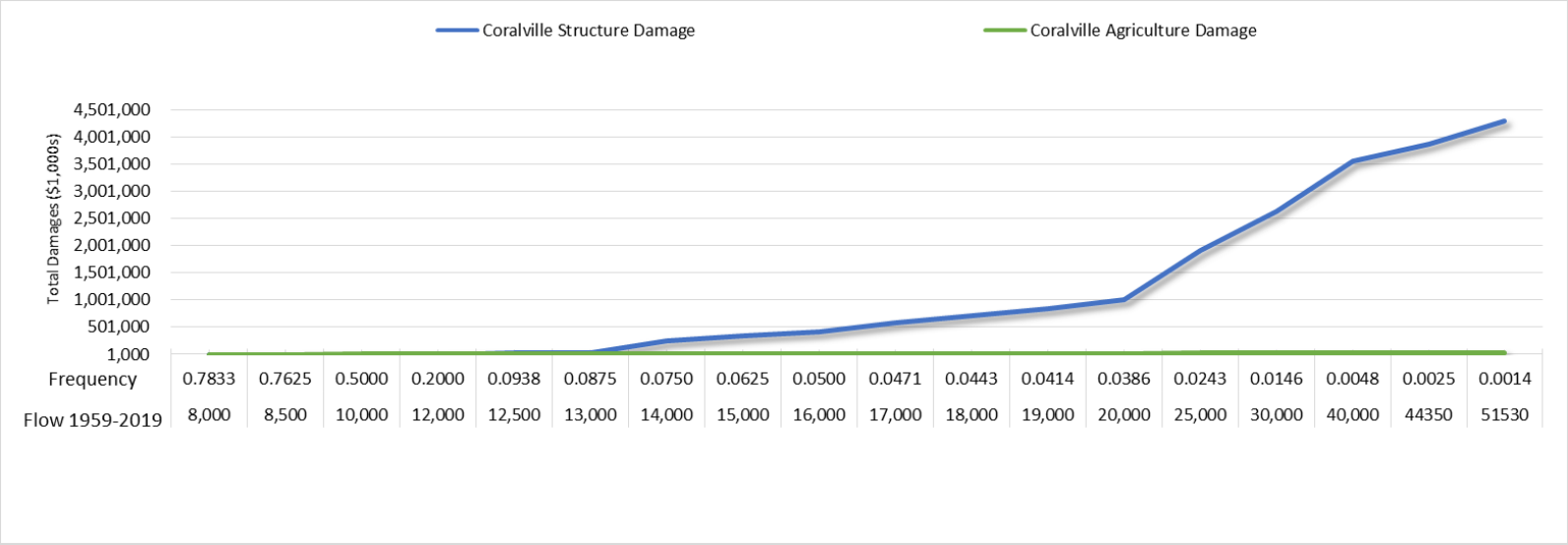

Figure C-6. Alternative 2C 1917-2019 Coralville Reach Damage-Frequency

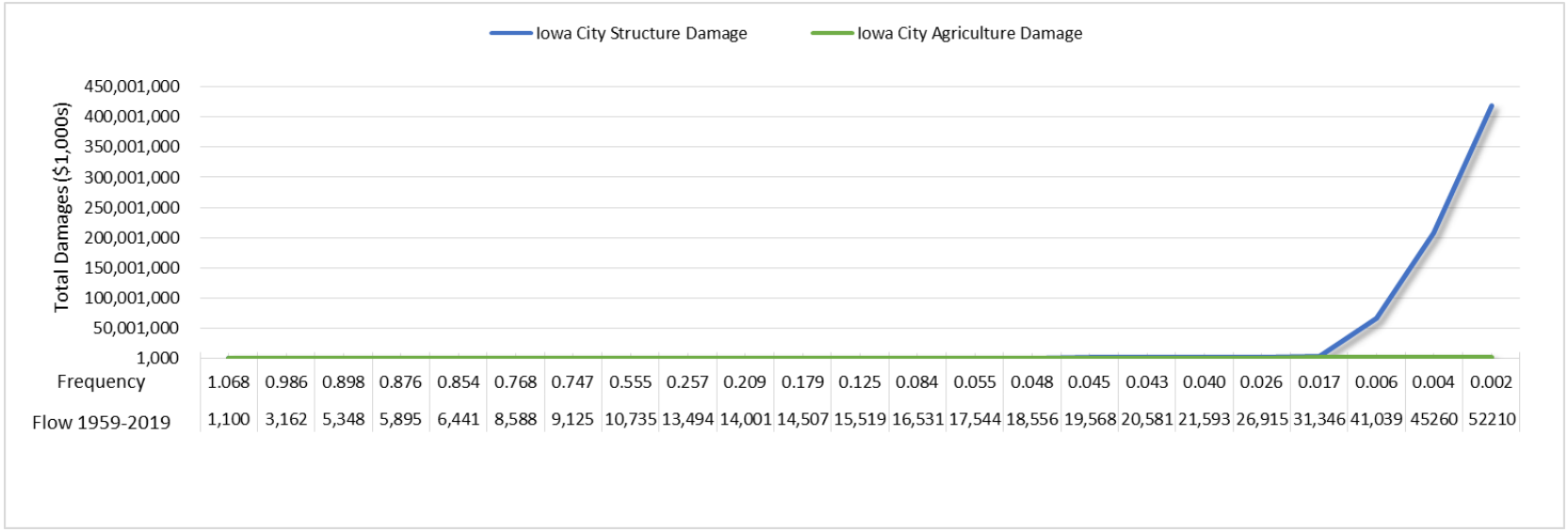

Figure C-7. Alternative 2C 1959-2019 Iowa City Reach Damage-Frequency

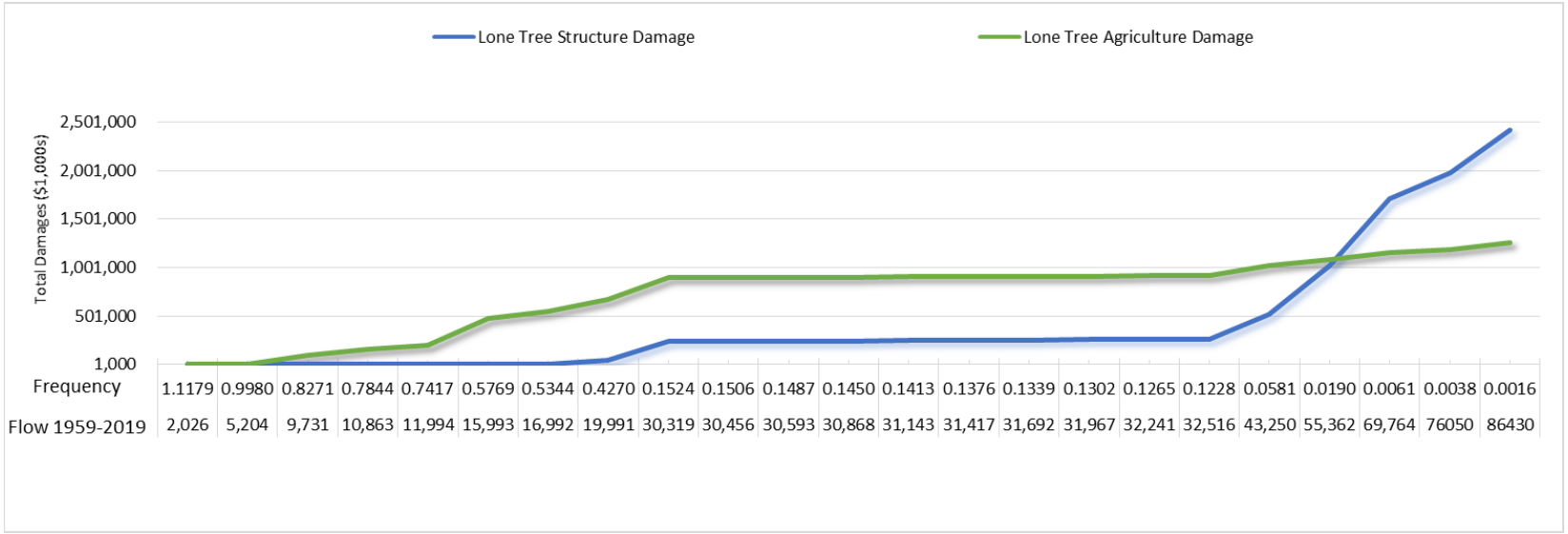

Figure C-8. Alternative 2C 1959-2019 Lone Tree Reach Damage-Frequency

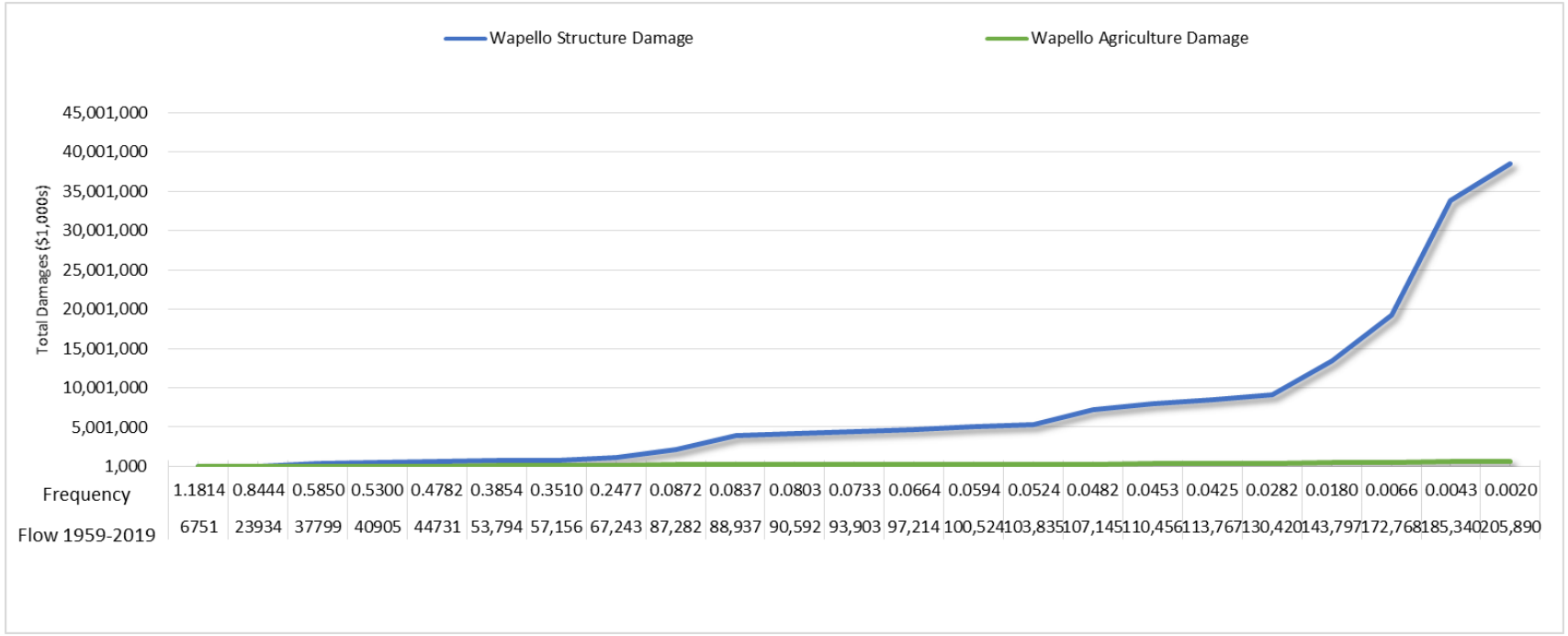

Figure C-9. Alternative 2C 1959-2019 Wapello Reach Damage-Frequency

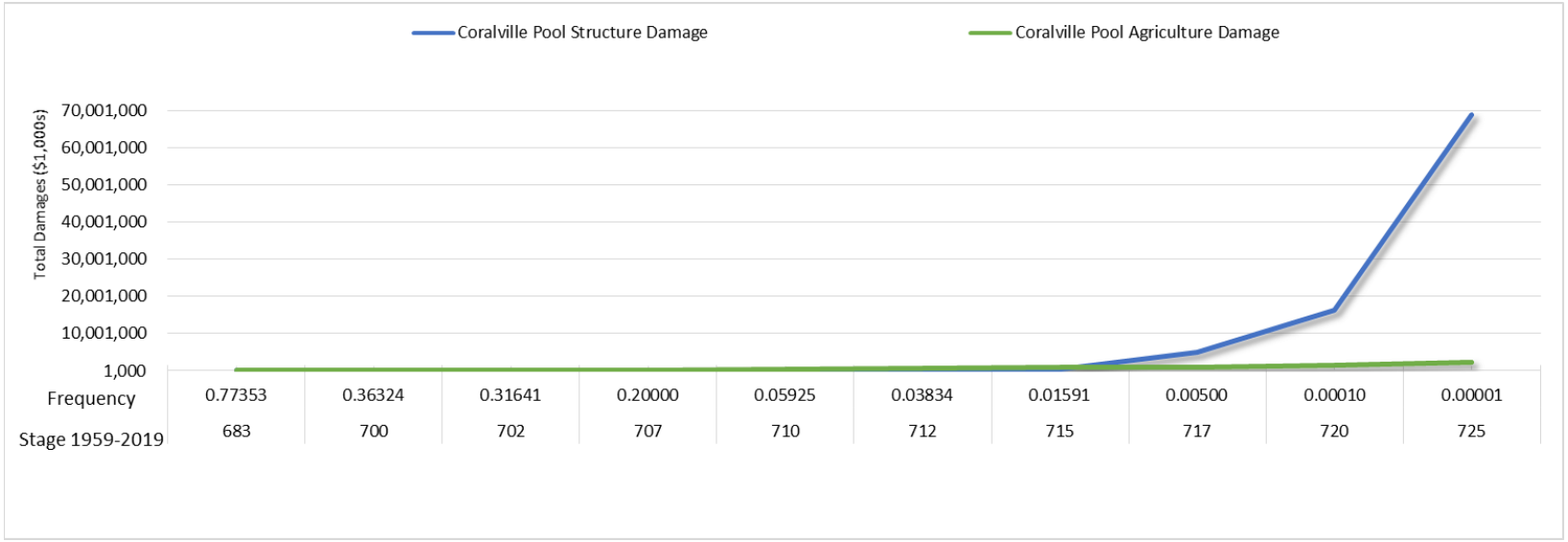

Figure C-10. Alternative 2C 1959-2019 Coralville Pool Reach Damage-Frequency

IX. FLOOD IMPACT ANALYSIS ALTERNATIVE COMPARISON

The results from the HEC-FIA modeling showed Alternative 2C reduced average annual damages (AAD) more than Alternatives 1, 5 and 8 for the full period of record (1919-2019) and the abbreviated wetter period (1959-2019) for the overall system as well as in 3 of the 5 damage reaches Studied. Average Annual Damages were slightly higher in the Lone Tree reach under Alternative 2C than any of the other alternatives considered including Alternative 1. In the Wapello reach, while AAD in Alternative 2 C were slightly higher than Alternative 1, they were lower than alternatives 5 and 8. However, flood damages in the Wapello reach are influenced to a much greater degree by the Cedar River which is uncontrolled, than by the operation of Coralville Reservoir. Additionally, much of the agricultural land in the Wapello reach has been converted from production to conservation land as offered through the federal Conservation Reserve Program (CRP). Moreover, since Alternative 2C provides for a higher maximum allowable release than either alternatives 1, 5 or 8, there is flexibility to respond to potential future upward trends in precipitation and streamflow. Table C-11 shows the summary tables for the full record 1917-2019 and Table C-12 show the period of higher rainfall 1959-2019.

Table C-11. Average Annual Damage Alternative Comparison (1917-2019)

	Coralville	Iowa City	Lone Tree	Wapello	Coralville pool	Cumulative Total
	Average Annual Damages ($)					
Alt 1 1917-	103,000	976,000	434,000	999,000	270,000	2,782,000
Alt 2C 191	65,000	857,000	498,000	998,000	160,000	2,578,000
Alt 5 1917-	77,000	874,000	495,000	1,016,000	185,000	2,647,000
Alt 8 1917-	67,000	870,000	495,000	999,000	180,000	2,611,000

	Coralville	Iowa City	Lone Tree	Wapello	Coralville pool	Cumulative Total
	Average Annual Damages Reduced (From Existing Flows)					
Alt 2C 191	38,000	119,000	(64,000)	1,000	110,000	204,000
Alt 5 1917-	26,000	102,000	(61,000)	(17,000)	85,000	135,000
Alt 8 1917-	36,000	106,000	(61,000)	0	90,000	171,000

	Coralville	Iowa City	Lone Tree	Wapello	Coralville pool	Cumulative Total
	Percentage (%) Average Annual Damages Reduced (From Existing Flows)					
Alt 2C 191	58%	14%	-12.85%	0.10%	68.75%	7.91%
Alt 5 1917-	34%	12%	-12.32%	-1.67%	45.95%	5.10%
Alt 8 1917-	54%	12%	-12.32%	0.00%	50.00%	6.55%

Table C-12. Average Annual Damage Alternative Comparison (1959-2019)

	Coralville	Iowa City	Lone Tree	Wapello	Coralville pool	Cumulative Total
	Average Annual Damages ($)					
Alt 1 1959	148,000	1,840,000	587,000	1,389,000	282,000	4,246,000
Alt 2C 195	110,000	1,560,000	659,000	1,413,000	205,000	3,947,000
Alt 5 1959	122,000	1,589,000	610,000	1,434,000	255,000	4,010,000
Alt 8 1959	120,000	1,570,000	643,000	1,419,000	209,000	3,961,000

	Coralville	Iowa City	Lone Tree	Wapello	Coralville pool	Cumulative Total
	Average Annual Damages Reduced (From Existing Flows)					
Alt 2C 195	38,000	280,000	(72,000)	(24,000)	77,000	299,000
Alt 5 1959	26,000	251,000	(23,000)	(45,000)	27,000	236,000
Alt 8 1959	28,000	270,000	(56,000)	(30,000)	73,000	285,000

	Coralville	Iowa City	Lone Tree	Wapello	Coralville pool	Cumulative Total
	Percentage (%) Average Annual Damages Reduced (From Existing Flows)					
Alt 2C 195	35%	18%	-11%	-2%	38%	7.58%
Alt 5 1959	21%	16%	-4%	-3%	11%	5.89%
Alt 8 1959	23%	17%	-9%	-2%	35%	7.20%