Report to Congress for Future Water Resources Development (WRRDA 7001) Submission Package

Proposal Name: Papillion Creek Basin Flood Risk Management Feasibility Study

Submission Date: 08/10/2017

Proposal ID Number: 2fedbadd-d8a8-4dab-89a2-d8ab307f69de

Purpose of Proposal: The purpose of the feasibility study is to identify a comprehensive solution to reduce flood damage risks and restore degraded ecosystem habitats in the 400 sq. mi. Basin. The Basin includes Omaha and over 1/3 of the State's population. The Basin is prone to flooding and experiences continued u rbanization. The Papio Missouri River NRD and the Papillion Creek Watershed Partnership (PCWP) hav e worked since 2001 toward a solution to address flood risks. This study will evaluate engineering, economi c and environmental data in applying an approach utilizing structural and non-structural flood risk reducti on and habitat restoration to reduce risks and improve resiliency. Relevant USACE missions include flood risk management, aquatic ecosystem restoration, and recreation. In 1971, a study was authorized through 2 resolutions adopted by the U.S. Senate/House Committees on Public Works. The resolutions called for r eview of the Reports of the Chief of Engineers on the Missouri River and Tributaries and referenced provid ing an Omaha plan. Prior to authorization, NRD and Omaha joined with USACE to develop a Comprehe nsive Plan (1967) to reduce flood risks in response to catastrophic flooding in 1959, 1964 and 1965 that res ulted in 7 fatalities. The Plan was partially implemented, including 4 of 21 flood controls authorized in the original plan and 6 levees, until it was deauthorized due to lack of local support. Federal funding is neede d to provide solutions to address flood risks and improve resiliency. NRD worked with surrounding munici palities through PCWP to develop the Papillion Creek Watershed Management Plan that outlines projects and management practices to reduce flood risks. As a result, NRD has implemented projects, including ad ded flood control structures, water quality basins, and levee systems. An updated hydrologic analysis foun d greater peak discharges and runoff volumes, resulting in a higher flood risk in the Basin, and heightened need to complete an evaluation

1. Administrative Details

Proposal Name: Papillion Creek Basin Flood Risk Management F easibility Study

by Agency: Papio-Missouri River Natural Resources District

Locations: NE

Date Submitted: 08/10/2017

Confirmation Number: 2fedbadd-d8a8-4dab-89a2-d8ab307f69de

Supporting Documents

File Name	Date Uploaded
Annual Section 7001 report Support letter 080817 Ralston.pdf	08/10/2017
Attachment B-2014-Papio-Watershed-Update-Executive Summary.pdf	08/10/2017
Sarpy County letter of support.pdf	08/10/2017
Attachment C-FRM-Fact-Sheet-PAPILLIONCREEK-NWD-28APR16.pdf	08/10/2017
Omaha support letter.pdf	08/10/2017
20170809-Vicinity Map Papillion Creek Basin.pdf	08/10/2017
Attachment D-FloodRiskReport-BigPapillionMosquito.pdf	08/10/2017
Attachment E-2017 Econ Study FYRA Engineering.pdf	08/10/2017
20170809-ProposedPapioCreekBasinStudyAreaMap11x17.pdf	08/10/2017
USACE support letter Gretna.pdf	08/10/2017
NRD letter of support.pdf	08/10/2017
USACE Support Letter-La Vista-Section 7001Study-20170803.pdf	08/10/2017
Attachment A-2009 Papillion Creek Watershed Plan Executive Summary.pdf	08/10/2017

2. Provide the name of the primary sponsor and all non-Federal interests that have contributed or are expected to contribute toward the non-Federal share of the proposed feasibility study or modification.

Sponsor	**Letter of Support**
Papio-Missouri River Natural Resourc es District(Primary)	The Papio-Missouri River Natural Resources District (NR D) has had a mission since 1972 to wisely conserve, manag e and enhance the soil, water, wildlife, and forest resource s for the good of all people residing within the District's b oundaries. The NRD along with its non-Federal partners of the Papillion Creek Watershed Partnership (PCWP) in cluding the Cities of Bellevue, Boys Town, Gretna, La Vis ta, Omaha, Papillion, Ralston, and Sarpy County have wo rked since 2001 to develop a watershed plan to address wa ter quantity and water quality for the Papillion Creek Bas in. Implementation of the plan began in 2009 and to dat e over $100 million dollars has been spent by the NRD an d PCWP members. These expenditures demonstrate that the commitment and local support exist to address import ant water issues in the basin. The planning efforts for th e Papillion Creek Basin to date are provided as supportin g documentation in Attachment A, Executive Summary of the Papillion Creek Watershed Management Plan 2009, a nd Attachment B, Executive Summary of the Papillion Cr eek Watershed Management Plan Update 2014. The NR D and partners support and will provide valuable data to leverage for a new feasibility study of flood risk in the Pap illion Creek Basin.
City of Gretna	Gretna is a member of the Papillion Creek Watershed Par tnership
City of La Vista	La Vista is a member of the Papillion Creek Watershed P artnership
City of Ralston	Ralston is a member of the Papillion Creek Watershed Pa rtnership
Sarpy County	Sarpy County is a member of the Papillion Creek Waters hed Partnership
City of Omaha	Omaha is a member of the Papillion Creek Watershed Par tnership

3. State if this proposal is for a feasibility study, a modification to an authorized USACE feasibility study or a modification to an authorized USACE project. If it is a proposal for a modification, provide the authorized water resources development feasibility study or project name.

[x] Feasibility Study

4. Clearly articulate the specific project purpose(s) of the proposed study or modification. Demonstrate that the proposal is related to USACE mission and authorities and specifically address why additional or new authorization is needed.

The purpose of the feasibility study is to identify a comprehensive solution to reduce flood damage risks an d restore degraded ecosystem habitats in the 400 sq. mi. Basin. The Basin includes Omaha and over 1/3 o f the State's population. The Basin is prone to flooding and experiences continued urbanization. The Papi o Missouri River NRD and the Papillion Creek Watershed Partnership (PCWP) have worked since 2001 to ward a solution to address flood risks. This study will evaluate engineering, economic and environmental d ata in applying an approach utilizing structural and non-structural flood risk reduction and habitat restora tion to reduce risks and improve resiliency. Relevant USACE missions include flood risk management, aq uatic ecosystem restoration, and recreation. In 1971, a study was authorized through 2 resolutions adopte d by the U.S. Senate/House Committees on Public Works. The resolutions called for review of the Reports of the Chief of Engineers on the Missouri River and Tributaries and referenced providing an Omaha plan. Prior to authorization, NRD and Omaha joined with USACE to develop a Comprehensive Plan (1967) to r educe flood risks in response to catastrophic flooding in 1959, 1964 and 1965 that resulted in 7 fatalities. T he Plan was partially implemented, including 4 of 21 flood controls authorized in the original plan and 6 le vees, until it was deauthorized due to lack of local support. Federal funding is needed to provide solutions to address flood risks and improve resiliency. NRD worked with surrounding municipalities through PCW P to develop the Papillion Creek Watershed Management Plan that outlines projects and management pra ctices to reduce flood risks. As a result, NRD has implemented projects, including added flood control stru ctures, water quality basins, and levee systems. An updated hydrologic analysis found greater peak discha rges and runoff volumes, resulting in a higher flood risk in the Basin, and heightened need to complete an e valuation

5. To the extent practicable, provide an estimate of the total cost, and the Federal and non-Federal share of those costs, of the proposed study and, separately, an estimate of the cost of construction or modification.

	Federal	**Non-Federal**	**Total**
Study	$1,500,000	$1,500,000	$3,000,000
Construction	$115,000,000	$115,000,000	$230,000,000

Explanation (if necessary)

The anticipated costs for the feasibility study are intended to be a maximum as the NRD and local partner s have considerable information to leverage. Lidar data exists in the entire watershed and is updated ever y six years, hydrology has recently been updated for the Papillion Creek Basin and detailed hydraulics are in progress as part of a Federal Emergency Management Agency flood mapping project. This along with o ther information from previous watershed planning efforts would help to further the efforts of the local age ncies to address a comprehensive solution to the existing flood risk and ecosystem degradation. The const ruction costs to implement the feasibility study are estimated from current watershed planning efforts. At tachment B includes estimated costs to complete the current watershed plan which includes a number of fl ood control reservoirs and water quality basins. The results of the proposed feasibility study would deter mine if those projects and costs continue to be applicable and appropriate.

6. To the extent practicable, describe the anticipated monetary and nonmonetary benefits of the proposal including benefits to the protection of human life and property; improvement to transportation; the national economy; the environment; or the national security interests of the United States.

The study will investigate and identify a system-wide plan to reduce flood risk and improve ecosystem func tions directly contributing benefits to the Nation, the Midwest, and Omaha. The population at risk is appr ox. 25,000 in the current 1% floodplain. Severe to catastrophic flooding would have far-reaching effects on over 100,000 people due to infrastructure, power, transportation, and business disruptions. Urbanization of the basin has caused the Papillion Creek to experience recurring floods with warning times of only 4-6 hour s. During severe floods, large portions of the floodplain experience flood depths over 6 feet (some 10-14 feet). Preliminary analysis identified at least 3 police and 3 fire stations, 1 hospital, 2 schools, 1 municipal offic e, 5 water and sewer facilities, and 2 electrical substations within the floodplain. An on-going FEMA Risk MAP project inventoried $1.6 billion of development in the 1% floodplain and computed average annual da mages at $24.2 million using HAZUS (Attach. D). A 2017 NRD study quantified the total average annual benefits from flood risk reduction and recreation at $11.1 million (Attach. E). Expected benefits include t he protection of life and property, and improvements to transportation and other public infrastructure thro ugh reduced risk of flooding. Expected benefits to the environment include reestablishing the riparian funct ion of the Papillion Creek and its tributaries, as well as reduced stream degradation. With effective flood ri sk measures and floodplain regulations, mapped floodplains can be reduced with an average annual savings of $7.2 million in flood insurance premiums realized (Attach. E). In addition, STRATCOM is located on Offutt AFB in Bellevue, which is within the Papillion Creek and the Missouri River floodplains. The AFB is protected by a system of Federal levees. STRATCOM serves an instrumental role in our national defens e and security interests and provides a large economic benefit to Omaha.

7. Does local support exist? If 'Yes', describe the local support for the proposal.

[x] Yes

Local Support Description

Nine of the twelve communities within the Papillion Creek Basin along with the NRD have worked togethe r since 2001 through the Papillion Creek Watershed Partnership (PCWP) to design a strategy and implem ent a watershed plan addressing water quantity and water quality. The interlocal agreement that outlines responsibilities and implementation of the watershed plan is voted on by each municipality's respective Bo ard or Council on a five year term. The longevity of the agreement shows the local support along with the actions taken by communities within the basin to protect water quality through development restrictions a nd stormwater ordinances. The PCWP and NRD have made significant financial contributions in the wat ershed demonstrating local support however federal funding is necessary to continue to implement a flood r isk and ecosystem restoration plan before full development of the basin.

8. Does the primary sponsor named in (2.) above have the financial ability to provide for the required cost share?

[x] Yes

Other Non-Federal Sponsors Letter(s) of Support

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Annual Section 7001 report Support letter 080817 Ralston.pdf

RALSTON
NEBRASKA
INDEPENDENCE CITY

MAYOR
Donald A. Groesser

CITY COUNCIL
Maureen Konwinski
Lee Fideline
Craig Alberhasky
Jerry Krause
Michael Sanchez
Ben Preis

July 26, 2017

Robert M. Speer
Acting Secretary of the Army
US Army Corps of Engineers
Submitted online

RE: Proposal from Non-Federal Sponsor for inclusion in the Annual Section 7001 Report to Congress for WRRDA – Papillion Creek Basin Flood Risk Management Feasibility Study

Dear Mr. Speer,

This letter is to document our support and financial commitment for the development and implementation of the Papillion Creek Basin Flood Risk Management Feasibility Study. As a member of the Papillion Creek Watershed Partnership (Partnership), Ralston supports the proposal for a comprehensive watershed feasibility study to build upon the existing watershed planning and identify projects to reduce flood risks and restore the degraded ecosystem habitats in the basin. Since 2001, we have been a part of the Partnership to address these concerns.

Development in the watershed is rapidly changing what is left of the rural landscape and the need to implement projects to address flood risk and protect natural resources is critical. Because of this need, Ralston has contributed to the Partnership financially to develop watershed management plans in 2009 and an update in 2014 as well as a commitment through ordinances to collect development fees as a way to help fund the high cost of implementing flood risk projects.

The Papio-Missouri River Natural Resources District (P-MRNRD) is the administering agent for the Partnership and is the lead on this proposal. The P-MRNRD intends to fund the local share of the feasibility study; however, Ralston remain committed to contributions through the Partnership to assess the watershed and implement projects.

On behalf of the citizens and business community, Ralston gives it full support for the P-MRNRD's proposal and urge the US Army Corps of Engineers to recognize the importance and need to support and funding this important project.

Sincerely,

Dan Freshman

Dan Freshman
Public Works Director/Inspector
Ralston Nebraska

The Spirit of Independence

5500 South 77th Street
Ralston, NE 68127-3896
(402) 331-6677
Fax (402) 331-4553
E-mail: city hall@cityofralston.com

Additional Proposal Information

(This is as uploaded, a blank page will show if nothing was submitted)

Attachment B_2014_Papio_Watershed_Update_Executive Summary.pdf

Papillion Creek Watershed Management Plan

March 2014 Update

Papillion Creek Watershed Partnership

HDR | ONE COMPANY *Many Solutions*℠

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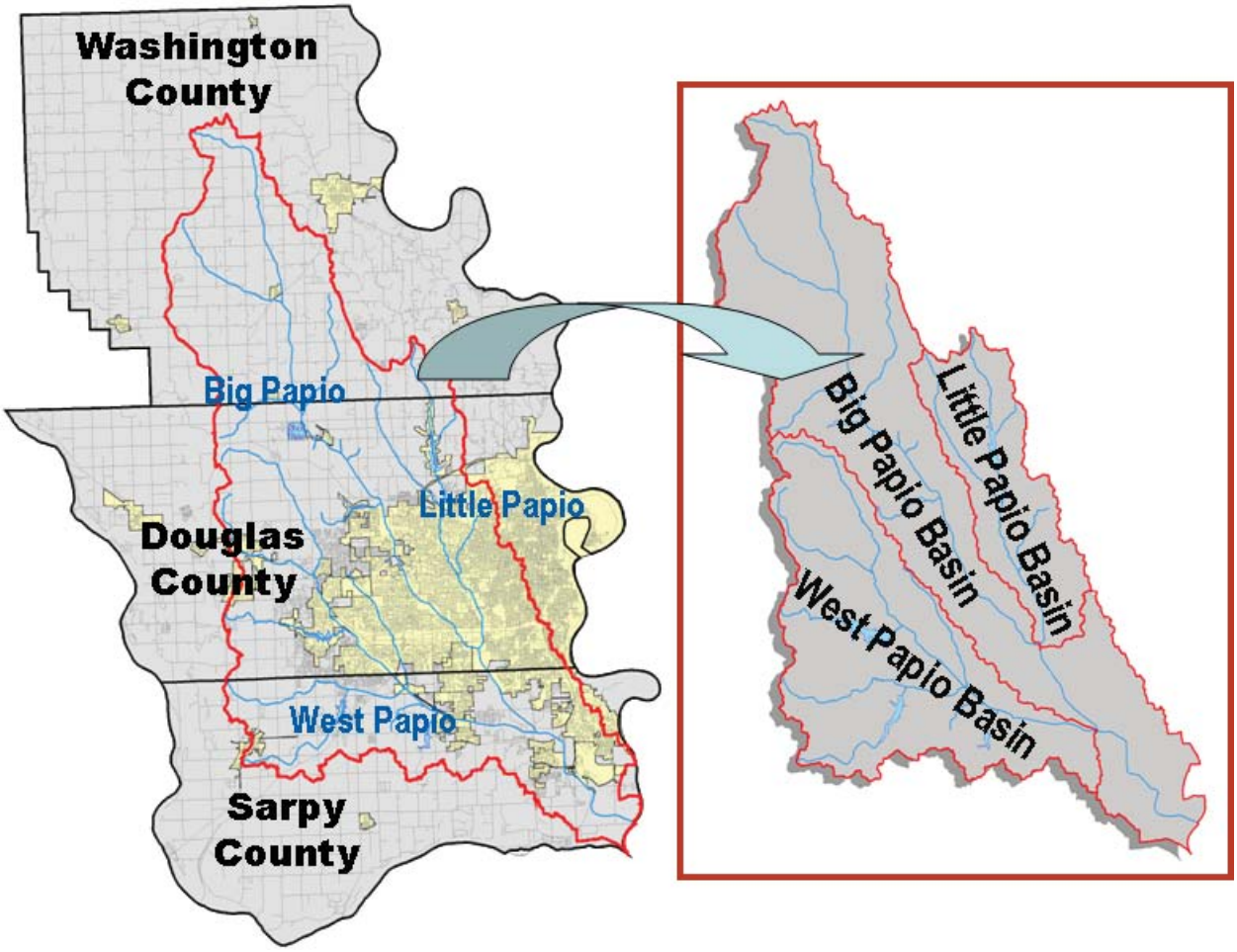
Executive Summary

E.1 Background and Purpose

Improved stormwater management within the Papillion Creek Watershed (Watershed) has been the on-going objective of the Papillion Creek Watershed Partnership (PCWP) since its formation in August 2001. The Watershed covers approximately 402 square miles of drainage area extending from northern Washington Country southward through Douglas and Sarpy Counties and ultimately discharges to the Missouri River south of Bellevue – see Figure E-1. PCWP members presently consist of the cities of Bellevue, Boys Town, Gretna, La Vista, Omaha, Papillion, and Ralston; Sarpy County; and the Papio-Missouri River Natural Resources District (P-MRNRD).

Figure E-1 Papillion Creek Watershed



It is the desire of the PCWP to review and update the Watershed Fees framework and rates, the Watershed Management Plan, and the Implementation Plan with respect to availability of needed funds and rate of development within the Watershed every 3 to 5 years. This 2014 Update represents the first effort to update the implementation plan. The 2014 Update is intended to provide interim progress updates for the various management practices. Specifically, the financial needs for the entire list of remaining structural projects were evaluated so that the PCWP could reach consensus for the necessary long-term and near-term strategies, including defining the Program structural projects for the next 2014 to 2018 planning period.

E.2 2014 Review and Update

The following text summarizes the general efforts and findings from the 2014 Update:

Water Quality Evaluation: The Nebraska Department of Environmental Quality (NDEQ) updated its various water quality impairment listings in 2012 for area lakes and stream segments. There are a number of new water body impairment listings, including nutrients (Total Nitrogen and Total Phosphorus) and Chlorophyll "a" in four of the existing area lakes. Additional details are covered in this 2014 Update and in Appendix A.

Peak Flow Reduction Evaluation: No additional technical analyses were conducted for the 2014 Update; however, a summary of interim activities within the Watershed was provided:

- The U.S. Army Corps of Engineers (USACE) updated the hydrologic analyses for the Papillion Creek Watershed.
- The National Oceanic and Atmospheric Administration (NOAA) derived new precipitation data that included some statistical increases. In particular, the 100-year, 24-hour precipitation increased from 6.7 inches to 7.0 inches

Status of 2009-2013 Watershed Implementation Plan: Projects identified in the 2009 Watershed Management Plan as Program Projects are listed in Table E-1. The Papio-Missouri River NRD (P-MRNRD) constructs the projects on behalf of the PCWP. Table E-1 provides an updated current completion status and cost obligations of the 2009-2013 Program Projects. The currently estimated completion costs of the structures are nearly $40 million which is less than estimated in the 2009 Plan. This was primarily due to reconfiguration of the water quality basins upstream of WP-5 and DS 15A.

Proposed Watershed Management Plan: The Watershed Management Plan Update deals primarily with the continuation of how to implement the remaining water quality and structural flood control projects. Table E-2 shows the proposed list of remaining structural projects, along with updated estimated capital costs. The project sequencing for some water quality basins has changed to reflect recent changes in development interest, management priorities, and financial constraints. Figure E-2 shows the locations of the remaining structural projects.

Financial modeling was conducted for eight project funding scenarios. Each modeling scenario identified the number of remaining structural projects that could likely be completed within the next 35-year planning period from 2014 to 2049. The following components provided inputs to the financial modeling scenarios:

- Updated land use maps to help establish spatial relationships of existing and future development relative to the approximate timing of remaining structural projects.
- Updated population and land use projections. Progressive land consumption from development forms the basis for Watershed Management Fee (Watershed Fee) revenue

Table E- 1 Status of 2009 Program Projects for Years 2011 to 2013

Structure Name	Approx. Location & Planning Jurisdiction	Drainage Area (acres)	Estimated Project Funding Sources (Millions of $)				Current Status
			Bonding	General Fund	Watershed Fees	Total Est, Project Cost	
WP-5 and Associated Water Quality Basins [1]	126th & Cornhusker Road; Papillion	3,310	$18.5	$17.4	$0	$35.9	Under Construction; Est. June 2014 Completion
DS 15A and Associated Water Quality Basin [2]	168th & Fort Streets; Omaha	7,100	$42.6	$1.2	$0	$43.8	Design In Progress; Est. Fall 2014 Construction Start and 2015 Completion.
WQ-Zorinsky 1	Upstream of Zorinsky Lake; Omaha	1,660	$1.5	$1.3	$1.4	$4.2	Design Complete; Est. Spring 2014 Construction Start and Completion in 2014
WQ-CL-6	Upstream of Cunningham Lake; Omaha	510					Deferred.
		Totals:	$62.6	$19.9	$1.4	$83.9	

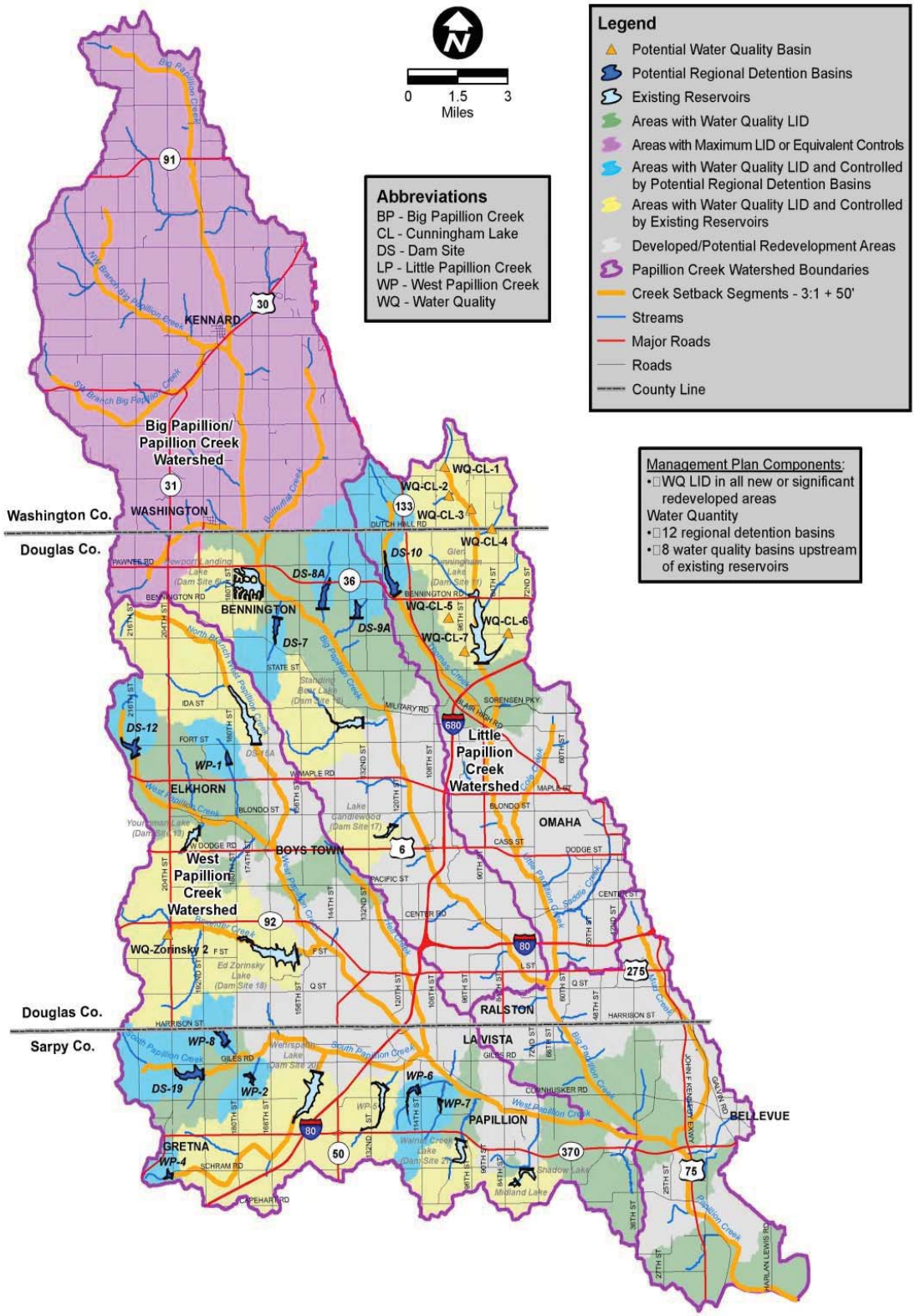
Notes:

[1] Original single basin concept revised to two basins.
[2] Original two basin concept revised to form a single basin.

Table E- 2 Summary of Estimated Capital Costs for Remaining Projects

Structure Name	Stream Reach	Approx. Location/Jurisdiction	Drainage Area (Acres)	Est. Project Costs, 2013 Basis	
				Est. Normal Pool Area (Acres)	Total Est. Project Capital Costs, $ Millions
WP-6	Trib. to Unnamed West Papillion Trib.	114th & Cornhusker Road; Sarpy Co.	1,260	32	$11.6
WP-7	Trib. to Unnamed West Papillion Trib.	108th & Cornhusker Road; Sarpy Co.	450	12	$6.4
WP-4	Trib. to South Papillion	204th & Schram Road; Gretna	563	16	$9.9
DS 19	South Papillion Creek	192nd & Giles Road; Sarpy Co.	2,750	100	$23.7
WP-8	Trib. to South Papillion	180th & Harrison St.; Douglas & Sarpy Co.	1,470	45	$11.0
WP-2	Trib. to South Papillion	180th & Giles Road; Sarpy Co.	679	21	$9.9
WP-1	Trib. to West Papillion	180th & Fort St., Omaha	864	24	$13.7
DS 12	West Papillion Creek	216th & Fort Streets; Douglas Co. & Omaha	1,670	70	$20.7
DS 10	Thomas Creek	120th & Bennington Road; Omaha	2,950	97	$23.2
DS 7	Trib to Big Papillion	168th & Bennington Road, Bennington & Omaha	1,600	47	$13.8
DS 9A	Trib to Big Papillion	132nd & Bennington Road, Omaha	1,280	38	$10.5
DS 8A	Trib to Big Papillion	144th St. & Bennington Road, Bennington	1,850	75	$15.6
				Regional Detention Subtotal	$169.9
WQ-CL-6	Upstr. Existing Cunningham Lake	Omaha	510		$9.5
WQ-Zorinsky 2	Upstr. Existing Zorinsky Lake	Omaha	1,000		$9.9
WQ-CL-5	Upstr. Existing Cunningham Lake	Omaha	470		$9.1
WQ-CL-7	Upstr. Existing Cunningham Lake	Omaha	200		$7.0
WQ-CL-4	Upstr. Existing Cunningham Lake	Omaha & Washington Co.	915		$14.2
WQ-CL-2	Upstr. Existing Cunningham Lake	Washington Co.	845		$13.7
WQ-CL-3	Upstr. Existing Cunningham Lake	Washington Co.	790		$13.3
WQ-CL-1	Upstr. Existing Cunningham Lake	Washington Co.	740		$13.3
				Water Quality Basins Subtotal	$ 89.9
				Total Regional Detention and Water Quality Basins	$ 259.8

Figure E- 2 2014 Watershed Management Plan Update for Full Build-Out Conditions



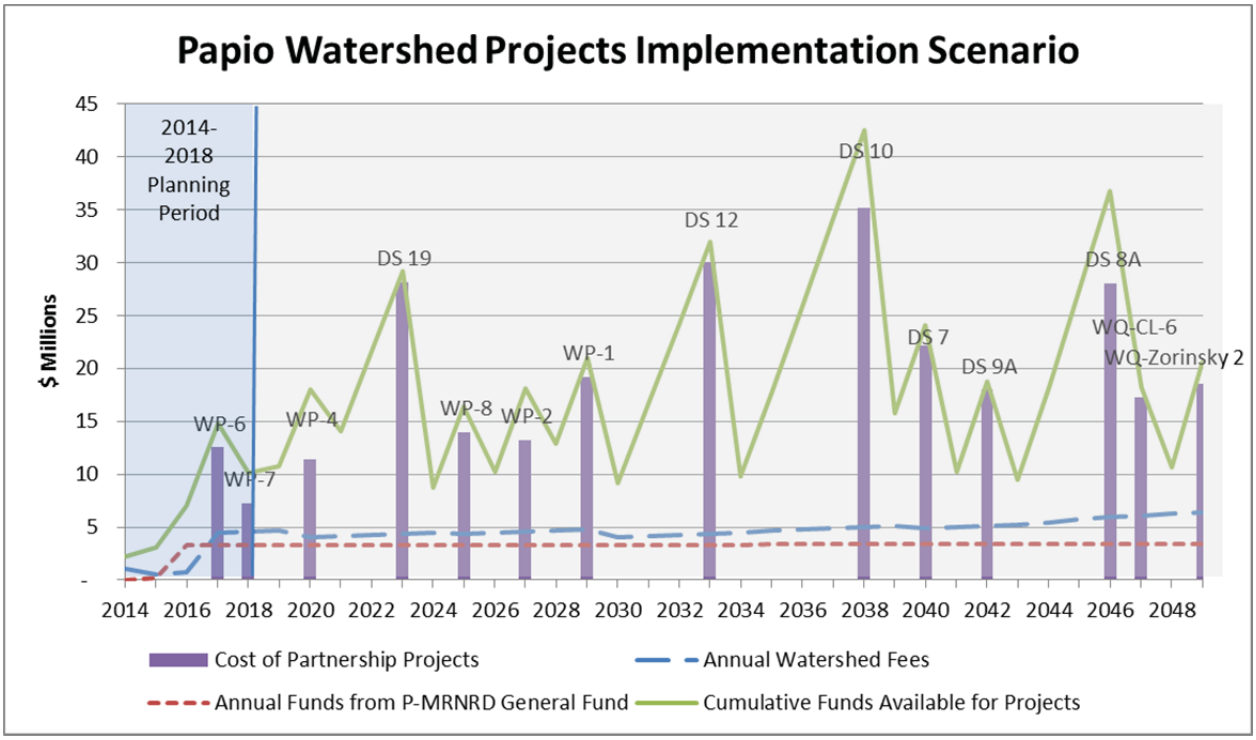
stream projections. Watershed Fees are assessed to developers and home builders based on projected capital costs for structural projects, projected land consumption, and the underlying intent to maintain a ratio of 1/3 private to 2/3 public financing for the overall structural program projects as per Root Policy Group #6 in Appendix C.

- The Papio-Missouri River Natural Resources District (P-MRNRD) Long-Range Implementation Plan (LRIP). This document formed the basis for probable available General Fund allocations for structural projects.
- Annual bond repayment obligations. Current P-MRNRD bond obligations are approximately $5 million per year for three existing bonds totaling approximately $71.5 million that will expire in 2032, 2033, and 2034 respectively. Approximately $10 million in remaining bonding capacity exists and was also considered.
- The Program Project planning period was changed by the PCWP from 3 years to 5 years; the latter of which will now result in a 2014 to 2018 time frame.

2014-2018 Implementation Plan: The Implementation Plan addresses proposed Program Projects and funding needs for the 2014 to 2018 planning period as follows:

- Financial and administrative needs to implement the proposed Program Projects were identified.
- A number of scenarios were studied to help identify a reasonable revenue generation strategy to fund the Program Projects. Figure E-3 depicts Project Funding Scenario 1A as a reasonable baseline means for project financing using pay-as-you-go (P-A-Y-G) General Fund allocations at the existing P-MRNRD mill levy, along with the proposed Watershed Fee Schedule. Under this funding strategy, all twelve (12) of the remaining regional detention basin projects could potentially be implemented, along with two (2) of the eight (8) remaining water quality basin projects.

Figure E- 3 Scenario 1A: P-A-Y-G with Existing Mill Levy and Dedicated General Fund Allocation per LRIP, Begin 2016



- Table E-3 identifies the two structural projects that were selected by the PCWP for the 2014 to 2018 Implementation Plan and their projected costs.

Table E- 3 Watershed Management Plan Program Projects for Years 2014 to 2018

Structure	Approx. Location & Planning Jurisdiction	Drainage Area (acres)	Est. Project Capital Costs, 2014 Basis, $ Millions
WP- 6	114th & Cornhusker Road; Sarpy County	1,260	$11.6
WP- 7	108th & Cornhusker Road; Sarpy County	450	$6.4
		Total	**$18.0**

Note: The abbreviation "WP" = West Papillion Creek Watershed.

- Table E-4 contains the schedule of Watershed Fees selected by PCWP for the 2014 to 2018 planning period.

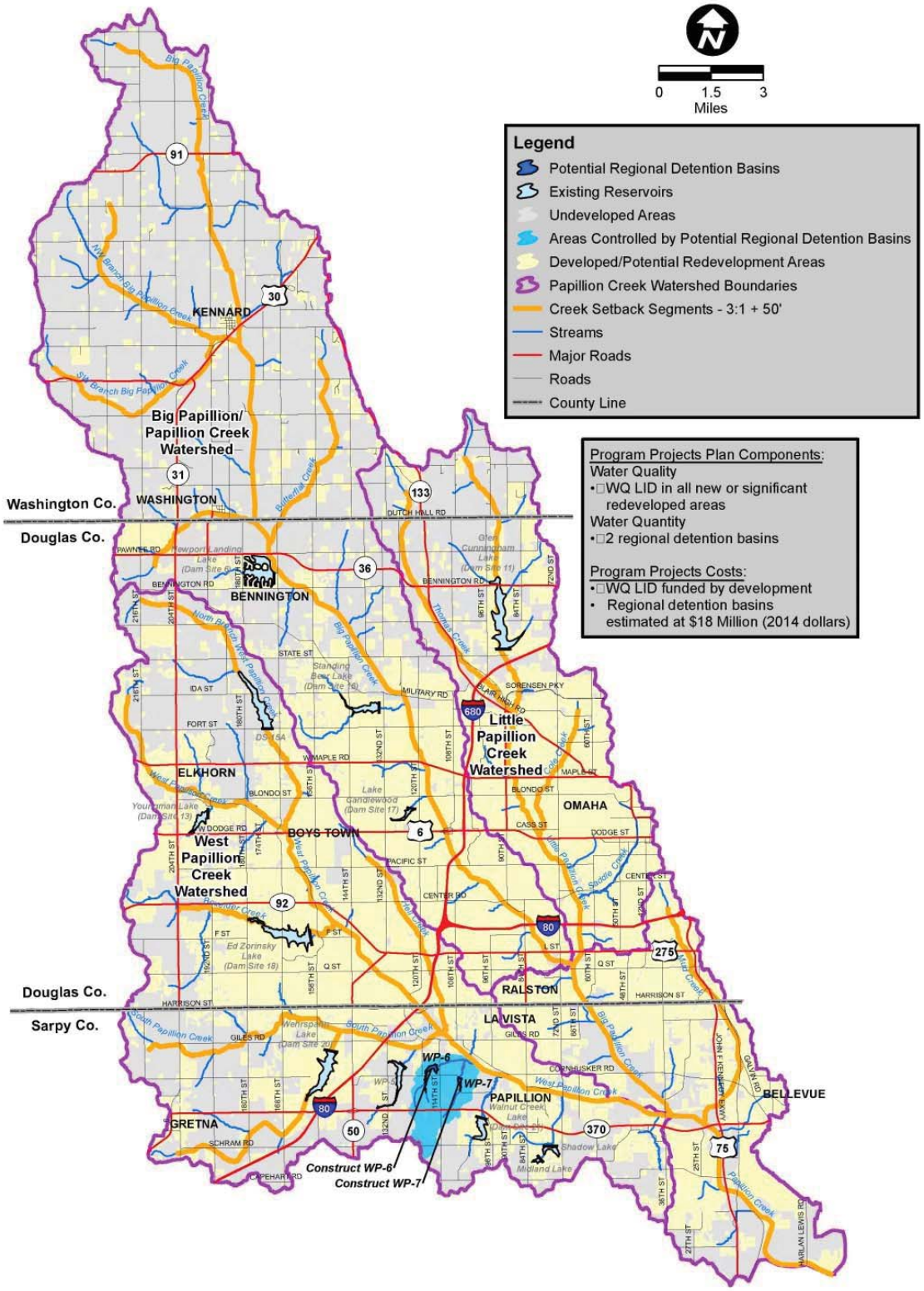
Table E- 4 Schedule of Watershed Fees for Years 2014 to 2018

Fee Category	Current Developer Fee Amounts	2014	2015	2016	2017	2018
Single Family Residential (also includes low-density multi-family up to 4-plexes)	$750 per lot (same as per Housing Unit or per Dwelling Unit)	$823	$843	$864	$886	$908
High-Density Multi-Family Residential (beyond 4-plexes)	$3,300 per Gross Developable Acre	$3,619	$3,710	$3,803	$3,898	$3,995
Commercial/Industrial	$4,000 per Gross Developable Acre	$4,387	$4,497	$4,609	$4,724	$4,842

Note: The annual increase for 2015 to 2018 is 2.5 percent per year.

- Figure E-4 represents the Implementation Plan that depicting the locations for the proposed two Program Projects for the 2014 to 2018 planning period.

Figure E-4 Papillion Creek Watershed Implementation Plan (Years 2014 to 2018)



Other Non-Federal Sponsors Letter(s) of Support

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Sarpy County letter of support.pdf

Sarpy County Board of Commissioners

1210 GOLDEN GATE DRIVE
PAPILLION, NE 68046-2895
593-4155
www.sarpy.com
ADMINISTRATOR Dan Hoins
DEPUTY ADMINISTRATOR Scott Bovick
FISCAL ADMIN./PURCHASING AGT. Brian Hanson

COMMISSIONERS
Don Kelly District 1
Jim Thompson District 2
Brian Zuger District 3
Gary Mixan District 4
Jim Warren District 5

July 28, 2017

Robert M. Speer
Acting Secretary of the Army
US Army Corps of Engineers
Submitted online

RE: Proposal from Non-Federal Sponsor for inclusion in the Annual Section 7001 Report to Congress for WRRDA – Papillion Creek Basin Flood Risk Management Feasibility Study

Dear Mr. Speer,

This letter is to document our support and financial commitment for the development and implementation of the Papillion Creek Basin Flood Risk Management Feasibility Study. As a member of the Papillion Creek Watershed Partnership (Partnership), Sarpy County supports the proposal for a comprehensive watershed feasibility study to build upon the existing watershed planning and identify projects to reduce flood risks and restore the degraded ecosystem habitats in the basin. Since 2001, we have been a part of the Partnership to address these concerns.

Development in the watershed is rapidly changing what is left of the rural landscape and the need to implement projects to address flood risk and protect natural resources is critical. Because of this need, Sarpy County has contributed to the Partnership financially to develop watershed management plans in 2009 and an update in 2014 as well as a commitment through ordinances to collect development fees as a way to help fund the high cost of implementing flood risk projects.

The Papio-Missouri River Natural Resources District (P-MRNRD) is the administering agent for the Partnership and is the lead on this proposal. The P-MRNRD intends to fund the local share of the feasibility study; however, Sarpy County remains committed to contributions through the Partnership to assess the watershed and implement projects.

On behalf of the citizens and business community, Sarpy County gives it full support for the P-MRNRD's proposal and urge the US Army Corps of Engineers to recognize the importance and need to support and funding this important project.

Sincerely,

Dan Hoins
Sarpy County Administrator
Sarpy County, Nebraska

Additional Proposal Information

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Attachment
C_FRM_Fact_Sheet_PAPILLIONCREEK_NWD_28APR16.pdf

US Army Corps of Engineers

Papillion Creek Basin, Nebraska (NWO)

Flood Risk Management Feasibility

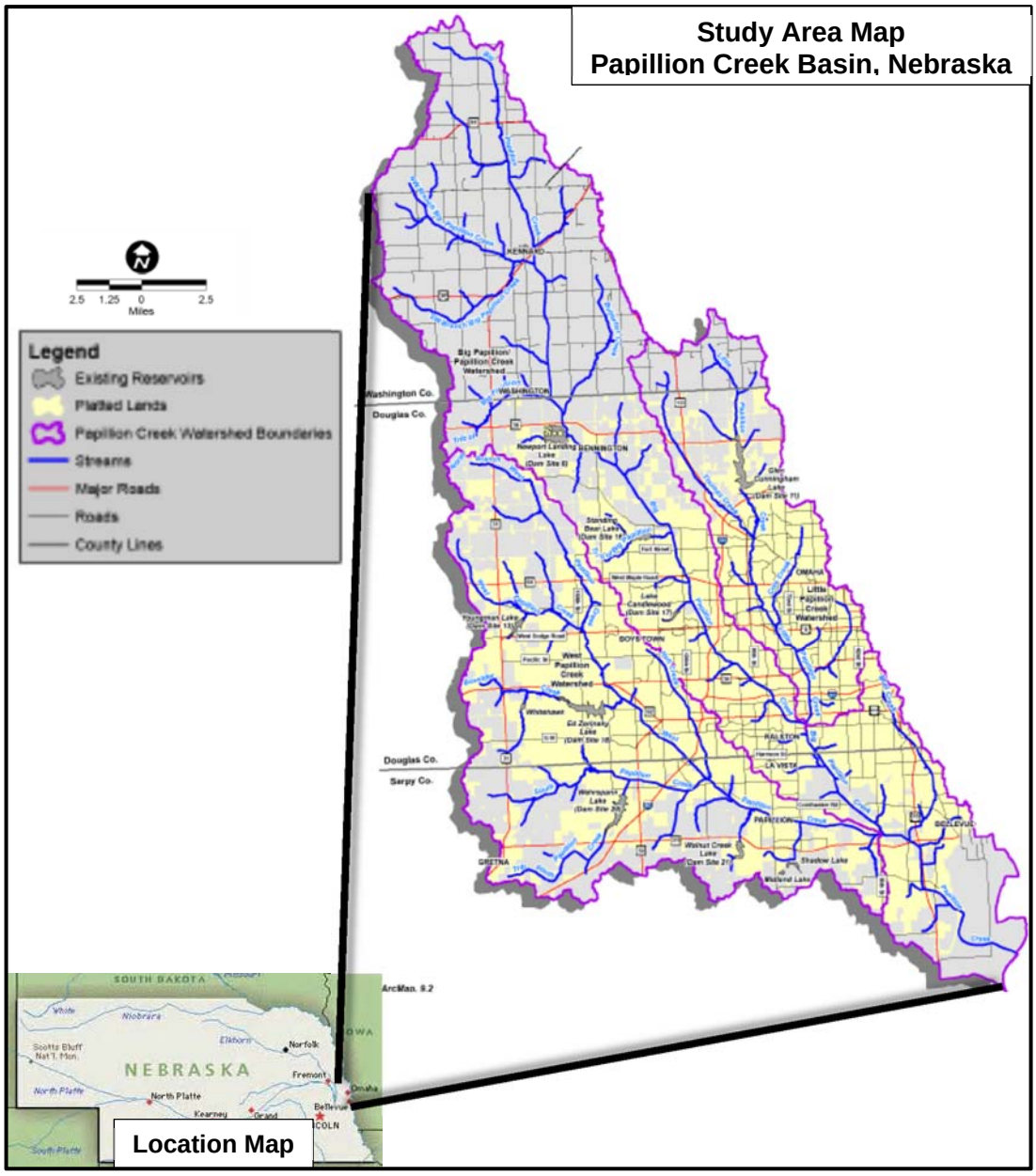
Authorization: The study authority is a pair of identical resolutions adopted by the U.S. Senate Committee on Public Works and the U.S. House of Representatives Committee on Public Works, dated May 6, 1971 and July 29, 1971, respectively. The resolutions call for a review of the Reports of the Chief of Engineers on the Missouri River and Tributaries, published as House Document 238, 73rd Congress, and other pertinent reports . . . with particular reference to providing a plan for the development, utilization and conservation of water and related land resources of the metropolitan region of Omaha, Nebraska . . . to include appropriate consideration of the needs for protecting against floods, wise use of flood plain lands, [and related purposes]; and shall be harmonious components of comprehensive development plan formulated by various [agencies].

Sponsors and Letter of Intent (LOI):
Most recent Letter of Intent was received from the Papio-Missouri River Natural Resources District (NRD) dated April 12, 2016.

Project Location Description (see Map): The Papillion Creek Basin covers 402 square miles of eastern Nebraska in Washington, Douglas, and Sarpy Counties including over 156 stream miles along the Big Papillion, Little Papillion, and West Papillion Creeks and their tributaries. The study area encompasses most of the Omaha metropolitan area with over 1/3 of the State's population. In response to catastrophic flooding in 1959, 1964, and 1965 which resulted in 7 fatalities, the NRD and City of Omaha partnered with the Corps to develop a Comprehensive Plan to reduce flood risks. The plan was approved in 1967 and partially implemented through the 1980s before being deauthorized. The portion of the federal project which was completed consists of 4 flood control dams and reservoirs (21 dams and reservoirs were authorized in the original plan) and 6 levee systems. Since the 1980s, the NRD has continued to promote aggressive flood risk management and has implemented several risk reduction projects on their own including 4 additional dams and reservoirs, several detention/retention basins, and 9 non-federal levee systems.

Problems and Opportunities: The Papillion Creek Basin and its tributaries have experienced periodic flooding for over 100 years, including severe floods in 1936, 1943, and 1946 with the most severe events occurring in 1959, 1964, and 1965. Flooding continues to occur regularly, most recently in 1994, 1997, 2004, 2008, and 2014 with one fatality each associated with the 1999, 2004, and 2014 events. Recent severe flooding in surrounding areas led the Papio-Missouri Natural Resources District (NRD) to conduct a study in 2015 to simulate and estimate impacts from an 8-inch rain over 3-days on the Papillion Creek Basin (similar to the August 2010 flood in Ames, Iowa, and the May 2015 flood in Lincoln, Nebraska). Using updated topographic mapping, land use data, and modeling and applying the Federal Emergency Management Agency's (FEMA) HAZUS damage model, the study estimated impacts of approximately $2.1 Billion in property and infrastructure damage, 13,000 acres of land inundated, and over 13,000 evacuations.

More recently a FEMA RiskMAP project that is being conducted along with revision and update of the flood insurance rate maps shows a total of 93.2 square miles in the 0.2% annual exceedance probability (AEP) floodplain (a 47% increase from the previous study). The 0.2% AEP floodplain contains a total of $1.6 billion in structures and contents including several critical facilities: three police and three fire stations, one hospital, two schools, one city municipal office, five water and sewer facilities, and two electrical substations. In unimproved reaches along the upper reaches of the watershed and tributaries the existing development is at risk from 10% AEP flooding whereas in areas of both federal and non-federal projects the level of protection ranges between 5% to 1% AEP.



The feasibility study would investigate reducing flood damage and life safety risks through evaluation of engineering, economic, and environmental data, and apply a contemporary approach to integrate nonstructural and structural flood risk reduction and ecosystem restoration system-wide, including examining the configuration of the existing channels and levees as well as many of the contributing tributaries which continue to experience growth. Potential measures include dams and reservoirs; detention basins; channels; levees and floodwalls; and flood risk adaptive measures (FRAM) such as elevation, floodproofing, and relocation. Where feasible and practical, habitat restoration, and recreation will be incorporated as complementary elements. There is significant interest in investigating FRAM, and a high probability that a comprehensive plan would integrate components from structural measures, FRAM, habitat restoration, and recreation.

Budget Criteria:

Population at Risk (PAR): The PAR for the entire 0.2% AEP floodplain is estimated to be 25,000 with as many as 100,000 persons who could be affected due to impacts to infrastructure, transportation, and business and industry disruptions.

Summary of Recent Flood Events and Damages Impacting the Project Area: The June 16-17, 1964 flood is the flood of record on the Big Papillion Creek (8-inches of rain in 3 hours producing a peak flow estimate at 45,900 cfs) which equates to a little less than a 2% AEP flood (48,320 cfs), and was also the flood of record for the West Papillion Creek and Hell Creek both of which were greater than a 0.2% AEP flood. June 21, 1960 is the flood of record for the Little Papillion Creek (15,300 cfs at Irvington) which equates to about a little less than a 1% AEP (16,870 cfs). Total damages from the 1964 event were estimated to exceed $5 million to structures (not including damage to contents and vehicles) including complete destruction of nearly 100 trailer homes. Flooding in 1999 resulted in significant damage to more than 1,000 homes, eight apartment complexes, and over 30 businesses, with total damage estimated at approximately $11 million. Historic flood related fatalities include 7 fatalities in 1964, and 1 fatality each in 1999, 2004, and 2014.

Summary of existing risk screening/risk assessments: The portion of the 1967 Comprehensive Plan which was implemented includes a series of channels and levees. There are six Federal levee systems total length of 15.9 miles along the Big Papillion Creek which includes 10.7 miles that serve as tie-backs along the Papillion Creek for Missouri River levees R-613 and R-616 at the confluence. Levee screenings performed on these levees from July 2013 through September 2015 identified the total population at risk as 1,968 (day). The levee screenings generally identified a moderate likelihood of performance issues with drainage culverts, but overall it is anticipated the levees will perform as designed during a flood event, with underseepage being the primary risk driver prior to overtopping. The highest contributor to flood risk for the levee systems is capacity exceedance (overtopping), which is projected to occur between the 2% and 0.5% AEP flood depending on location within the levee systems.

In addition to the Federal levees, there are 9 Non-Federal levee systems totaling 28.8 miles currently in the P.L. 84-99 program. Levee screenings performed on these levees from May 2015 through March 2016 identified a total population at risk as 1,518 (day). The levee screenings generally identified low to moderate likelihood of performance issues for these levees with underseepage being the primary risk driver prior to overtopping. The highest contributor to flood risk for these levee systems is also capacity exceedance (overopping), which is projected to occur between the 5% and 1% AEP flood depending on location within the levee systems.

The total length of levees both Federal and Non-Federal accounts for only 14% of the total stream miles in the study area (44.7 miles of levees compared to 313 miles of banks) and the PAR for the area affected by the levees is a small portion of the total PAR for the 0.2% AEP floodplain which is estimated to be 25,000. FEMAs Draft RiskMAP Report from February 2016 estimates the average annual damage potential to structures and contents to be $23.5 million. Other risks prevalent throughout the Papillion Creek Basin include erosion and channel incision which is threatening property and utility and transportation infrastructure.

Summary of ongoing actions/activities being implemented by the sponsor to address the flood risk: The NRD has an aggressive flood risk management program consisting of planning and constructing new risk reduction projects, educating the public, monitoring flood events, acquiring repetitive loss properties, and operating and maintaining numerous existing flood risk infrastructure (incl. 8 dams, several detention basins, and over 80 miles of levees and channels – not all are Papillion Creek specific). The NRD is currently constructing a new dam and 220-acre multi-use reservoir (Dam Site 15A) in Northwest Omaha, and completed another new dam and 135-acre multi-use reservoir

(Regional Basin 5) in Sarpy County in 2015. The NRD is partnering with the municipalities to work with FEMA on their RiskMAP project to produce updated floodplain mapping and characterize flood risks throughout the Basin. The Draft RiskMAP Report was released in February 2016 and the Final Report is expected in summer 2016.

Summary of Section 408 modification planned or ongoing. The NRD has been working on a proposed Section 408 modification to Missouri River Levees R-613 and R-616 which would raise the top elevation of the levees and address potential underseepage issues so that both levee systems can be meet FEMA accreditation under 44.CFR. The NRD is coordinating response to technical review comments from the Omaha District on their 90% design and report, and it is anticipated that the 100% design and report will be submitted for review and approval during FY16. The NRD has partnered with the City of Bellevue and the State of Nebraska to secure the approximately $25 million needed for the modification. The proposed study would investigate flood risks and potential risk reduction alternatives upstream from the proposed 408 modification.

Budget Criteria Summary: The Papillion Creek Basin study will investigate and identify a system plan to reduce flood risks directly contributing significant benefits to the nation, the Midwest region, and the greater Omaha metropolitan area. The population at risk is approximately 25,000 and severe to catastrophic flooding would have far reaching effects to over 100,000 people due to infrastructure, power, transportation, and business disruptions. Due to existing and continuing urbanization of the basin, the Papillion Creek experiences recurring flash floods that can develop quickly with warning times of 4-6 hours, and during severe floods large portions of the floodplain experience depths over 6 feet (some as high as 10-14 feet). Preliminary examination of critical facilities identified a minimum of three police and three fire stations, one hospital, two schools, one city municipal office, five water and sewer facilities, and two electrical substations that are within the floodplain. An on-going FEMA RiskMAP project inventoried $1.6 billion of development in the floodplain and computed average annual damages at $23.5 million using their HAZUS software.

Regionally/National Significant: The Papillion Creek Basin is home to approximately 600,000 residents (over 1/3 of the population in the State of Nebraska) and serves as a national and regional center for commerce, finance, and transportation and energy. The Papio-Missouri River NRD will serve as the sponsor and has a proven track record of sponsoring numerous Corps projects for both flood risk reduction and ecosystem restoration. The NRD partnered with the surrounding municipalities to develop the Papillion Creek Watershed Management Plan which was originally published in 2009 and updated in 2014 that outlines projects and management practices to reduce flood risks. The Papillion Creek Basin study will build upon data and prior studies conducted by the Corps, NRD, and others to develop a system plan to reduce flood risk for the Basin.

Relationship to Corps or Projects Funded by Other Agencies: Besides construction of the original Federal project from the 1960s, the Corps has completed one Section 1135 wetland restoration project along the Papillion Creek called Heron Haven which was completed in 2012. The NRD and City of Omaha have utilized FEMA Hazard Mitigation Grants to conduct some buyouts of repetitive loss properties along the Little Papillion Creek and Cole Creek.

Other Non-Federal Sponsors Letter(s) of Support

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Omaha support letter.pdf

City of Omaha
Jean Stothert, Mayor

Public Works Department

Omaha/Douglas Civic Center
1819 Farnam Street, Suite 601
Omaha, Nebraska 68183-0601
(402) 444-5220
Fax (402) 444-5248

Robert G. Stubbe, P.E.
Public Works Director

August 9, 2017

Mr. Robert M. Speer
Acting Secretary of the Army
US Army Corps of Engineers
Submitted online

RE: Proposal from Non-Federal Sponsor for inclusion in the Annual Section 7001 Report to Congress for WRRDA – Papillion Creek Basin Flood Risk Management Feasibility Study

Dear Mr. Speer:

This letter is to document our support and financial commitment for the development and implementation of the Papillion Creek Basin Flood Risk Management Feasibility Study. As a member of the Papillion Creek Watershed Partnership (Partnership), the City of Omaha supports the proposal for a comprehensive watershed feasibility study to build upon the existing watershed planning and identify projects to reduce flood risks and restore the degraded ecosystem habitats in the basin. Since 2001, we have been a part of the Partnership to address these concerns.

Development in the watershed is rapidly changing what is left of the rural landscape, and the need to implement projects to address flood risk and protect natural resources is critical. Because of this need, the City of Omaha has contributed to the Partnership financially to develop watershed management plans in 2009 and an update in 2014 as well as a commitment through ordinances to collect development fees as a way to help fund the high cost of implementing flood risk projects.

The Papio-Missouri River Natural Resources District (P-MRNRD) is the administering agent for the Partnership and is the lead on this proposal. The P-MRNRD intends to fund the local share of the feasibility study; however, the City of Omaha remains committed to contributions through the Partnership to assess the watershed and implement projects.

On behalf of the citizens and business community, the City of Omaha gives it full support for the P-MRNRD's proposal and urges the US Army Corps of Engineers to recognize the importance and need to support and fund this important project.

Sincerely,

Robert G. Stubbe, P.E.
Public Works Director

Map Document

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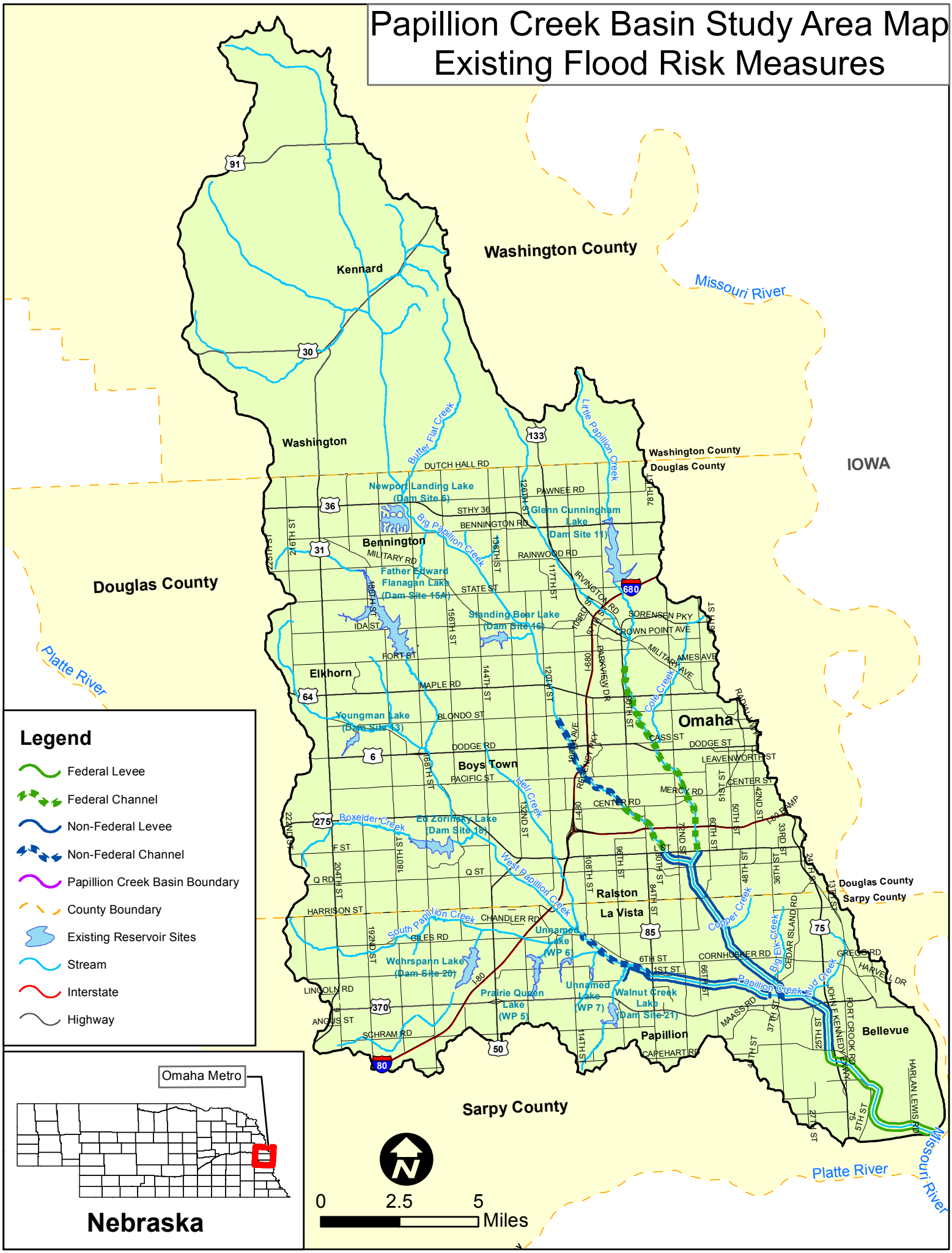
Papillion Creek Basin Study Area Map
Existing Flood Risk Measures



Additional Proposal Information

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Attachment D_FloodRiskReport_BigPapillionMosquito.pdf

Flood Risk Report

Big Papillion-Mosquito Watershed, Nebraska

*Douglas County, Sarpy County, Washington County**

Nebraska

2/18/2016

Draft

FEMA

RiskMAP

Increasing Resilience Together

Project Area Community List

Community Name
City of Bellevue
City of Bennington
Village of Boystown
Douglas County
City of Gretna
City of La Vista
City of Omaha
City of Papillion
City of Ralston
Sarpy County
Village of Washington
Washington County*

*Spans more than one watershed. This report only covers the area within the studied watershed.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire Flood Risk Project as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

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FLOOD RISK REPORT

1 Introduction

1.1 About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

1.1.1 Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

- **Flood Risk** (or Vulnerability) **= Probability x Consequences**; where
- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans activities within an area and how a flood impacts the natural and built environments.

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is

1.1.2 Risk MAP Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FISs) that focus on the probability of floods and that show where flooding may

occur as well as the calculated 1% annual chance flood elevation. The 1% annual chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA understands that flood risk is dynamic—that flooding does not stop at a line on a map—and as such, provides the following flood risk products:

- **Flood Risk Report (FRR):** The FRR presents key risk analysis data for the flood Risk Project.
- **Flood Risk Map (FRM):** Like the example found in Section 3.1 of this document, the FRM shows a variety of flood risk information in the project area. More information about the data shown on the FRM may be found in Section 2 of this report.
- **Flood Risk Database (FRD):** The FRD is in GIS format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a jurisdictional level.

1.2 Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Vulnerability of infrastructure is another important consideration.

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Federal Stafford Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.

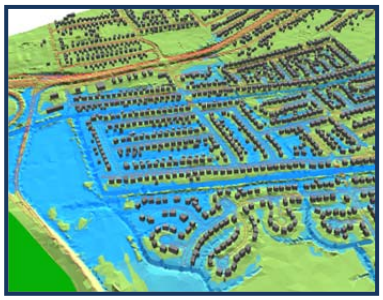
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.
- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Flooding along the Wabash River in Clark County, Illinois, contributed to a federal disaster declaration on June 24, 2008.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Map, and Flood Risk Report are “non-regulatory” products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

1.3 Sources of Flood Risk Assessment Data Used



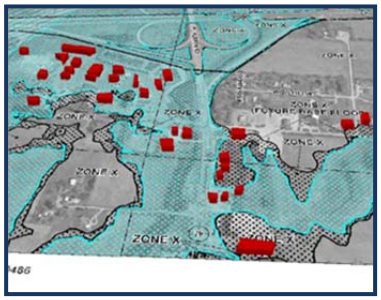
To assess potential community losses, or the consequences portion of the “risk” equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe
- For most Flood Risk Projects, FEMA uses the following sources of flood risk information to develop this report:
- Hazus estimated flood loss information

- New engineering analyses (e.g., hydrology and hydraulic modeling) to develop new flood boundaries
- Locally supplied data (see Section 7 for a description)
- Sources identified during the Discovery process

1.4 Related Resources

For a more comprehensive picture of flood risk, FEMA recommends that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.



FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

- **FIRMs and FISs**. This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).
- **Hazus Flood Loss Estimation Reports**. Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.
- **Flood or multi-hazard mitigation plans**. Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.
- **FEMA Map Service Center (MSC)**. The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view DFIRM databases and the National Flood Hazard Layer (NFHL) Database.

2 Flood Risk Analysis

2.1 Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

2.2 Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information to help describe and visualize flood risk within the project area. Depending on the scope of the Flood Risk Project for this project area, this information may include some or all of the following elements:

- Changes Since Last FIRM
- Water Surface, Flood Depth, and Analysis Grids
- Flood Risk Assessment Information
- Areas of Mitigation Interest

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

2.2.1 Changes Since Last FIRM

The Changes Since Last FIRM (CSLF) dataset, stored in the FRD and shown in Section 3 of this report, illustrates where changes to

flood risk may have occurred since the last FIRM was published for the subject area. Communities can use this information to update their mitigation plans, specifically quantifying “what is at risk” and identifying possible mitigation activities.

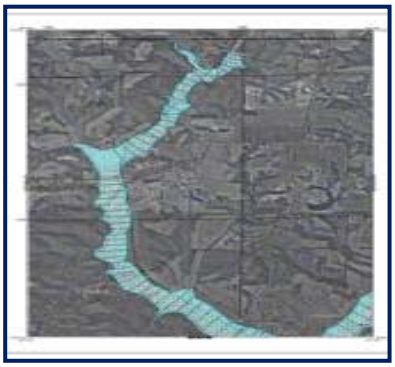
The CSLF dataset identifies changes in the Special Flood Hazard Area (SFHA) and floodway boundary changes since the previous FIRM was developed. These datasets quantify land area increases and decreases to the SFHA and floodway, as well as areas where the flood zone designation has changed (e.g., Zone A to AE, AE to VE, shaded Zone X protected by levee to AE for de-accredited levees).

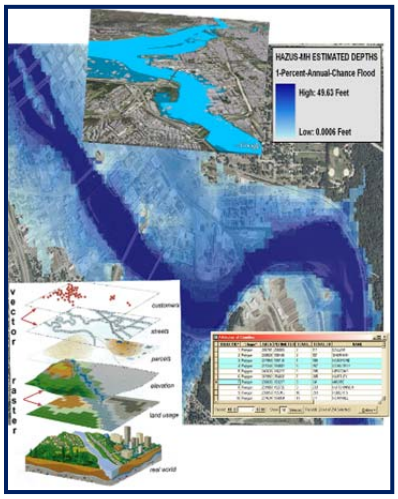
The CSLF dataset is created in areas that were previously mapped using digital FIRMs. The CSLF dataset for this project area includes:

- **Floodplain and/or Floodway Boundary Changes:** Any changes to the existing floodplain or floodway boundaries are depicted in this dataset
- **Floodplain Designation Changes:** This includes changed floodplain designations (e.g., Zone A to Zone AE).
- **CSLF Information:** Within this dataset additional information is provided to help explain the floodplain and floodway boundary changes shown on the FIRM. This information is stored as digital attributes within the CSLF polygons and may include some or all of the following:
    - Changes in peak discharges
    - Changes to the modeling methodology (e.g., tide gage analysis)
    - New flood control structures (e.g., dams, levees, etc.)
    - Changes to hydraulic structures (e.g., bridges, culverts, etc.)
    - Sedimentation and/or Erosion
    - Man-made changes to a watercourse (e.g., realignment or improvement)

It should be noted that reasons for the floodplain and floodway changes (also known as Contributing Engineering Factors) are intended to give the user a general sense of what caused the change, as opposed to providing a reason for each and every area of change.

- **Count of Affected Structures:** The total estimated count of affected buildings within the area of change. The data is only made available because the local jurisdiction was able to provide accurate building footprint data indicating the





Floodplain maps have evolved considerably from the older paper-based FIRMs to the latest digital products and datasets.

CSLF data can be used to communicate changes in the physical flood hazard area (size, location) as part of the release of new FIRMS. It can also be used in the development or update of hazard mitigation plans to describe changes in hazard as part of the hazard profile.

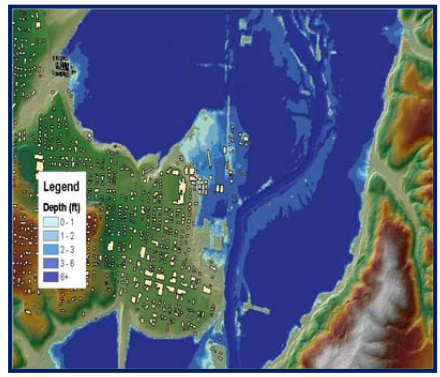
CSLF data is shown in the FRR, and underlying data is stored in the FRD.

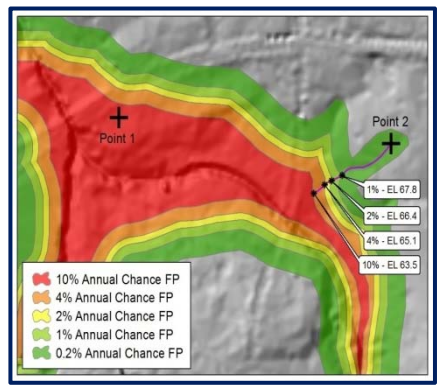
location of structures in and adjacent to the identified floodplains).

- **Count of Affected Population:** The total estimated affected population within the area of change. The data is only made available because the local jurisdiction was able to provide population data that accompanied the structure data noted above.

2.2.2 Flood Depth and Analysis Grids

Grids are FEMA datasets provided in the FRD to better describe the risk of the flood hazard. While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. Grids provided in the FRD for this project area include the following:





Grid data can make flood mapping more informative. The top image is a flood depth grid showing relative depths of water in a scenario flood event. The bottom image is a percent annual chance of flooding grid, which shows inundation areas of various frequency floods.

- **Flood Depth Grids: (for the calculated flood frequencies included in the FIS Report):** Flood Depth Grids are created for each flood frequency calculated during the course of a Flood Risk Project. These grids communicate flood depth as a function of the difference between the calculated water surface elevation and the ground. Five grids will normally be delivered for riverine areas for the standard flood frequencies (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance). Coastal areas only receive the 1-percent-annual-chance grid.

  Depth grids form the basis for refined Hazus loss estimates (as presented in a table in Section 3 of this report) and are used to calculate potential flood losses for display on the FRM and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

- **Percent Annual Chance of Flooding Grid:** This is a grid dataset that represents the percent annual chance of flooding for locations along a flooding source. This grid uses the five standard flood frequencies.

- **Percent 30-Year Chance of Flooding Grid:** This is a grid dataset that represents the estimated likelihood of flooding at least once within a 30-year period, which is the average lifespan for a home mortgage, for all locations within the extent of the 1-percent-annual-chance and 0.2-percent-annual-chance floodplain.

- **Water Surface Elevation Change Grid:** This dataset provides the ability to see vertical changes in the water surface elevation between the existing FIRM and the revised FIRM. This dataset would be the equivalent of the CSLF dataset, but as a vertical analysis as opposed to a horizontal analysis since last FIRM.

- **Water Surface Elevation Grids:** This dataset represents the raw results of the hydrologic and hydraulic analysis before adjustments are made to account for influences associated with other flooding sources.
- **1-Percent Plus Flood Depth Grid:** This riverine-only dataset communicates the inherent uncertainty associated with the 1-percent-annual-chance flood elevation band by highlighting the areas subject to inundation by the upper limit of the 1-percent-annual-chance flood discharge confidence interval.
- **Velocity Grid:** This dataset describes the average flood velocity that occurs within the floodplain. Velocity grids can be used to increase public awareness of flood hazards associated with rapidly moving floodwaters.
- **Water Surface and/or Depth Grids Based on Additional Flood Frequencies:** In addition to the standard flood frequencies referenced above, this dataset is provided when additional flood frequencies are calculated, such as a 20-percent-annual-chance (5-year) or 0.5-percent-annual-chance (200-year) event.

2.2.3 Estimated Flood Loss Information

Flood loss estimates provided in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Originally developed for earthquake risk assessment, Hazus has evolved into a multi-hazard tool developed and distributed by FEMA that can provide loss estimates for floods, earthquakes, and hurricane winds. Hazus is a nationally accepted, consistent flood risk assessment tool to assist individuals and communities to create a more accurate picture of flood risk. Some benefits of using Hazus include the following:

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region
- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis (what is at risk for different frequencies) and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR. Visualizations of grids (maps) are not provided.

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus for the 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events. In this report, these losses are expressed in dollar amounts and are provided for the Flood Risk Project area only, even though results are shown for the entire watershed and at the local jurisdiction level.

Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates are being provided at the project and community levels for multiple flood frequencies including:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content and inventory losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content and inventory losses.
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards. Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

Hazus-estimated loss data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRM can show where flood risk varies by geographic location. For emergency management, Hazus data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. *Also, awareness of exposed essential facilities and infrastructure encourages mitigation actions to protect citizens from service disruption should flooding occur*.

Hazus estimated loss data is summarized in the FRR and on the FRM and stored in the FRD.

Infrastructure: For analysis of infrastructure, Hazus supports the analysis of transportation systems and lifeline utility systems. Transportation systems include highways, railways, light railways, busses, ports and harbors, ferries, and airport systems. Utility systems include potable water systems, wastewater, oil, natural gas, electric power, and communication systems. For this report, Hazus calculates the types of infrastructure impacted.

- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.
- **Annualized Losses**: Annualized losses are calculated using Hazus by taking losses from multiple events over different frequencies and expressing the long-term average by year. These factors in historic patterns of frequent smaller floods with infrequent but larger events to provide a balanced presentation of flood damage.
- **Loss Ratio:** The loss ratio expresses the scenario losses divided by the total building value for a local jurisdiction and can be a gage to determine overall community resilience as a result of a scenario event. For example, a loss ratio of 5 percent for a given scenario would indicate that a local jurisdiction would be more resilient and recover more easily from a given event, versus a loss ratio of 75 percent which would indicate widespread losses. An annualized loss ratio uses the annualized loss data as a basis for computing the ratio. Loss ratios are not computed for business disruption. These data are presented in the FRR.
- **Hazus Flood Risk Value:** On the FRM, flood risk is expressed in the following five categories: very low, low, medium, high, and very high for census blocks that have flood risk. It is based on the 1-percent-annual-chance total asset loss by census block.

2.2.4 Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the federal government, state agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **Dams**

  A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Hoover Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential

pond). “Dry dams,” which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Even dams that follow current dam safety programs may not be regulated, as downstream risk may have changed since the dam was constructed. Years after a dam is built, a house, subdivision, or other development may be constructed in the area downstream of the dam. Thus, a subsequent dam failure could result in damage. Since these dams are not regulated, it is impossible to predict how safe they are.

This dam failure caused flooding that damaged several homes and vehicles.

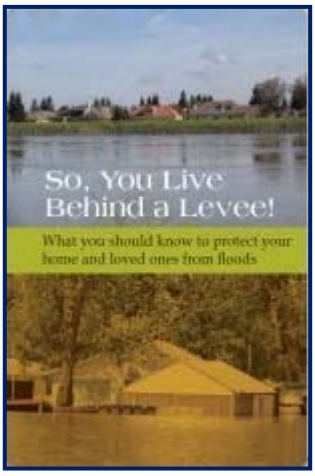
  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property. However, there may have been buildings constructed in violation of the flood easement.
  - When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
  - For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees and Major Embankments**

  FEMA defines a levee as “a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.” Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to provide protection from a flood in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood protection rating, and the areas behind them are still at some risk for flooding. This threat is called residual risk. In some states, residual risk areas can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

Major embankments, on the other hand, are rarely designed with any flood protection level in mind. Railroads, road abutments, and canals—especially in the Western United States—are not considered levees or dams and have issues such as unknown construction materials/methods. These embankments are not regulated from a flood risk standpoint.

- **Reasons levees and major embankments are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.

    A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased flood protection. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.

Canal levee breaches as a result of Hurricane Katrina in New Orleans in 2005. Note damages can be more extensive due to high velocity flood flows than if the levee was not there.

- Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
- A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures are used to "harden" the shoreline for a variety of purposes and include:

  - Jetties: Structures constructed to direct currents or accommodate vessels.
  - Groynes: Protective structures of stone or concrete that extend from shore into the water to prevent a beach from washing away.
  - Sea walls: A form of hard and strong coastal defense constructed on the inland part of a coast to reduce the effects of strong waves.
  - As the rate of sea level rise accelerates, an increase in coastal erosion is likely. We are now facing rapid sea level changes on a scale of decades. Higher sea levels could affect the coastal zone and accelerate coastal erosion and flooding in a variety of ways, including greater shoreline retreat; increased coastal erosion rates; property destruction; and saltwater intrusion into bays, rivers, and underground water resources. In addition, a general elevation in the water table due to sea level rise will result.
  - **Reasons coastal structures are considered AoMIs:**
    - While coastal structures or "hardening of the shoreline" may provide a temporary level of flood reduction for a very specific site, it also interrupts the dynamic processes of the littoral flow (flow along the coastline) which results in accelerated coastal erosion.
    - Erosion often occurs along beaches during storms, especially severe storms that stay offshore for days and result in ongoing battering of the shoreline through high wind and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding, storm surge, wave heights, wave run up, and coastal erosion.

Severe beach erosion and damage resulting from a nor'easter.

    - Higher water tables associated with sea level rise could lead to the failure of septic systems and other drainage systems, such as storm drains, which need to be located at a certain elevation above the water table. Elevation of the water table would also affect the river drainage systems by affecting the rate of infiltration and increasing the amount of runoff which would, in turn, increase the risk of flooding.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage

potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

- **Reasons stream flow constrictions are considered AoMIs:**
  - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
  - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
  - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
  - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **At-Risk Essential Facilities**

  Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

  - **Reasons at-risk essential facilities are considered AoMIs:**
    - Costly and specialized equipment may be damaged and need to be replaced.
    - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
    - Critical records and information stored at these facilities may be lost.

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

  Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

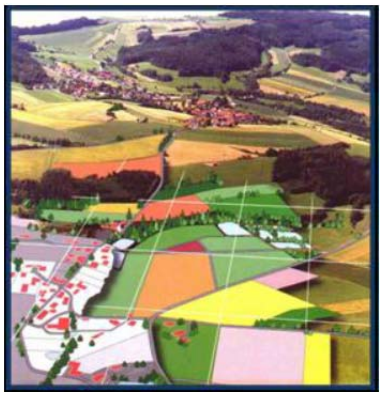
  Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past

claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
  - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
  - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.



Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

Sometimes a major land use change may be for planning purposes only. For example, a land use change that rezones land from a classification such as floodplain that restricts development to a zone such as industrial or high density residential could result in significant new infrastructure and structures in high flood risk areas.

- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
  - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
    - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
    - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. An extensive list of mitigation actions can be found in Section 4.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels and coastlines are constantly subject to the forces of erosion. Areas of erosion (stream or coastal) threaten infrastructure, general building stock, and businesses, and also pose a threat to human life.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**

- A community may wish to avoid development in areas identified as subject to erosion hazards.
- Riverine flood damage assessments generally consider inundation alone.
- Landslides and mudslides are a result of erosion.
- Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations.
- Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
- Approximately one-third of the nation's streams experience severe erosion problems.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3 Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

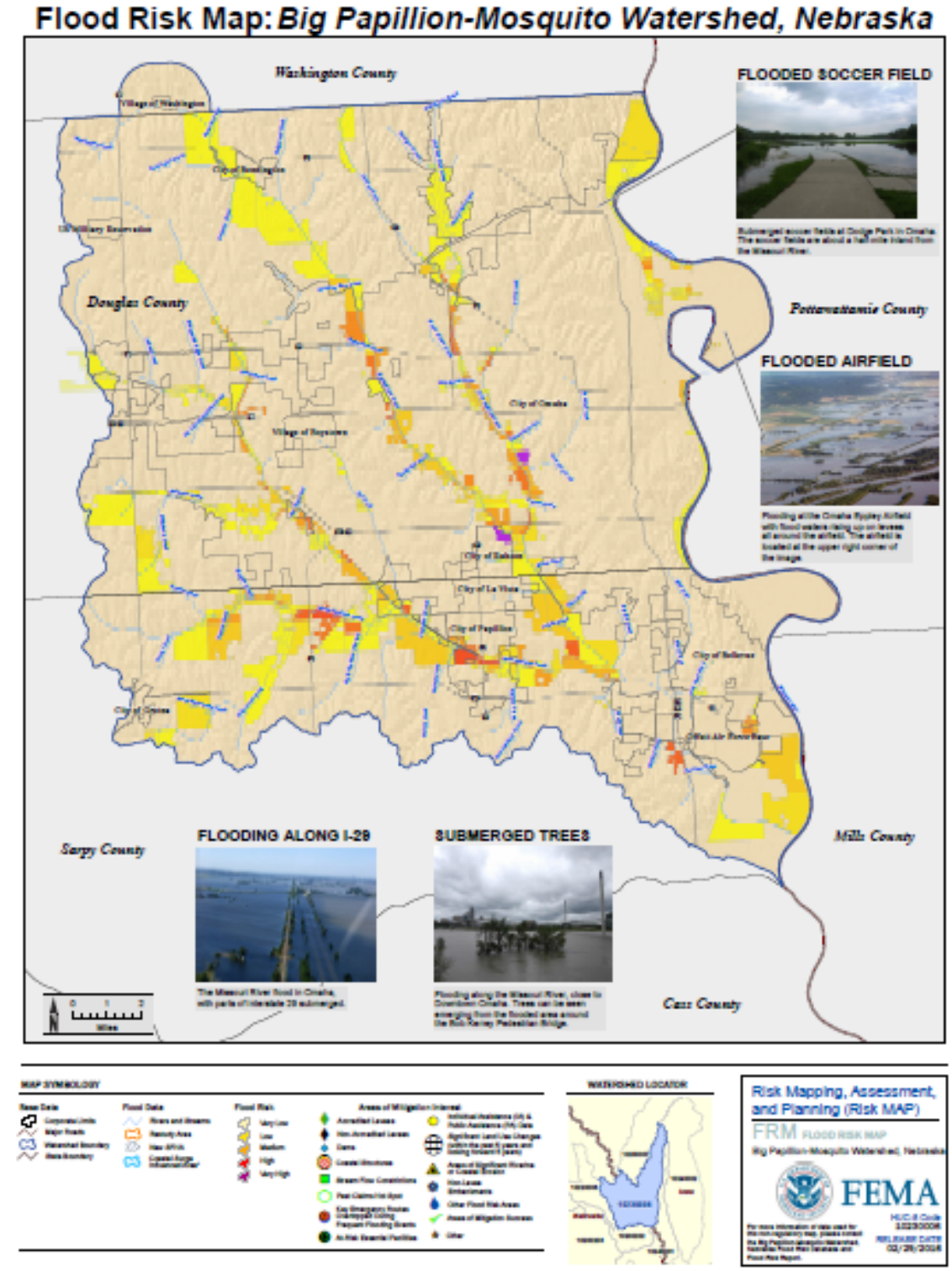
- **Flood Risk Map (FRM).** Within the Flood Risk Project the FRM displays base data reflecting community boundaries, major roads, and stream lines; potential losses that include both the 2010 Flood Average Annualized Loss (AAL) Study supplemented with new Hazus runs for areas with new or updated flood modeling; new Flood Risk Project areas; a bar chart summarizing community per capita loss; and graphics and text that promote access and usage of additional data available through the FRD, FIRM, and National Flood Hazard Layer and viewers (desktop or FEMA website, etc.). This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

> The FRM provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

- **Flood Risk Project Summary.** Within the Flood Risk Project area, summary data for some or all of the following datasets are provided for the entire project area and also on a jurisdiction by jurisdiction basis:
  - **Changes Since Last FIRM (CSLF).** This is a summary of where the floodplain and flood zones have increased or decreased (only analyzed for areas that were previously mapped using digital FIRMs).
  - **Flood Depth and Analysis Grids.** A general discussion of the data provided in the FRD.
  - **Flood Risk Assessment Information.** A loss estimation of potential flood damages using different flood scenarios.
  - **Areas of Mitigation Interest.** A description of areas that may require mitigation or additional risk analysis.

3.1 Flood Risk Map

The Flood Risk Map for this Flood Risk Project is shown below. In addition to this reduced version of the map, a full size version is available within the FRD.



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3.2 Big Papillion-Mosquito Watershed, Nebraska Flood Risk Project Area Summary

The following pages include Flood Risk data for the Big Papillion-Mosquito Watershed, Nebraska. The watershed encompasses all or portions of 3 counties and 12 communities in Nebraska, with a total drainage area of 945.5 square miles. The Missouri River and the Papillion River are the main water body in the watershed.

3.2.1 Overview

Big Papillion-Mosquito Watershed, located in Nebraska, includes the following communities

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Bellevue	310191	53,936	100	14.1	100	Y	N/A	Y
City of Bennington	310074	1,482	100	0.9	100	Y	N/A	N/A
City of Gretna	310375	5,890	58	1.2	58	Y	N/A	Y
City of La Vista	310192	17,636	100	3.1	100	Y	N/A	Y
City of Omaha	315274	446,599	99	133.6	99	Y	9	Y
City of Papillion	315275	23,270	100	4.5	100	Y	8	Y
City of Ralston	310077	7,216	100	1.6	100	Y	N/A	Y
Douglas County	310073	543,244	63	176.0	63	Y	N/A	Y
Offutt Air Force Base	31FEO	8,901	100	4.4	100	N	N/A	N
Sarpy County	310190	172,193	40	213.9	40	Y	N/A	Y
US Military Reservation	31FED	00	100	0.6	100	N	N/A	N/A
Village of Boystown	310353	649	100	1.4	100	Y	N/A	N
Village of Washington	315496	150	100	0.2	100	Y	N/A	N/A
Washington County	310483	20,234	1	390.0	1	Y	N/A	Y

Community-specific results are provided on subsequent pages. Data provided below and on subsequent pages only includes areas located within the Watershed Flood Risk Project and do not necessarily represent community-wide totals.

Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.2.2 Flood Risk Datasets

As a part of this Flood Risk Project, flood risk datasets were created for inclusion in the Flood Risk Database. Those datasets are summarized for this Flood Risk Project below:

- **Changes Since Last FIRM**

  Special Flood Hazard Area (SFHA) boundaries within the Big Papillion-Mosquito Watershed were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based topographic data for the Flood Risk Project. The data in this section reflects a comparison between the effective FIRM(s) and the new analysis in this study.

The table below summarizes the increases, decreases, and net change of SFHAs for the watershed.

Area of Interest	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Area within SFHA*	93.2	40.4	8.6	31.8
Area within Floodway*	43.3	8.8	13.1	-4.3

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Watershed, Nebraska, the figures in this table only represent information within the Watershed, Nebraska.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the watershed.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	6,048	-3,457	2,591	N/A	N/A	N/A
Within Floodway	657	-541	116	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Big Papillion-Mosquito Watershed, Nebraska, the figures in this table only represent information within Big Papillion-Mosquito Watershed, Nebraska.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

This project did not include data for studying changes to affected structures or population for this watershed.

- **Flood Depth and Analysis Grids**
    - The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Results**
    - Watershed's flood risk analysis incorporates results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Potential losses were estimated as well as potential loss ratios for multiple scenarios. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Big Papillion-Mosquito: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$528,500,000	34%	$56,800,000	11%	$89,400,000	17%	$122,200,000	23%	$253,700,000	48%	$6,400,000	1%
Commercial Building/Contents	$796,700,000	51%	$58,700,000	7%	$163,200,000	20%	$209,800,000	26%	$351,700,000	44%	$13,300,000	2%
Other Building/Contents	$232,800,000	15%	$23,600,000	10%	$45,100,000	19%	$59,600,000	26%	$100,900,000	43%	$3,600,000	2%
Total Building/Contents[2]	$1,558,500,000	100%	$139,300,000	9%	$297,700,000	19%	$391,500,000	25%	$706,500,000	45%	$23,500,000	2%
Business Disruption[3]	$39,600,000	N/A	$4,600,000	N/A	$8,700,000	N/A	$10,600,000	N/A	$15,000,000	N/A	$700,000	N/A
TOTAL[4]	$1,598,100,000	N/A	$143,900,000	N/A	$306,400,000	N/A	$402,100,000	N/A	$721,500,000	N/A	$24,200,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the Big Papillion-Mosquito Watershed.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation	Number of Occurrences	Data Source
Areas of Mitigation Success		
Areas of Significant Erosion		
At Risk Essential Facilities		
Dam		
Key Emergency Routes Overtopped		
Other Flood Risk Areas		
Past Claims Hot Spot		

3.3 Communities

The following sections provide an overview of the community's floodplain management program as of the date of this publication, as well as summarize the flood risk analysis performed for each project area in Big Papillion-Mosquito Watershed, Nebraska.

3.3.1 City of Bellevue Summary (CID 310191)

The following pages include Flood Risk data for the City of Bellevue.

3.3.1.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Bellevue	310191	53,936	100	14.1	100	Y	N/A	Y

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 202 policies totaling approximately $45,010,800

Data provided below only includes areas in the City of Bellevue that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.1.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	1.2	0.2	0.3	-0.1
Within Floodway	1.0	0.1	0.4	-0.3

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Bellevue, the figures in this table only represent information within the City of Bellevue.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	395	-496	-101	N/A	N/A	N/A
Within Floodway	12	-94	-82	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Bellevue, the figures in this table only represent information within the City of Bellevue.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results**
  - The City of Bellevue's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of Bellevue: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$10,500,000	0%	$1,300,000	0%	$1,900,000	0%	$2,600,000	0%	$4,600,000	0%	$100,000	0%
Commercial Building/Contents	$1,600,000	0%	$0	0%	$60,000	0%	$200,000	0%	$1,300,000	0%	$10,000	0%
Other Building/Contents	$5,000,000	1%	$100,000	0%	$300,000	0%	$1,000,000	0%	$3,600,000	1%	$30,000	0%
Total Building/Contents[2]	$17,400,000	0%	$1,500,000	0%	$2,300,000	0%	$3,800,000	0%	$9,600,000	0%	$200,000	0%
Business Disruption[3]	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
TOTAL[4]	$17,400,000	0%	$1,500,000	N/A	$2,300,000	N/A	$3,800,000	N/A	$9,600,000	N/A	$200,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of Bellevue.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.2 City of Bennington Summary (CID 310074)

The following pages include Flood Risk data for the City of Bennington.

3.3.2.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Bennington	310074	1,482	100	0.9	100	Y	N/A	N/A

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 6 policies totaling approximately $875,000

Data provided below only includes areas in the City of Bennington that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.2.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.2	N/A	0.1	-0.1
Within Floodway	0.1	0.1	N/A	0.1

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Bennington, the figures in this table only represent information within the City of Bennington.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	14	-60	-46	N/A	N/A	N/A
Within Floodway	7	-3	4	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Bennington, the figures in this table only represent information within the City of Bennington.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results**
  - The City of Brooklyn's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of Bennington: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$500,000	0%	$80,000	0%	$70,000	0%	$100,000	0%	$200,000	0%	$10,000	0%
Commercial Building/Contents	$20,000	0%	$0	0%	$0	0%	$0	0%	$20,000	0%	$0	0%
Other Building/Contents	$90,000	0%	$10,000	0%	$20,000	0%	$20,000	0%	$40,000	0%	$0	0%
Total Building/Contents[2]	$600,000	0%	$90,000	0%	$90,000	0%	$100,000	0%	$300,000	0%	$10,000	0%
Business Disruption[3]	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
TOTAL[4]	$600,000	0%	$90,000	N/A	$90,000	N/A	$100,000	N/A	$300,000	N/A	$10,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of Bennington.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.3 Village of Boystown Summary (CID 310353)

The following pages include Flood Risk data for the Village of Boystown.

3.3.3.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
Village of Boystown	310353	649	100	1.4	100	Y	N/A	N

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 1 policies totaling approximately $113,900
- NFIP-recognized repetitive loss properties = 7

3.3.3.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.1	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Village of Boystown, the figures in this table only represent information within the Village of Boystown.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	2	N/A	2	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Village of Boystown, the figures in this table only represent information within the Village of Boystown.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results**
  - The City of Cedar Rapids' flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Village of Boystown: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Commercial Building/Contents	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Other Building/Contents	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Total Building/Contents[2]	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Business Disruption[3]	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
TOTAL[4]	$0	0%	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the Village of Boystown.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.4 City of Gretna Summary (CID 310375)

The following pages include Flood Risk data for the City of Gretna.

3.3.4.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Gretna	310375	5,890	58	1.2	58	Y	N/A	Y

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 2 policies totaling approximately $322,000

Data provided below only includes areas in the City of Gretna that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.4.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	N/A	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Gretna, the figures in this table only represent information within the City of Gretna.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	N/A	N/A	N/A	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Gretna, the figures in this table only represent information within the City of Gretna.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results**
  - The City of Chelsea's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of Gretna: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Commercial Building/Contents	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Other Building/Contents	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Total Building/Contents[2]	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%
Business Disruption[3]	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
TOTAL[4]	$0	0%	$0	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of Gretna.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	Number of Occurances	Data Source
At Risk Essential Facilities		
Past Claims		

3.3.5 City of La Vista Summary (CID 310192)

The following pages include Flood Risk data for the City of La Vista.

3.3.5.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of La Vista	310192	17,636	100	3.1	100	Y	N/A	Y

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 40 policies totaling approximately $12,759,100.

Data provided below only includes areas in the City of La Vista that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.5.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.4	N/A	N/A	N/A
Within Floodway	0.2	N/A	0.1	-0.1

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of La Vista, the figures in this table only represent information within the City of La Vista.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	14	-45	-31	N/A	N/A	N/A
Within Floodway	N/A	-9	-9	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of La Vista, the figures in this table only represent information within the City of La Vista.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results**
  - The City of La Vista's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of La Vista: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$4,000,000	0%	$60,000	0%	$600,000	0%	$1,000,000	0%	$2,300,000	0%	$30,000	0%
Commercial Building/Contents	$56,700,000	22%	$3,600,000	1%	$13,300,000	5%	$16,300,000	7%	$22,600,000	9%	$900,000	0%
Other Building/Contents	$1,100,000	3%	$70,000	0%	$300,000	1%	$300,000	1%	$400,000	1%	$20,000	0%
Total Building/Contents[2]	$61,700,000	3%	$3,700,000	0%	$14,100,000	1%	$17,600,000	1%	$25,300,000	1%	$1,000,000	0%
Business Disruption[3]	$4,200,000	N/A	$300,000	N/A	$1,000,000	N/A	$1,200,000	N/A	$1,600,000	N/A	$70,000	N/A
TOTAL[4]	$65,900,000	3%	$4,000,000	N/A	$15,000,000	N/A	$18,700,000	N/A	$26,800,000	N/A	$1,000,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of La Vista.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.6 City of Omaha Summary (CID 315274)

The following pages include Flood Risk data for the City of Omaha.

3.3.6.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Omaha	315274	446,599	99	133.6	99	Y	9	Y

National Flood Insurance Program (NFIP) policy coverage (policies/values) = 957 policies totaling approximately $253,681,700.

Data provided below only includes areas in the City of Omaha that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.6.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	16.9	8.3	1.7	6.6
Within Floodway	6.0	1.1	1.2	-0.1

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Omaha, the figures in this table only represent information within the City of Omaha.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	4,244	-1,817	2,427	N/A	N/A	N/A
Within Floodway	580	-300	280	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Omaha, the figures in this table only represent information within the City of Omaha.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**
  - The City of Papillion's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of Omaha: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$222,900,000	0%	$19,700,000	0%	$33,000,000	0%	$48,900,000	0%	$119,100,000	0%	$2,200,000	0%
Commercial Building/Contents	$491,200,000	2%	$34,400,000	0%	$93,700,000	0%	$125,500,000	1%	$229,600,000	1%	$8,000,000	0%
Other Building/Contents	$95,900,000	1%	$9,700,000	0%	$17,700,000	0%	$23,900,000	0%	$43,200,000	1%	$1,400,000	0%
Total Building/Contents[2]	$810,200,000	0%	$63,800,000	0%	$144,500,000	0%	$198,300,000	0%	$391,900,000	0%	$11,700,000	0%
Business Disruption[3]	$12,000,000	N/A	$1,700,000	N/A	$2,700,000	N/A	$3,200,000	N/A	$4,200,000	N/A	$200,000	N/A
TOTAL[4]	$822,200,000	0%	$65,200,000	N/A	$146,800,000	N/A	$201,100,000	N/A	$395,600,000	N/A	$11,900,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of Omaha.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.7 City of Papillion Summary (CID 315275)

The following pages include Flood Risk data for the City of Papillion.

3.3.7.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Papillion	315275	23,270	100	4.5	100	Y	8	Y

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 145 policies totaling approximately $37,071,000.

Data provided below only includes areas in the City of Papillion that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.7.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.7	0.1	N/A	0.1
Within Floodway	0.2	N/A	0.2	-0.2

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Papillion, the figures in this table only represent information within the City of Papillion.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	122	-65	57	N/A	N/A	N/A
Within Floodway	N/A	-27	-27	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Papillion, the figures in this table only represent information within the City of Papillion.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**
  - The City of Papillion's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of Papillion: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$37,500,000	1%	$2,800,000	0%	$7,800,000	0%	$10,100,000	0%	$16,200,000	1%	$600,000	0%
Commercial Building/Contents	$73,600,000	20%	$11,300,000	3%	$16,400,000	5%	$18,600,000	5%	$25,900,000	7%	$1,400,000	0%
Other Building/Contents	$24,800,000	12%	$2,500,000	1%	$4,600,000	2%	$6,300,000	3%	$11,100,000	6%	$300,000	0%
Total Building/Contents[2]	$136,100,000	5%	$16,600,000	1%	$28,900,000	1%	$35,000,000	1%	$53,200,000	2%	$2,400,000	0%
Business Disruption[3]	$4,800,000	N/A	$600,000	N/A	$1,000,000	N/A	$1,200,000	N/A	$1,900,000	N/A	$80,000	N/A
TOTAL[4]	$140,900,000	5%	$16,900,000	N/A	$29,500,000	N/A	$35,800,000	N/A	$54,400,000	N/A	$2,400,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of Papillion.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.8 City of Ralston Summary (CID 310077)

The following pages include Flood Risk data for the City of Ralston.

3.3.8.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
City of Ralston	310077	7,216	100	1.6	100	Y	N/A	Y

- National Flood Insurance Program (NFIP) policy coverage (policies/values) = 15 policies totaling approximately $4,938,500.

Data provided below only includes areas in the City of Ralston that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.9.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.1	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Ralston, the figures in this table only represent information within the City of Ralston.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	20	-58	-38	N/A	N/A	N/A
Within Floodway	N/A	-9	-9	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of City of Ralston, the figures in this table only represent information within the City of Ralston.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**

  The City of Papillion's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

City of Ralston: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$4,200,000	0%	$300,000	0%	$800,000	0%	$1,100,000	0%	$1,900,000	0%	$60,000	0%
Commercial Building/Contents	$73,700,000	38%	$300,000	0%	$21,500,000	11%	$23,000,000	12%	$27,500,000	14%	$1,400,000	1%
Other Building/Contents	$300,000	0%	$0	0%	$0	0%	$0	0%	$300,000	0%	$0	0%
Total Building/Contents[2]	$77,900,000	7%	$600,000	0%	$22,200,000	2%	$24,000,000	2%	$29,700,000	3%	$1,400,000	0%
Business Disruption[3]	$40,000	N/A	$10,000	N/A	$10,000	N/A	$10,000	N/A	$10,000	N/A	$0	N/A
TOTAL[4]	$77,900,000	7%	$600,000	N/A	$22,200,000	N/A	$24,000,000	N/A	$29,700,000	N/A	$1,400,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the City of Ralston.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

3.3.9 Village of Washington Summary (CID 315496)

The following pages include Flood Risk data for the Village of Washington.

3.3.9.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
Village of Washington	315496	150	100	0.2	100	Y	N/A	N/A

Data provided below only includes areas in the Village of Washington that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	N/A	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Village of Washington, the figures in this table only represent information within the Village of Washington.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	N/A	N/A	N/A	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes since Last FIRM information outside of Village of Washington, the figures in this table only represent information within the Village of Washington.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**

  The Village of Washington's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Village of Washington: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	#	#	#	#	#	#	#	#	#	#	#	#
Commercial Building/Contents	1	#	#	#	#	#	#	#	#	#	#	#
Other Building/Contents	1	#	#	#	#	#	#	#	#	#	#	#
Total Building/Contents[2]	1	#	#	#	#	#	#	#	#	#	#	#
Business Disruption[3]	1	#	#	#	#	#	#	#	#	#	#	#
TOTAL[4]	1	#	#	#	#	#	#	#	#	#	#	#

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the Village of Washington.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation	Number of Occurrences	Data Source

3.3.10 Douglas County Summary (CID 310073)

The following pages include Flood Risk data for the Douglas County.

3.3.10.1. Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
Douglas County	310073	543,244	63	176.0	63	Y	N/A	Y

National Flood Insurance Program (NFIP) policy coverage (policies/values) = 298 policies totaling approximately $52,249,600.

Data provided below only includes areas in Douglas County that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.10.2. Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	6.3	1.6	1.0	0.6
Within Floodway	3.9	1.2	1.1	0.1

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Douglas County, the figures in this table only represent information within the Douglas County.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	215	-315	-100	N/A	N/A	N/A
Within Floodway	14	-48	-34	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Douglas County, the figures in this table only represent information within Douglas County.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**

  The Village of Washington's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Douglas County: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$19,300,000	0%	$2,900,000	0%	$3,900,000	0%	$4,900,000	0%	$7,300,000	0%	$300,000	0%
Commercial Building/Contents	$16,100,000	2%	$800,000	0%	$1,500,000	0%	$5,000,000	1%	$8,600,000	1%	$200,000	0%
Other Building/Contents	$12,900,000	3%	$1,400,000	0%	$2,300,000	1%	$3,700,000	1%	$5,300,000	1%	$200,000	0%
Total Building/Contents[2]	$48,600,000	0%	$5,200,000	0%	$7,800,000	0%	$13,600,000	0%	$21,300,000	0%	$700,000	0%
Business Disruption[3]	$1,700,000	N/A	$200,000	N/A	$300,000	N/A	$500,000	N/A	$700,000	N/A	$20,000	N/A
TOTAL[4]	$50,300,000	0%	$5,300,000	N/A	$8,100,000	N/A	$14,000,000	N/A	$21,900,000	N/A	$700,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the Douglas County.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation	Number of Occurrences	Data Source

3.3.11 Sarpy County Summary (CID 310190)

The following pages include Flood Risk data for the Sarpy County.

3.3.12 Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
Sarpy County	310190	172,193	40	213.9	40	Y	N/A	Y

National Flood Insurance Program (NFIP) policy coverage (policies/values) = 519 policies totaling approximately $118,340,600.

Data provided below only includes areas in Sarpy County that are located within the Big-Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.13 Community Analyses and Results

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	18.6	8.3	0.9	7.4
Within Floodway	10.1	1.8	3.5	-1.7

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Sarpy County, the figures in this table only represent information within Sarpy County.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	871	-601	270	N/A	N/A	N/A
Within Floodway	44	-51	-7	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Sarpy County, the figures in this table only represent information within the Sarpy County.*

Values in the above table are rounded to the nearest tenth .Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**

  The Sarpy County's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Sarpy County: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	$229,700,000	2%	$29,700,000	0%	$41,300,000	0%	$53,500,000	1%	$102,100,000	1%	$3,100,000	0%
Commercial Building/Contents	$83,800,000	8%	$8,300,000	1%	$16,700,000	2%	$21,200,000	2%	$36,200,000	3%	$1,400,000	0%
Other Building/Contents	$92,700,000	12%	$9,800,000	1%	$19,900,000	3%	$24,400,000	3%	$37,000,000	5%	$1,600,000	0%
Total Building/Contents[2]	$406,000,000	3%	$47,800,000	0%	$77,800,000	1%	$99,100,000	1%	$175,200,000	1%	$6,100,000	0%
Business Disruption[3]	$16,900,000	N/A	$1,800,000	N/A	$3,700,000	N/A	$4,500,000	N/A	$6,600,000	N/A	$300,000	N/A
TOTAL[4]	$422,900,000	3%	$49,500,000	N/A	$81,300,000	N/A	$103,400,000	N/A	$181,500,000	N/A	$6,400,000	N/A

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the Sarpy County.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation	Number of Occurrences	Data Source

3.3.14 Washington County Summary (CID 310483)

The following pages include Flood Risk data for the Washington County.

*3.3.14.1. **Overview***

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in Watershed	Total Community Land Area (sq mi)	Percent of Land Area in Watershed	NFIP	CRS Rating	Mitigation Plan
Washington County	310483	20,234	1	390.0	1	Y	N/A	Y

Data provided below only includes areas in the Washington County that are located within the Big Papillion-Mosquito Watershed Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

*3.3.15.2. **Community Analyses and Results***

Results for each of the Flood Risk Datasets developed for this Flood Risk Project are summarized below:

- **Changes Since Last FIRM**

The table below summarizes the increases, decreases, and net change of SFHAs for the community.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.5	N/A	0.3	-0.3
Within Floodway	0.1	0.1	N/A	0.1

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Washington County, the figures in this table only represent information within the Washington County.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

The table below summarizes the increases, decreases, and net change of affected structures and population for the community.

Area of Study	Buildings			Population		
	Increase	Decrease	Net Change	Increase	Decrease	Net Change
Within SFHA	N/A	N/A	N/A	N/A	N/A	N/A
Within Floodway	N/A	N/A	N/A	N/A	N/A	N/A

**Although the Flood Risk Database may contain Changes Since Last FIRM information outside of Washington County, the figures in this table only represent information within Washington County.*

Values in the above table are rounded to the nearest tenth. Communities with values of 0.0 may still be affected by flooding and included in the risk assessment.

Section 2 of this report provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Multi-frequency flood depth grids (10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood events)
    - Percent annual chance of flooding grids
    - Percent chance of flooding over a 30-year period grids
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.
- **Flood Risk Results**

  The Washington County's flood risk analysis uses results from a FEMA-performed Hazus analysis which accounts for newly modeled areas in the Flood Risk Project and newly modeled depths for certain flood events. Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Washington County: Estimated Potential Losses for Flood Event Scenarios

Type	Total Inventory		10% (10-yr)		2% (50-yr)		1% (100-yr)		0.2% (500-yr)		Annualized ($/yr)	
	Estimated Value	% of Total	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]	Dollar Losses[5]	Loss Ratio[1,6]
Residential Building/Contents	#	#	#	#	#	#	#	#	#	#	#	#
Commercial Building/Contents	1	#	#	#	#	#	#	#	#	#	#	#
Other Building/Contents	1	#	#	#	#	#	#	#	#	#	#	#
Total Building/Contents[2]	1	#	#	#	#	#	#	#	#	#	#	#
Business Disruption[3]	1	#	#	#	#	#	#	#	#	#	#	#
TOTAL[4]	1	#	#	#	#	#	#	#	#	#	#	#

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Loss ratio = Dollar Losses / Estimated Value
[2]Total Building/Contents Loss = Residential Building/Contents Loss + Commercial Building/Contents Loss + Other Building/Contents Loss.
[3]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[4]Total Loss = Total Building/Contents + Business Disruption
[5]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[6]Loss Ratios rounded to nearest integer percent.

The figures in this table only represent information within the Washington County.

- **Areas of Mitigation Interest**
  - Section 2.2.4 of the FRR provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Type of Mitigation Interest	*Number of Occurrences*	*Data Source*
Other Flood Risk Areas		

4 Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

4.1 Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

4.1.1 Preventative Measures

Preventative measures are intended to keep flood hazards from getting worse. They can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations
- Open space preservation
- Building codes
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements
- Participation in the NFIP Community Rating System (CRS)

NFIP's 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 community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

4.1.2 Property Protection Measures

Property protection measures protect existing buildings by modifying the building to withstand floods, or by removing buildings from hazardous locations. Examples include:

- Building relocation

- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

4.1.3 Natural Resource Protection Activities

Natural resource protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Improved forestry practices such as reforesting or selective timbering (extraction)

4.1.4 Structural Mitigation Projects

Structural mitigation projects lessen the impact of floods by modifying the environmental natural progression of the flooding event. Structural protection such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance

4.1.5 Public Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Libraries
- Technical assistance
- Real estate disclosure
- Environmental education

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

- Risk information via the nightly news

4.1.6 Emergency Service Measures

Although not typically considered a mitigation technique, emergency service measures minimize the impact of flooding on people and property. These are actions commonly taken immediately prior to, during, or in response to a hazard event. Examples include:

- Hazard warning system
- Emergency response plan
- COOP and COG planning
- Critical facilities protection
- Health and safety maintenance
- Post flood recovery planning

In Section 3, specific AoMIs were identified. Table 4.1 below identifies possible mitigation actions for each AoMI to consider.

Table 4-1. Mitigation Actions for Areas of Mitigation Interest

AoMI	*Possible Actions to Reduce Flood Risk*
Dams	*Engineering assessment* *Dam upgrades and strengthening* *Emergency Action Plan* *Dam removal* *Easement creation in impoundment and downstream inundation areas*
Levees (accredited and non-accredited) and significant levee-like structures	*Generally same as dams above* *Purchase of flood insurance for at-risk structures*
Coastal Structures *Jetties* *Groynes* *Seawalls* *Other structures*	*Increase coastal setbacks for construction* *Habitat restoration programs* *Wetland restoration and mitigation banking programs*
Stream Flow Pinch Point *Undersized culverts or* *bridge openings*	*Engineering analysis* *Replacement of structure pre- and post-disaster*
Past Claims and IA/PA Hot Spots	*Acquisition* *Elevation* *Relocation* *Floodproofing*
Major Land Use Changes (past 5 years or next 5 years)	*Higher regulatory standard* *Stormwater BMPs* *Transfer of Development rights* *Compensatory storage and equal conveyance standards*
Key Emergency Routes Overtopped During Frequent Flooding Events	*Elevation* *Creation of alternate routes* *Design as low water crossing*

AoMI	*Possible Actions to Reduce Flood Risk*
Areas of Significant Riverine or Coastal Erosion	*Relocation of buildings and infrastructure* *Regulations and planning* *Natural vegetation* *Hardening*
Drainage or Stormwater- Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to be Inundated	*Identification of all flood hazard areas*
Areas of Mitigation Success	*N/A*

4.2 Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA Mitigation Planning How To Guide #3 (FEMA 386-3) "Developing the Mitigation Plan - Identifying Mitigation Actions and Implementation Strategies" for more information on how to identify specific mitigation actions to address hazard risk in your community.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?
- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information go to www.planning.org. or http://www.fema.gov/library.

Your local Hazard Mitigation Plan is a valuable place to identify and prioritize possible mitigation actions. The plan includes a mitigation strategy with mitigation actions that were developed through a public and open process. You can then add to or modify those actions based

on what is learned during the course of the Risk MAP project and the information provided within this FRR.

4.3 Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several state and federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at http://www.fema.gov/government/grant/hma/index.shtm.

4.3.1 FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 4.2 below.

Table 4-2. FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards
Repetitive Flood Claims (RFC)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduce flood claims against the NFIP through flood mitigation; properties must be currently NFIP insured and have had at least one NFIP claim
Severe Repetitive Loss (SRL)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduce or eliminate the long-term risk of flood damage to SRL residential structures currently insured under the NFIP

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA, RFC, and SRL programs focus funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, tribes, and territories (applicant) that, in turn, provide subgrants to local governments and communities (sub applicant). The applicant selects and prioritizes sub applications developed and submitted to them by sub applicants and submits them to FEMA for funding consideration. Prospective sub applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

4.3.2 Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5 Acronyms and Definitions

5.1 Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	*Areas of Mitigation Interest*

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

N

NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

RFC	Repetitive Flood Claims
Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SRL	Severe Repetitive Loss

U

USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

5.2 Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

Cfs – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).
Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. Sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. Sometimes referred to as flood risk.

Floodborne debris impact – Floodwater moving at a moderate or high velocity can carry floodborne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.
Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress, and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Probability (of flood) – The likelihood that a flood will occur in a given area.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater –Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6 Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

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FEMA, 2001. *Understanding Your Risks: Identifying Hazards and Estimating Losses*, FEMA 386-2. Washington, DC, August 2001.

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FEMA, 2002b. *Integrating Manmade Hazards into Mitigation Planning*, FEMA 386-7. Washington, DC, September 2002.

FEMA, 2003a. *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies*, FEMA 386-3. Washington, DC, April 2003.

FEMA, 2003b. *Bringing the Plan to Life: Implementing the Hazard Mitigation Plan*, FEMA 386-4. Washington, DC, August 2003.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*, FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006a. *Multi-Jurisdictional Mitigation Planning*, FEMA 386-8. Washington, DC, August 2006.

FEMA, 2006b. *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*, FEMA 386-9. Washington, DC, August 2008.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007a. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007b. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007c. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007d. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007e. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007f. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

7 Data Used to Develop Flood Risk Products

GIS base map information was acquired from the following sources:

- Federal Emergency Management Agency (FEMA)
- Nebraska Department of Natural Resources (NE DNR)
- Strategic Alliance for Risk Reduction (STARR)
- United States Geological Survey (USGS)
- Douglas County, NE
- Sarpy County, NE

Additional Proposal Information

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Attachment E_2017 Econ Study FYRA Engineering.pdf

Technical Memorandum

To: Papio-Missouri River NRD
From: FYRA Engineering
Re: Papillion Creek Watershed Dams – 2017 Economic Benefits
Date: July, 2017

EXECUTIVE SUMMARY

This TM is intended to calculate the most readily quantifiable benefits provided by the existing and planned dams in the Papillion Creek Watershed. A range of methods were used for the benefit types studied and are described within this TM. A summary of the total average annual benefits are:

Flood Damage Reduction:	$7,534,850
Flood Insurance Premium Reductions:	$7,196,970
Recreation:	$3,606,130
Property Tax Increase (annual):	$6,760,880
Total Average Annual Benefits:	$25,098,830

The four average annual benefits combined with a one-time property value increase of $321,946,710, could support a project cost of nearly $910,000,000 utilizing the current Federal Discount Rate of 3.125% over a 100-year project life.

FLOOD DAMAGE REDUCTION

To assess the flood damage reductions due to constructed and planned dams in the Papillion Creek Watershed, the net impact on hydrology and hydraulics was required. This was performed for the WP-6&7 sites while preparing a grant application for the Nebraska Natural Resources Commission's Water Sustainability Fund (WSF). The methodology and technical process is explained in detail as part of that application and is available for review along with this document. The flood damage reduction benefits related to (with-project) reduced flood elevations are explained for structural damage reduction, infrastructure savings, and traffic delays.

To approximate watershed-wide flood damage reduction, the average annual benefits realized per acre of drainage area controlled was applied to the drainage areas of the other dams in the watershed. Flood damage reduction benefits are attributable to several factors, but variances in these factors will generally average out over an entire watershed. The watershed-wide benefits is calculated by taking an annual reduction in flood damages per acre calculated for WP-6&7 ($186,872/1,735 Ac)=$107.71/Ac and applying it to the total 69,955 acres controlled by the watershed project. This equates to $7,534,850 per year in average annual benefits. See Attachment 1 below for watershed drainage acres controlled.

FLOOD INSURANCE PREMIUM REDUCTIONS

Due to the presence of Zone A delineated floodplains, floodplain insurance is required whenever a home mortgage is written. With the recent modifications to the NFIP program through the Biggert-Watters Act, floodplain insurance costs have increased. Based on discussions with local insurance agents as well as the P-MRNRD, it is estimated that floodplain insurance ranges from $4,000-6,000 per year for residential homes in this vicinity that would be classified as high-risk. Moderate to low risk residences would pay less than $500/year, however, only high-risk structures were included in this analysis. A valid estimate of commercial and industrial floodplain insurance was not acquired for this study for high-risk areas; however, based on moderate risk rates from the NFIP (https://www.floodsmart.gov/floodsmart/pages/commercial_coverage/policy_rates.jsp), it is expected that high-risk, non-residential properties may reach $10,000/year. For this study, an average value of $5,000/year was utilized for both residential and commercial/industrial properties.

Our analysis included the savings realized by not having to purchase flood insurance which comes when a structure is removed from the delineated floodplain. Similar to the process described above for applying flood damage reduction benefits realized for regional detention sites WP-6&7, watershed-wide flood insurance premium reductions were estimated by applying the total benefits calculated for WP-6&7 to other sites on a per square mile of drainage area controlled basis. The watershed-wide benefits are calculated by taking an annual reduction in flood insurance premiums per acre calculated for WP-6&7 ($178,500/1,735 Ac)=$102.88/Ac and applying it to the total 69,955 acres

controlled by the watershed project. This equates to $7,196,970 per year in average annual benefits. See Attachment 1 for watershed drainage acres controlled.

RECREATION

Recreation benefits are realized when recreators participate in an activity. Several methods are utilized by planners for calculating these benefits. The Nebraska Natural Resources has a defined process used in calculating economic benefits related to recreation. The U.S. Army Corps of Engineers also has a similar process, which was used for this study.

The constructed dams were inventoried for their recreational facilities and some general planning assumptions were obtained from NRD staff for the planned sites. Attachment 1 shows the calculation process and the results for each site.

PROPERTY VALUE INCREASE

When dams with reservoirs are constructed, the water serves as an attractant for development, and relatively more expensive development is often the case. Many detailed studies have been conducted over the years about the value of water on development and the general consensus has been that for smaller lakes and reservoirs, property value increases are in the neighborhood of 15-20%.

A detailed calculation was performed for Sites WP-6&7 in the WSF application mentioned above. The total (one-time) value increase for those sites was calculated to be $7,399,410 in Table B-3.16 of the Supplemental Information Attachment. Using a ratio of size of permanent pools (vs. the drainage acres used for flood damage reduction described above), a watershed-wide, one-time increase in valuation can be calculated by taking the average increase per pool acre for WP-6&7 ($7,399,410/50.2)=$147,398 times the total acres in the watershed project of 2,184.2 equals a one-time valuation increase of $321,946,710. It should be noted that for every year, property taxes at an average of 2.1% would yield an additional $6,760,880 in property tax collections. See Attachment 1 below for watershed permanent pool acres.

Attachment 1

Flood Insurance Data

Flood Reduction Benefits

Size Factor	Units	15-A	WP-5	DS-12	DS-19	DS-7	WP-4	WP-1	WP-6	WP-7	DS-6	Cunningham	Standing Bear	Youngman	Zorinsky	Wehrspann	Walnut Creek	Shadow Lake	Midlands Lake	Candlewood	WP-2	DS-10	DS-9A	DS-8A	Total
Permanent Pool	Acres	220	125	70	100	47	16	24	34	16.2	40	392	135	54	253	246	97	37	15	32	21	97	38	75	2184.2
Drainage Area	Acres	7104	5376	1670	2750	1600	563	864	1267	468	510	11392	3840	1344	10496	8384	2112	1472	576	1408	679	2950	1280	1850	69955

Recreational Benefits Data

Recreation Benefits

Recreational Activity	Units	15-A	WP-5	DS-12	DS-19	DS-7	WP-4	WP-1	WP-6	WP-7	DS-6	Cunningham	Standing Bear	Youngman	Zorinsky	Wehrspann	Walnut Creek	Shadow Lake	Midlands Lake	Candlewood	WP-2	DS-10	DS-9A	DS-8A	Total	Parties / Unit	# Peak Days	Ave # Per Party	Turnover Rate	Peak Day Use Factor	% Activity on Peak Days	Total Activity Days	Recreation Days	Value Per Rec Day	Recreation Benefits
RV Camping	Pads	30										58					44								132	1	32	2.5	0.5	120	60	26400.00	13200.0	$ 30.62	$ 404,184
Hiking	Miles	6.4	4.4	4.85	7	3	2	2	1.6	1.1	2	6	3	0	7.9	6.2	3.5	1.42	0.59	0	2	4	3	3	74.96	**12**	**26**	**2.5**	**2**	**130**	**60**	194896.00	**97448.0**	$ 7.68	$ 748,401
Fishing	Acres	220	125	70	100	47	16	24	34	16.2	40	392	135	54	253	246	97	37	15	32	21	97	38	75	2184	**0.1**	**27**	**2.5**	**1.5**	**101.25**	**30**	73716.75	**36858.4**	$ 7.68	$ 283,072
Canoeing	Acres	220	125	70	100	47	16	24	34	16.2	40	392	135	54	253	246	97	37	15	32	21	97	38	75	2184	**0.1**	**28**	**2**	**2**	**168**	**65**	56453.17	**28226.6**	$ 7.68	$ 216,780
Bicycling	Miles	6.4	4.4	4.85	7	3	2	2	1.6	1.1	2	6	3	0	7.9	6.2	3.5	1.42	0.59	0	2	4	3	3	74.96	12	26	3	2	130	60	194896.00	97448.0	$ 7.68	$ 748,401
Picnicking	Tables	250	8	12	20	8	8	8	8	8	8	73	5	15	20	15	25				8	8	8	8	523	**1**	**17**	**4**	**2**	**136**	**60**	118546.67	**59273.3**	$ 7.68	$ 455,219
Tennis	Courts	4																							4	1	16	2.5	2	160	65	984.62	492.3	$ 30.62	$ 15,074
Horseback Riding	Miles	1.6																							1.6	8	22	3	2	110	50	2816.00	1408.0	$ 30.62	$ 43,113
Baseball	Field	4	3												5										12	2	70	11	2	120	50	5760.00	2880.0	$ 30.62	$ 88,186
Ice Fishing	Acres	220	125	70	100	47	16	24	34	16.2	40	392	135	54	253	246	97	37	15	32	21	97	38	75	2184	0.1	20	2.5	1.5	101.25	60	36858.38	18429.2	$ 7.68	$ 141,536
Basketball	Courts	2																							2	2	22	5	4	160	60	1066.67	533.3	$ 7.68	$ 4,096
Skate Park	Area	1																							1	30	35	2.5	4	150	70	6428.57	3214.3	$ 30.62	$ 98,421
Frisbee Golf	Course	1																							1	8	30	3	3	150	65	1846.15	923.1	$ 30.62	$ 28,265
LaCrosse	Field	1																							1	2	40	20	2	120	50	480.00	240.0	$ 30.62	$ 7,349
Rugby	Field	1																							1	4	40	24	2	120	50	960.00	480.0	$ 30.62	$ 14,698
Polo	Field	1																							1	4	40	20	1	130	70	742.86	371.4	$ 30.62	$ 11,373
Soccer	Field	14	3												3										20	2	80	24	2	130	50	10400.00	5200.0	$ 7.68	$ 39,936
Softball	Field	2	3																						5	2	70	11	2	120	50	2400.00	1200.0	$ 30.62	$ 36,744
Sledding	Area	1	1		1											1									4	50	16	4	4	150	70	42857.14	21428.6	$ 7.68	$ 164,571
Playground	Area	2	1											1	2	1	1								8	8	25	3	4	150	65	14769.23	7384.6	$ 7.68	$ 56,714

Total Recreation Benefits:	**$**	**3,606,133**

Notes

It is assumed that Supply = Unmet Demand
USACE Planning (EGM14-03 FY11) Generalized Rec: $3.84-$11.53 - Use Ave of $7.68
USACE Planning (EGM14-03 FY11) Specialized Rec: $15.61-$45.63 - Use Ave of $30.62

Additional Proposal Information

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20170809_ProposedPapioCreekBasinStudyAreaMap11x17.pdf

Papillion Creek Basin
Proposed & Existing Flood Risk Measures Map

Other Non-Federal Sponsors Letter(s) of Support

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USACE support letter Gretna.pdf

Gretna
THE GREAT LIFE

Jeff Kooistra
City Administrator
204 N McKenna Avenue
P.O. Box 69
Gretna, NE 68028

July 28, 2017

Robert M. Speer
Acting Secretary of the Army
US Army Corps of Engineers
Submitted online

RE: Proposal from Non-Federal Sponsor for inclusion in the Annual Section 7001 Report to Congress for WRRDA – Papillion Creek Basin Flood Risk Management Feasibility Study

Dear Mr. Speer,

This letter is to document our support and financial commitment for the development and implementation of the Papillion Creek Basin Flood Risk Management Feasibility Study. As a member of the Papillion Creek Watershed Partnership (Partnership), the City of Gretna supports the proposal for a comprehensive watershed feasibility study to build upon the existing watershed planning and identify projects to reduce flood risks and restore the degraded ecosystem habitats in the basin. Since 2001, we have been a part of the Partnership to address these concerns.

Development in the watershed is rapidly changing what is left of the rural landscape and the need to implement projects to address flood risk and protect natural resources is critical. Because of this need, the City of Gretna has contributed to the Partnership financially to develop watershed management plans in 2009 and an update in 2014 as well as a commitment through ordinances to collect development fees as a way to help fund the high cost of implementing flood risk projects.

The Papio-Missouri River Natural Resources District (P-MRNRD) is the administering agent for the Partnership and is the lead on this proposal. The P-MRNRD intends to fund the local share of the feasibility study; however, the City of Gretna remain committed to contributions through the Partnership to assess the watershed and implement projects.

On behalf of the citizens and business community, the City of Gretna gives it full support for the P-MRNRD's proposal and urge the US Army Corps of Engineers to recognize the importance and need to support and funding this important project.

Sincerely,

Jeff Kooistra
City Administrator
City of Gretna, NE

Primary Sponsor Letter of Support

(As uploaded)

NRD letter of support.pdf

PAPIO-MISSOURI RIVER
NATURAL
RESOURCES
DISTRICT

8901 S. 154TH ST.
OMAHA, NE 68138-3621
(402) 444-6222
FAX (402) 895-6543
www.papionrd.org

March 14, 2017

COLONEL JOHN W. HENDERSON, P.E.
District Commander
US Army Corps of Engineers, Omaha District
1616 Capitol Avenue
Omaha NE 68102-4901

Re: Papillion Creek Basin Feasibility Study - Letter Of Intent

Dear Colonel Henderson:

A study is needed to identify a project to reduce flood risks and restore degraded ecosystem habitats in the Papillion Creek Basin of eastern Nebraska. The 400 square mile Papillion Creek Basin in eastern Nebraska encompasses the entire Omaha Metropolitan Area and over 1/3 of the State's population. The basin is susceptible to severe flooding and continued urbanization and land use changes within the watershed have increased runoff peaks and volumes. The Papio-Missouri River Natural Resources District, City of Omaha, and surrounding communities continue to pursue a comprehensive solution to address flood threats. A feasibility study is needed that would examine engineering, economic, and environmental data, and apply a contemporary approach to integrate non-structural and structural flood risk reduction and ecosystem restoration into a system-wide plan that is expected to produce significant benefits.

The Papio-Missouri River NRD stands ready and able to serve as local sponsor for this project and to cost share at a rate of 50-50 on this feasibility study currently estimated to cost $3 million.

Thank you for your kind consideration.

With Highest Regards,

John Winkler,
General Manager

Other Non-Federal Sponsors Letter(s) of Support

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USACE Support Letter-La Vista-Section 7001Study-20170803.pdf

August 3, 2017

Robert M. Speer
Acting Secretary of the Army
US Army Corps of Engineers
Submitted online

La Vista
Community Pride. Progressive Vision.

RE: Proposal from Non-Federal Sponsor for inclusion in the Annual Section 7001 Report to Congress for WRRDA – Papillion Creek Basin Flood Risk Management Feasibility Study

Dear Mr. Speer,

This letter is to document our support and financial commitment for the development and implementation of the Papillion Creek Basin Flood Risk Management Feasibility Study. As a member of the Papillion Creek Watershed Partnership (Partnership), the City of La Vista, Nebraska supports the proposal for a comprehensive watershed feasibility study to build upon the existing watershed planning and identify projects to reduce flood risks and restore the degraded ecosystem habitats in the basin. Since 2001, we have been a part of the Partnership to address these concerns.

Development in the watershed is rapidly changing what is left of the rural landscape and the need to implement projects to address flood risk and protect natural resources is critical. Because of this need, the City of La Vista, Nebraska has contributed to the Partnership financially to develop watershed management plans in 2009 and an update in 2014 as well as a commitment through ordinances to collect development fees as a way to help fund the high cost of implementing flood risk projects.

The Papio-Missouri River Natural Resources District (P-MRNRD) is the administering agent for the Partnership and is the lead on this proposal. The P-MRNRD intends to fund the local share of the feasibility study; however, the City of La Vista, Nebraska remains committed to contributions through the Partnership to assess the watershed and implement projects.

On behalf of the citizens and business community, the City of La Vista, Nebraska gives it full support for the P-MRNRD's proposal and urges the US Army Corps of Engineers to recognize the importance and need to support and funding this important project.

Sincerely,

John M. Kottmann

John M. Kottmann, City Engineer

City of La Vista, Nebraska

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Community Development
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Fire
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f: 402-331-0410

Golf Course
8305 Park View Blvd.
p: 402-339-9147

Library
9110 Giles Rd.
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f: 402-537-3902

Police
7701 South 96th St.
p: 402-331-1582
f: 402-331-7210

Public Buildings & Grounds
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Public Works
9900 Portal Rd.
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f: 402-331-1051

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f: 402-331-0299

www.cityoflavista.org
info@cityoflavista.org

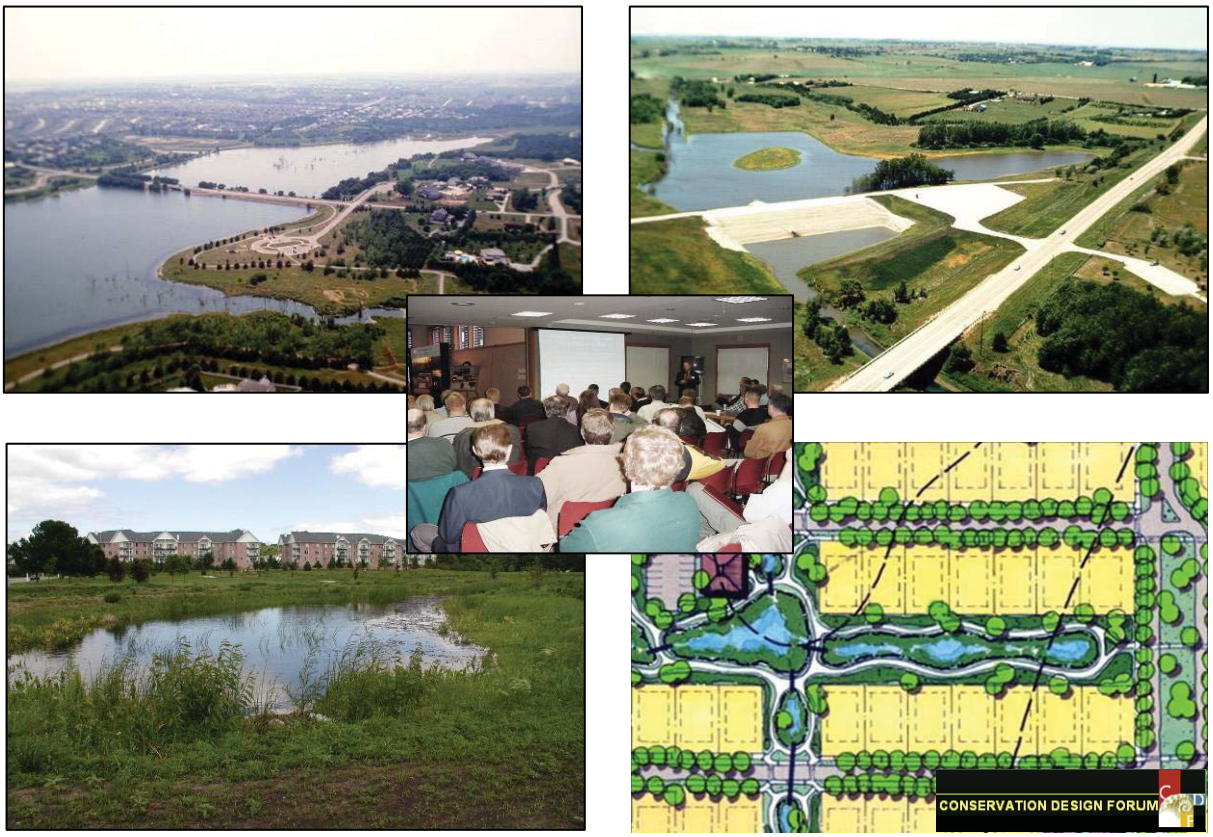
Additional Proposal Information

(This is as uploaded, a blank page will show if nothing was submitted)

Attachment A__2009 Papillion Creek Watershed Plan Executive Summary.pdf

PAPILLION CREEK WATERSHED MANAGEMENT PLAN

APRIL 2009



Papillion Creek Watershed Partnership

HDR | ONE COMPANY *Many Solutions*℠

in association with

Conservation Design Forum

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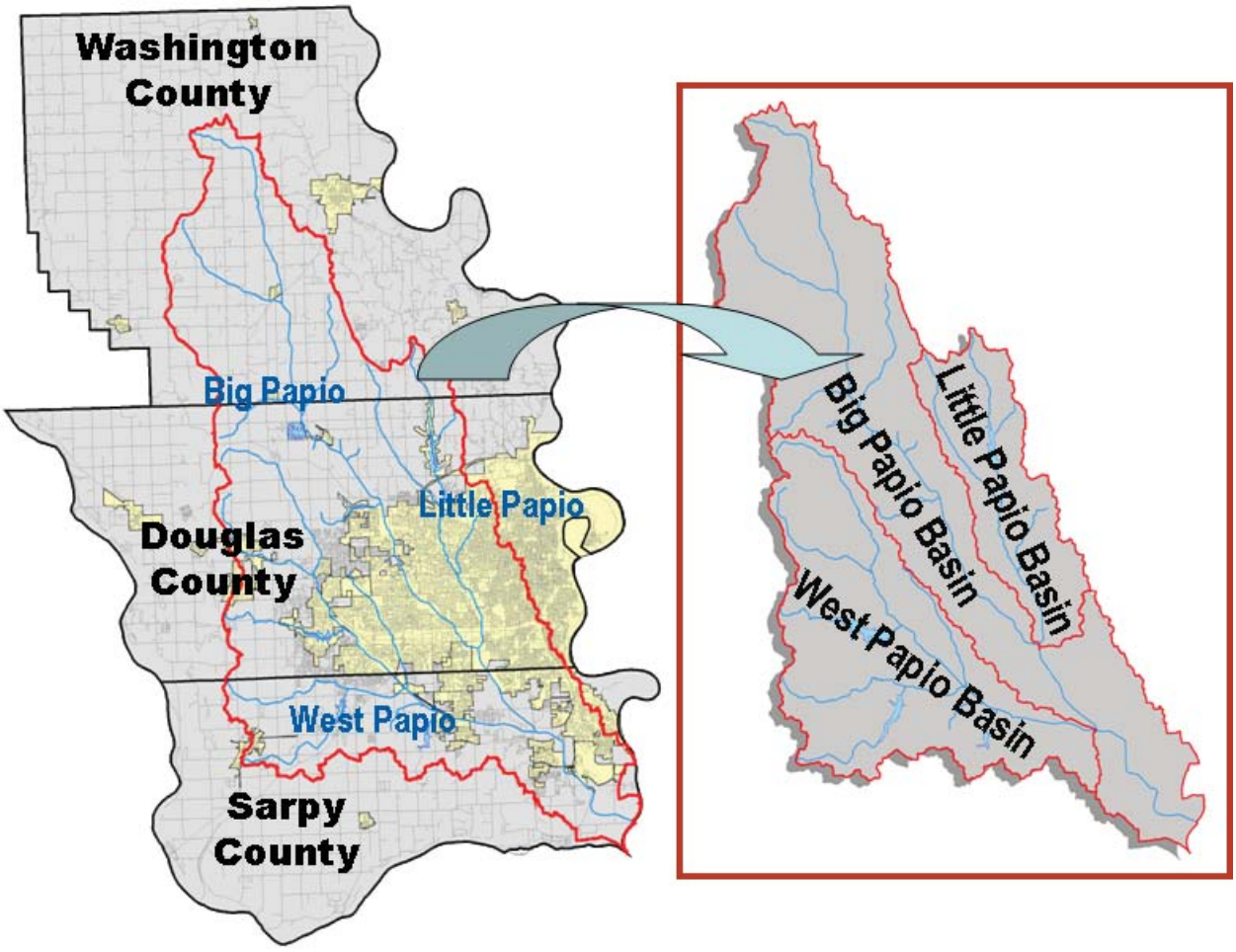
Executive Summary

E.1 Background and Purpose

Improved stormwater management within the Papillion Creek Watershed (Watershed) has been the on-going objective of the Papillion Creek Watershed Partnership (PCWP) since its formation in August 2001. The Watershed covers approximately 402 square miles of drainage area extending from northern Washington Country southward through Douglas and Sarpy Counties and ultimately discharges to the Missouri River south of Bellevue – see Figure E-1. PCWP members consist of the cities of Bellevue, Bennington, Boys Town, Gretna, La Vista, Omaha, Papillion, and Ralston; Douglas and Sarpy Counties; and the Papio-Missouri River Natural Resources District (P-MRNRD).

Figure E-1 Papillion Creek Watershed



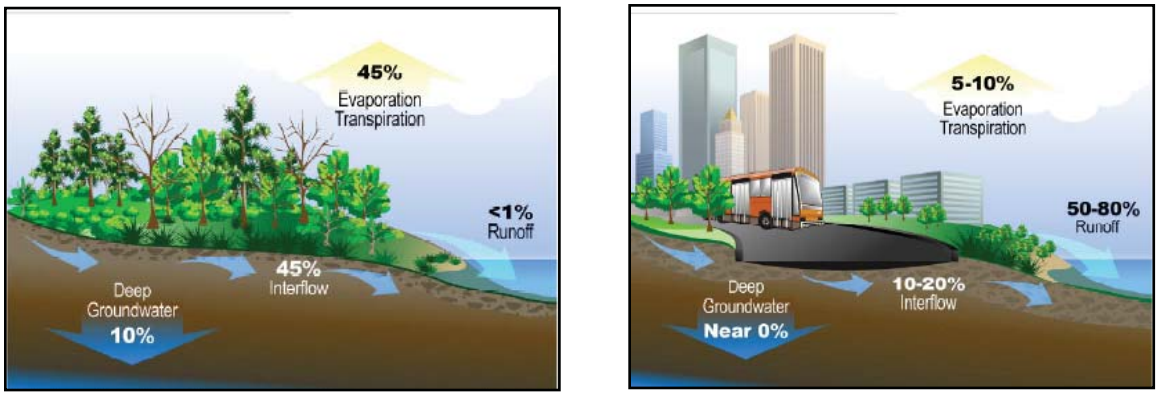
The Papillion Creek Watershed has a number of existing regulatory-driven water quality (WQ) impairments, as identified by the Nebraska Department of Environmental Quality (NDEQ). Water quality impairments as of NDEQ's March 2008 listing[1] include:

- *E. coli* bacteria contamination in the majority of the major tributaries in Douglas and Sarpy Counties. Tributaries in Washington County have not been studied in this regard, but high inbound bacterial counts exist near the northern border of Douglas County.
- Excessive nutrients (nitrogen and phosphorus) and low dissolved oxygen in Cunningham Lake. (Note: Walnut Creek, Wehrspann, and Zorinsky Lakes have been "de-listed" for nutrients, due to the placement of water quality basins and other pollution source controls above the lakes).
- Low dissolved oxygen in Cole Creek (a tributary of Little Papillion Creek).
- Excessive sediment in Candlewood Lake.
- Isolated cases of toxic pollutants in the form of mercury, selenium, dieldrin, and PCBs.

The majority of PCWP members have stormwater permits through NDEQ. As a part of the permit requirements[2], a Watershed Management Plan (Plan) containing strategies for structural and non-structural best management practices (BMPs), must be submitted to the NDEQ by the end of July 2009 to address stormwater management in general and water quality improvements in particular.

Figure E-2 illustrates how the water balance changes when a natural forest cover is replaced by urban development. The example percentages in the exhibit highlight the magnitude of the additional volume of water that must be handled by a drainage system after land is cleared and developed. The amount of surface runoff from a forested or naturally vegetated watershed is normally expected to be minimal, but after development, flow in streams typically originates as surface runoff.

Figure E-2 Rainfall-Runoff Response on the Built Environment



Natural Conditions **Urban Development**

Source: Metropolitan North Georgia Water Planning District Watershed Management Plan

[1] Available at NDEQ website: http://www.deq.state.ne.us/.

[2] NPDES permit requirement 5.c states "The applicant individually or as a member of the PCWP will develop and implement strategies that include a combination of structural and/or non-structural best management practices (BMPs) appropriate for the watershed."

In addition to water quality concerns, the Papillion Creek Watershed has a long history of flooding problems that have been studied and documented a number of times during the last 40 years, and various plans for flood control and flood damage mitigation have evolved. Significant flooding threats from major storms still exist, and continued new growth and re-development projects in the Watershed must implement appropriate surface runoff control measures to not only keep pace with such growth, but to also reduce peak flows below current baseline levels to the extent practicable. Under conventional development methods, as a watershed is cleared for development, and agricultural lands are converted to impervious surface, the surface runoff volume increases in proportion to the percentage of impervious surface area.

The PCWP has developed an integrated approach to address peak flow reduction and water quality controls in the Watershed: a combination of Low Impact Development (LID), water quality basins, and regional detention basins. The primary goal of LID control methods is to mimic or improve the pre-development site hydrology by using site design techniques that promote the storage, infiltration, and evaporation of stormwater runoff which thereby reduces runoff and improves water quality. Figure E-3 illustrates some examples of LID techniques. The primary goal of regional detention basins is to detain flood flows and then slowly release the water after the storm has subsided. Figure E-4 is an aerial photograph looking northeasterly at Walnut Creek Reservoir, a regional detention basin located on Walnut Creek, a tributary of West Papillion Creek. Note the lead-in water quality basins at the southeast and southwest corners of the main lake to help control sediment and nutrients.

Figure E-3 Samples of Low Impact Development BMPs

Bioretention Swales

Naturalized Detention

Source: Conservation Design Forum. Lisle, IL.

Figure E-4 Sample of Regional Detention Basin

Walnut Creek Reservoir

Source: Papio-Missouri River NRD.

Since water quality is inherently related to stream flow, it makes sense to merge both water quality improvement and flood protection improvement strategies into a single Watershed Management Plan; this being the purpose of this report.

HDR Engineering, Inc. (HDR), in association with Conservation Design Forum (CDF) under the direction of the PCWP and with previous feedback from stakeholders and the public has formulated a recommended three-tiered Plan that consists of a combination of stormwater management strategies:

1. Water quality improvements. The water quality structural portion of the Plan should remain flexible, and certainly additional lot-level LID source controls should be actively encouraged, but there are two baseline water quality improvement components of the Plan that should be considered mandatory:
   a. WQ LID Throughout the Entire Watershed. Localized low impact development (LID) source controls have two main stormwater runoff flow control objectives:
      - Capturing the first 0.5 inches of net runoff for all storms. This provision is intended to address the "first flush" of pollutants.
      - Providing "no net increase" in peak flows from a 2-year storm[3] relative to existing baseline conditions for all new development and significant re-development areas. This provision is specifically intended to decrease streambank erosion[4] and improve overall water quality.

      This water quality improvement approach will be termed "water quality LID" ("WQ

[3] As per U.S. Department of Commerce, *Technical Paper No. 40, Rainfall Frequency Atlas of the United States*, a 2-year, 24-hour storm equates to 3.0 inches of rainfall for the Papillion Creek Watershed area of Nebraska and has a 50% probability of occurrence in any given year. In actual design of LID controls, the storm duration, rainfall intensities, and net runoff will be determined by standard hydrologic practice on a site-specific basis to properly reflect the size and nature of the drainage area served.

[4] The lower-most "bank" of a stream is typically defined by approximately 2-year storm flows, so controlling 2-year storm events to existing baseline condtions will help to maintain stream bank stability.

LID"). WQ LID source controls primarily consist of engineered bioretention areas and natural vegetated drainage pathways that retard low-intensity peak storm flows, minimize pollutant transport, encourage surface water infiltration (volume reduction) but only have minimal detention storage within the vegetated drainage pathways. WQ LID measures are also intended to minimize downstream streambank erosion. WQ LID control measures are to be implemented in newly developed or significantly redeveloped areas at the same pace that growth occurs.

b. Water Quality Basins. A total of 12 potential water quality basins have been defined upstream of regional detention basins (9 sites upstream of existing regional detention sites and 3 sites upstream of potential regional detention basins). Water quality basins are impoundment structures that typically have wetlands type drainage approaches with receiving pool areas designed specifically for sediment capture and nutrient reduction. They are essentially a dedicated stormwater pretreatment system intended to decrease sediment, nutrients, and other pollutants from being transported to a downstream regional detention structure; thereby minimizing degradation in flood protection functionality, aesthetics, and water quality for aquatic life.

2. Peak flow reduction improvements for the 100-year storm[5] consisting of:

a. Max LID in Washington County in Lieu of Regional Detention. Localized on-site detention ponds or vegetated swales of comparable storage volume are included for all new residential estate (large lot) development in Washington County in lieu of regional detention. As an additional consideration, any future commercial/industrial areas may include any combination of 100-year storm controls in the form of on-site detention ponds, below-grade storage basins, or equivalent storage provided by permeable pavement underdrain systems. Such 100-year storm control measures are intended to be supplemental to baseline WQ LID controls; the combination of which is termed herein as "Maximum LID" (Max LID). The timing for implementation of peak flow reduction protection is limited by the pace of growth. It has been estimated via population projections that Max LID type protection in Washington County will be less than 20% complete by 2050 and that full build-out protection will extend for many decades beyond 2050. For Maximum LID conditions the net peak discharge performance requirements for on-site detention for LID development areas are 0.2 cfs per acre for a 2-year storm and 0.5 cfs per acre for a 100-year storm for all land use types.

b. Regional Detention Basins in Douglas and Sarpy Counties. A suite of 15 regional detention basins have been screened for relative performance effectiveness and implementation priority/scheduling. Regional detention has the potential advantage of being able to provide earlier flood protection in the Watershed (construction may occur prior to full build-out), provided that necessary funding is secured. Construction of regional detention basins is to be coordinated with other jurisdictional planning activities.

c. Watershed Management Plan Flexibility. The long-term Plan is intended to be flexible, in that Max LID measures may also be implemented in Douglas and Sarpy Counties to the extent deemed appropriate, which may in some cases be in lieu of or supplemental to regional detention.

---

[5] As per U.S. Department of Commerce, *Technical Paper No. 40, Rainfall Frequency Atlas of the United States,* a 100-year, 24-hour storm equates to 6.7 inches of rainfall for the Papillion Creek Watershed area of Nebraska and has a 1% probability of occurrence in any given year .

3. Plan implementation components:
   a. Adoption of updated stormwater management policies.
   b. Other enabling local and State legislation for general obligation bonding authority for the P-MRNRD and for the ability of cities to create a stormwater utility fee system.
   c. A financial framework that includes a Watershed Management Fee system for cost sharing for regional detention basins, water quality basins, and Max LID (on-site detention component only) projects for 100-year storm peak flow reduction.
   d. WQ LID costs would be the sole responsibility of the development (that is, not eligible for cost sharing).
   e. A list of potential long-term capital improvement projects through full build-out in the Watershed.
   f. Recommended projects and estimated costs for the first 3 years of Plan implementation; herein termed “Program Projects”.

The remainder of this Executive Summary and the main body of the report will be devoted to providing additional details of the Plan.

E.2 Water Quality Pollutant Loading Evaluation and Results

Annual water quality pollutant loadings in the Watershed were estimated using EPA’s simplified spreadsheet method. This method involves assigning net annual runoff and “event mean concentrations” of water-borne pollutants based on literature values for various land use types and, in turn, prorating the land use types by percentage of land area within each sub-basin.

It is important to note that this simplified method provides estimates of pollutants that could, in theory, be delivered to a receiving stream, but it does not address the actual dynamic progression of those pollutants down the various tributaries through the Watershed. For example, the simplified method does not account for other pollutant losses, such as becoming further removed or trapped in a downstream water quality basin, a regional detention structure, or within bottom sediments within the stream itself. The latter type of analysis would require much more complex fate-transport modeling, which is not within the scope of this study.

Figure E-5 and Figure E-6 for the Big Papillion Creek and West Papillion Creek tributaries, respectively, have been included herein as examples of estimated pollutant loadings for Total Suspended Solids (TSS), nutrients (Total Nitrogen and Total Phosphorus), and *E. coli* bacteria at a few of the pre-designated checkpoints in the Watershed with and without LID control measures in place.

Figure E-5 Example of Annual Pollutant Loadings for Big Papillion Creek

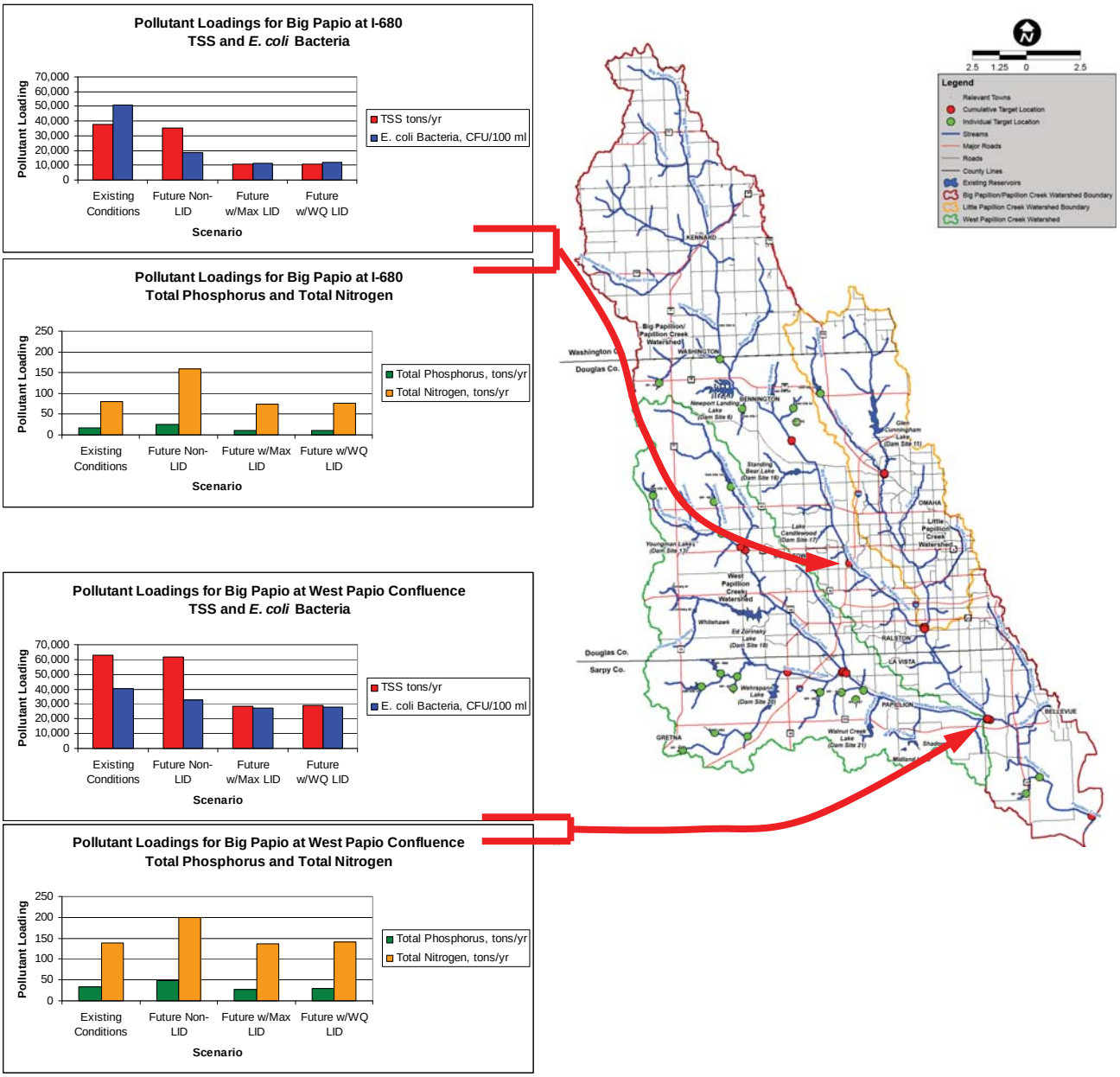
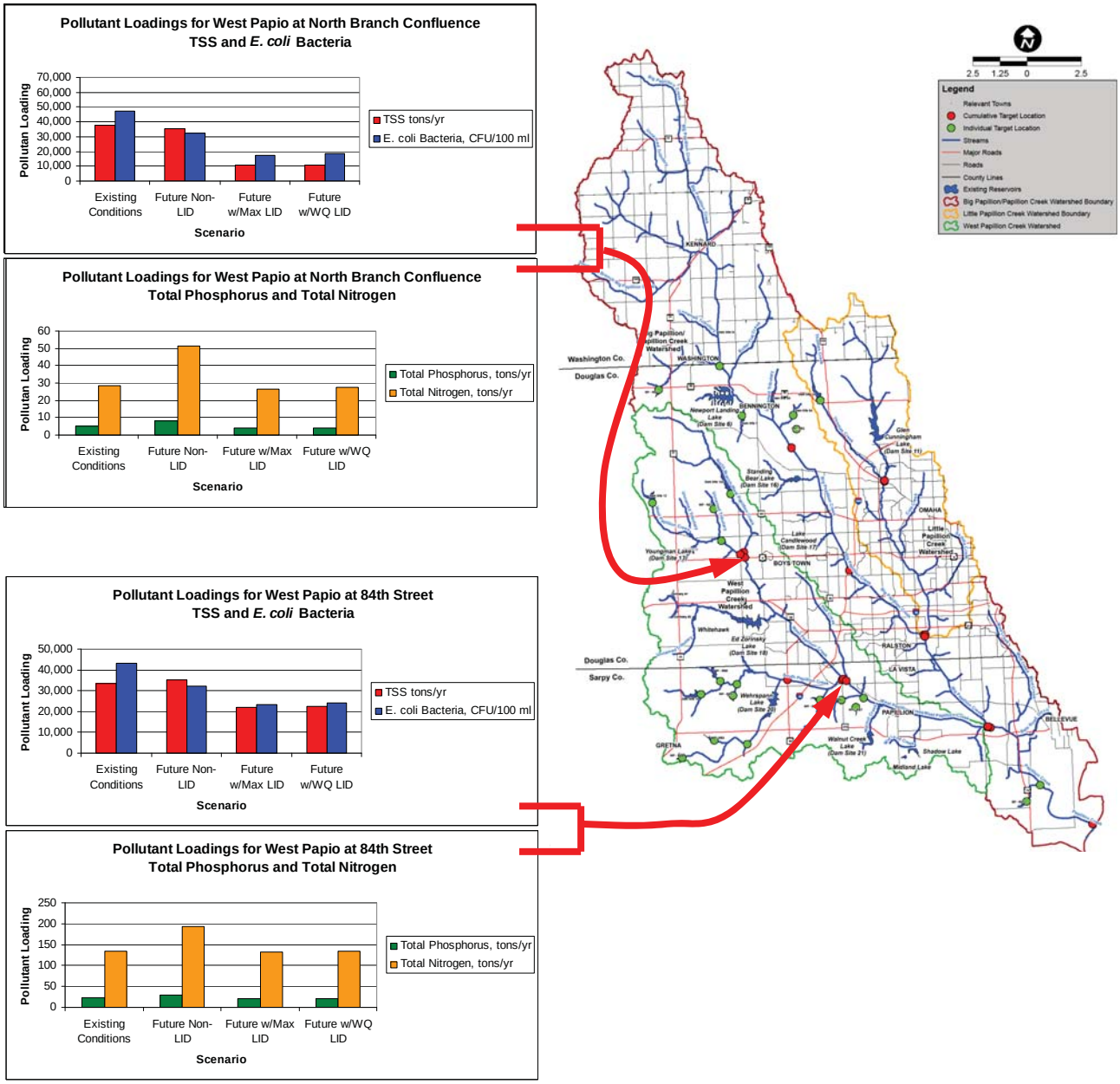


Figure E-6 Example of Annual Pollutant Loadings for West Papillion Creek



The figures above together with existing and anticipated future water quality regulatory standards suggest the following:

- WQ LID is an effective strategy to mitigate additional pollutant loadings from future development in the Watershed because it can be uniformly applied for all new development areas and for significant re-development areas. It is noted that the relative percent reductions in pollutants are the most pronounced closest to the source controls.
- As a corollary, overall pollutant loadings become increasingly compromised (increase) farther downstream with the progressive inclusion of higher percentages of existing development having no source controls.

- WQ LID pollutant source removal efficiencies would not be significantly enhanced by the addition of Max LID (addition of on-site detention measures). Most water quality related best management practices (BMPs) are not intended to provide source control beyond a 2-year storm (i.e. 3.0-inches for a 2-year, 24-hour storm). Max LID on-site detention volumes are typically not large enough to allow colloidal solids to settle to any great degree during larger peak flow events. Many pollutants, such as bacteria, heavy metals, and soil particle-bound nitrogen and phosphorus are often associated with water-borne suspended solids. From a regulatory perspective, in-stream water quality standards are generally not tied to minimum design storms or stream flows, but as a practical matter water quality type BMPs are generally not designed for storms beyond a 2-year storm.
- NDEQ does not regulate TSS as an in-stream parameter for non-point sources; however, controlling TSS to the extent possible with WQ LID and water quality basin controls will be reflected in much lower annual sediment accumulation in downstream detention basins. WQ LID source controls will also tend to decrease stream bank erosion.
- Source controls for nutrients will be very important for all regional detention basins. As previously mentioned, the nutrient impairment listings that were previously set for Walnut Creek Lake, Wehrspann Lake, and Ed Zorinsky Lake were able to be removed by NDEQ because of the addition of upstream water quality basins and other pollution controls.
- Limited water quality sampling has occurred in the Watershed. Continued field sampling at key locations in the Watershed will be important to gauge the success of water quality improvement efforts.
- NDEQ has not yet implemented in-stream water quality standards for Total Nitrogen and Total Phosphorus. Because of the relatively large amount of unprotected existing development and assuming that NDEQ will eventually adopt stream standards for nutrients that are similar to the guidance provided by EPA[6], it is not likely that such nutrient limitations could be met overall in the Watershed on a mean annual flow basis. If nutrient water quality standards become reality, then additional controls may become necessary, including fertilizer application and/or formulation restrictions.
- Similarly, it is not likely that *E. coli* bacterial water quality standards (126 CFU per 100 ml monthly average) can be consistently met within the overall Watershed even with WQ LID source controls, except under very low or non-runoff stream flow conditions.

Key Considerations of the Water Quality Plan:

Regardless if some NDEQ water quality standards may not be consistently met within all portions of the Watershed, the addition of WQ LID source controls is still highly desirable for all new development or significant re-development in terms of protecting downstream water bodies to the extent practicable. Such source controls would represent a good faith effort. Consequently, NDEQ may consider WQ LID and water quality basin source controls to be a sufficient response to meeting the requirements within the PCWP jurisdictional stormwater permits. The PCWP would be in a weak regulatory position in this regard without a reasonable commitment for such source controls.

---

[6] EPA has divided the nation into so-called "eco-regions" according to similarities in climate, topography, land use, soils, etc. and has assigned default Total Nitrogen and Total Nitrogen numerical limits for lakes and streams representing the upper 25th percentile of the best ambient water quality available in each eco-region. This approach creates very stringent water quality standards. States may develop their own site-specific water quality standards in lieu of EPA's default values; subject to EPA review and approval.

E.3 Peak Flow Reduction Evaluation and Results

To better define boundary conditions for peak flow reduction for overall Watershed management planning, it was necessary to develop a set of alternative modeling scenarios. The development of these scenarios also relates to water quality considerations previously discussed. The overall goal for the modeling alternatives development and evaluation is to facilitate consensus-building discussion among the PCWP, elected officials, and the general public, so that long-term Watershed planning can proceed in a logical, timely, and mutually understood manner.

The basic alternative scenarios for Watershed-level peak flow modeling that were established are summarized in Table E-1. Scenarios 2, 3, and 4 were intended to "book-end" performance results, so that Scenario 5 (combination) would have a better basis for derivation and evaluation.

Table E-1 Watershed-Level Modeling Alternative Scenarios Evaluated

Scenario	Description
1. Existing (2004)	• Existing land use conditions with respect to flood control and water quality based on 2004 aerial photography.
2. Full Build-Out, No New Stormwater Controls	• Future land use conditions based on community comprehensive plans with no new flood controls or water quality controls; that is, this scenario assumes that conventional development would continue as per present design standards through the time of full platting build-out.
3. Full Build-Out with Max LID Only	• Future land use conditions based on community comprehensive plans with Low Impact Development (LID) controls as the only type of additional stormwater management strategy. • Residential LID controls assumed to be on public rights-of-way for consistency of application, enforceability, and to encourage potential FEMA endorsement for the purpose of future floodplain remapping.
4. Full Build-Out with Regional Retention Only	• Future land use conditions based on community comprehensive plans with regional detention as the only additional stormwater management strategy. • Regional detention basins to be located throughout the Watershed, including upstream water quality basins where appropriate.
5. Combination of LID and Regional Detention	• Future land use conditions based on community comprehensive plan with a combination of LID controls and additional regional detention with upstream water quality basins where appropriate. • This scenario includes various subsets of combination type analyses based on performance and financial impacts.

E.3.1 Peak Flow Reduction Approach for Scenario 3 – Max LID Only

As a matter of review, Max LID includes WQ LID baseline measures, but it additionally incorporates up-scaled detention storage and restricted outlet pipe sizing for 100-year storm peak flow reduction. The additional detention storage may consist of either on-site detention ponds, below-grade basins, or in the case of commercial/industrial development, it could alternately or in combination include a permeable pavement system with underlying detention storage.

For Maximum LID conditions the net peak discharge performance goals for on-site detention for LID development areas were 0.2 cfs per acre for a 2-year storm and 0.5 cfs per acre for a 100-year storm for all land use types. From careful examination of prior modeling outputs for

existing regional detention basins, these are the values that approximated the performance approximately 4 to 5 miles downstream in flood prone areas. In other words, it was judged that using 0.5 cfs per acre as a design benchmark for 100-year flood protection for Max LID should produce approximately the same peak flow reduction results as using regional detention for the same downstream areas.

E.3.2 Peak Flow Reduction Approach for Scenario 4 - Regional Detention Only

Scenario 4, "Full Build-Out Land Use with Regional Detention Only", included evaluation of 19 potential regional detention basins. These 19 regional detention basins included 8 sites from the *2004 Multi-Reservoir Report*[7] (Sites 3C, 7, 8A, 9A, 10, 12, 15A, and 19), 10 sites from previously developed PCWP studies and policies (BP-RB 1, 2, and 3; WP-RB 1 through 7), and 1 additional site identified during field reconnaissance for this study (WP-RB 8).

Because their primary purpose is to reduce incoming water-borne sediment and nutrients into a downstream reservoir, water quality basins were not evaluated for peak flow reduction.

E.3.3 Peak Flow Reduction Approach for Scenario 5 - Combination of Max LID and Regional Detention

The next step in the modeling involved developing a series of combinations of Max LID and regional detention measures to see if the flooding potential could be further reduced. To start this effort, the relative effectiveness of potential regional detention basins were ranked on a relative scale of 1 to 5, with 1 meaning that minimal downstream peak flow reduction would be provided, and 5 would mean that significant peak flow reduction would likely be provided.

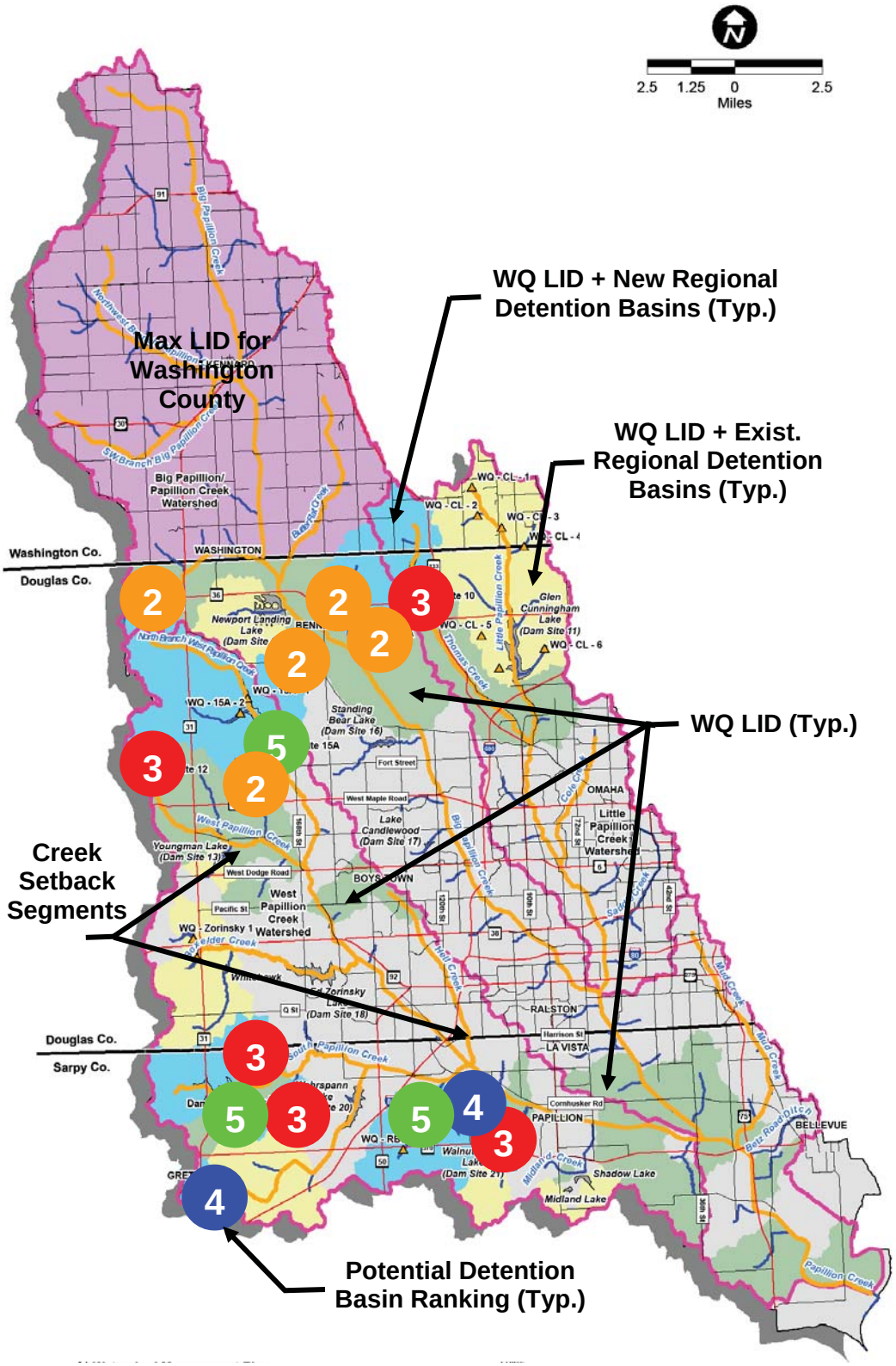
Potential regional detention basins in Douglas and Sarpy Counties, plus various amounts of Max LID in all three Counties were used to develop sequential combination modeling runs as intermediate results became available and were discussed. Combination run descriptions are summarized in Table E-2. Figure E-7 depicts the rankings of the various potential regional detention basins under Combination Plan D and the assumed areas for LID application under full build-out conditions.

Table E-2 Plan Elements for Combinations of Regional Detention and Maximum LID

Plan	Number of Regional Detention Basins	Rankings for Regional Detention Basins	Number of Water Quality Basins	Water Quality LID	Max LID in Washington County	Max LID in Douglas & Sarpy Counties	Max LID in Lower Portions of Watershed
A	10	3 to 5	12	√	√	√	√
B	10	3 to 5	12	√	√	√	
C	14	2 to 5	12	√	√	√	
D	15	2 to 5	12	√	√		

[7] Multi-Reservoir Analysis Papillion Creek Watershed, September 2004 prepared by HDR Engineering, Inc.

Figure E-7 Combination Plan D Regional Detention Site Rankings and LID Areas for Full Build-Out Conditions



E.3.4 Summary of Peak Flow Reduction Results

Figure E-8 and Figure E-9 show examples of the estimated overall peak flow reduction performance at key check points within the Big Papillion and West Papillion Creek tributaries, respectively, for baseline modeling runs, future "build-out" conditions with "regional detention only," Max LID only," and Combination Plans A and D described above.

Figure E-8 Peak Flow Reduction Results - Examples for Big Papillion Creek

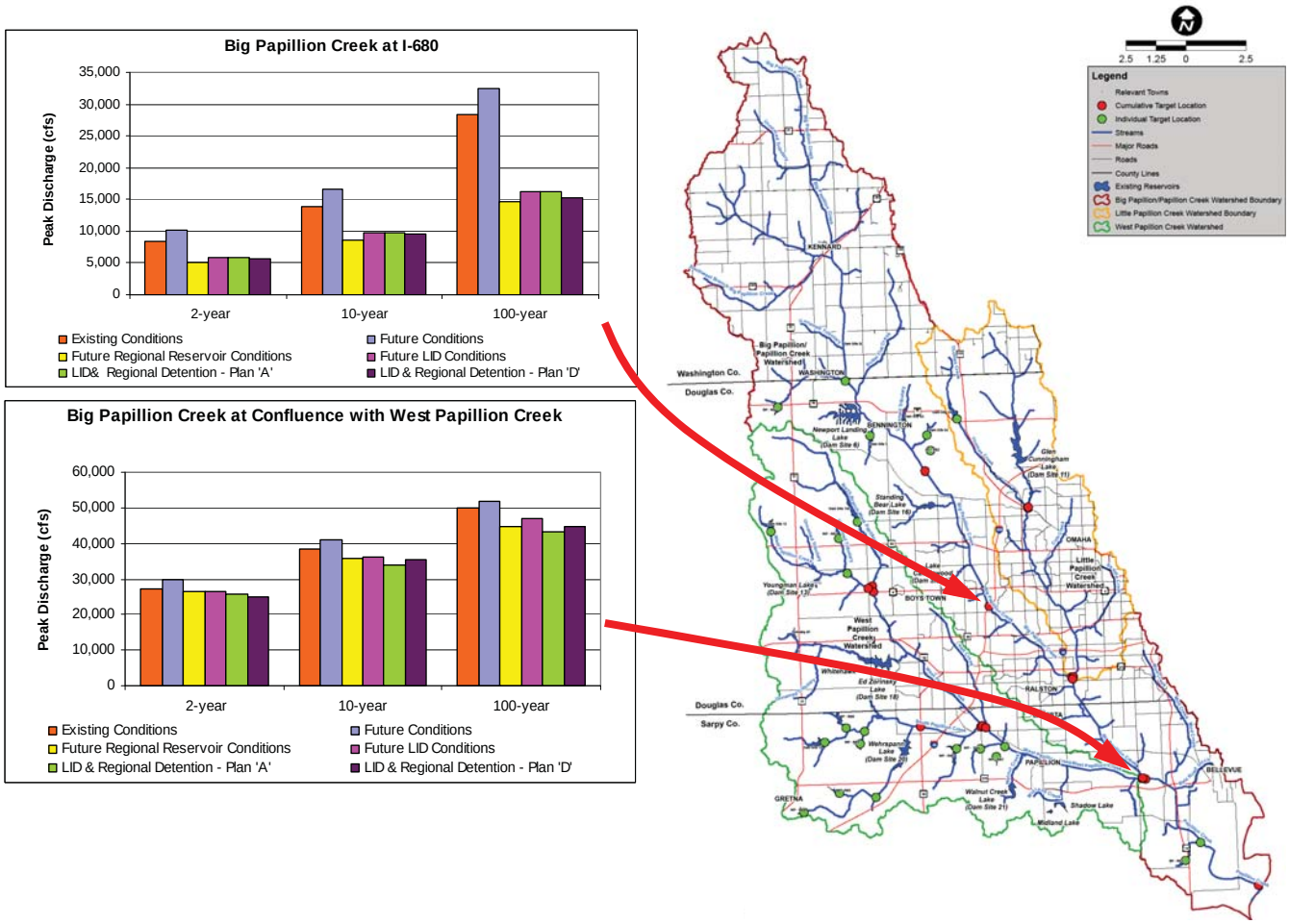
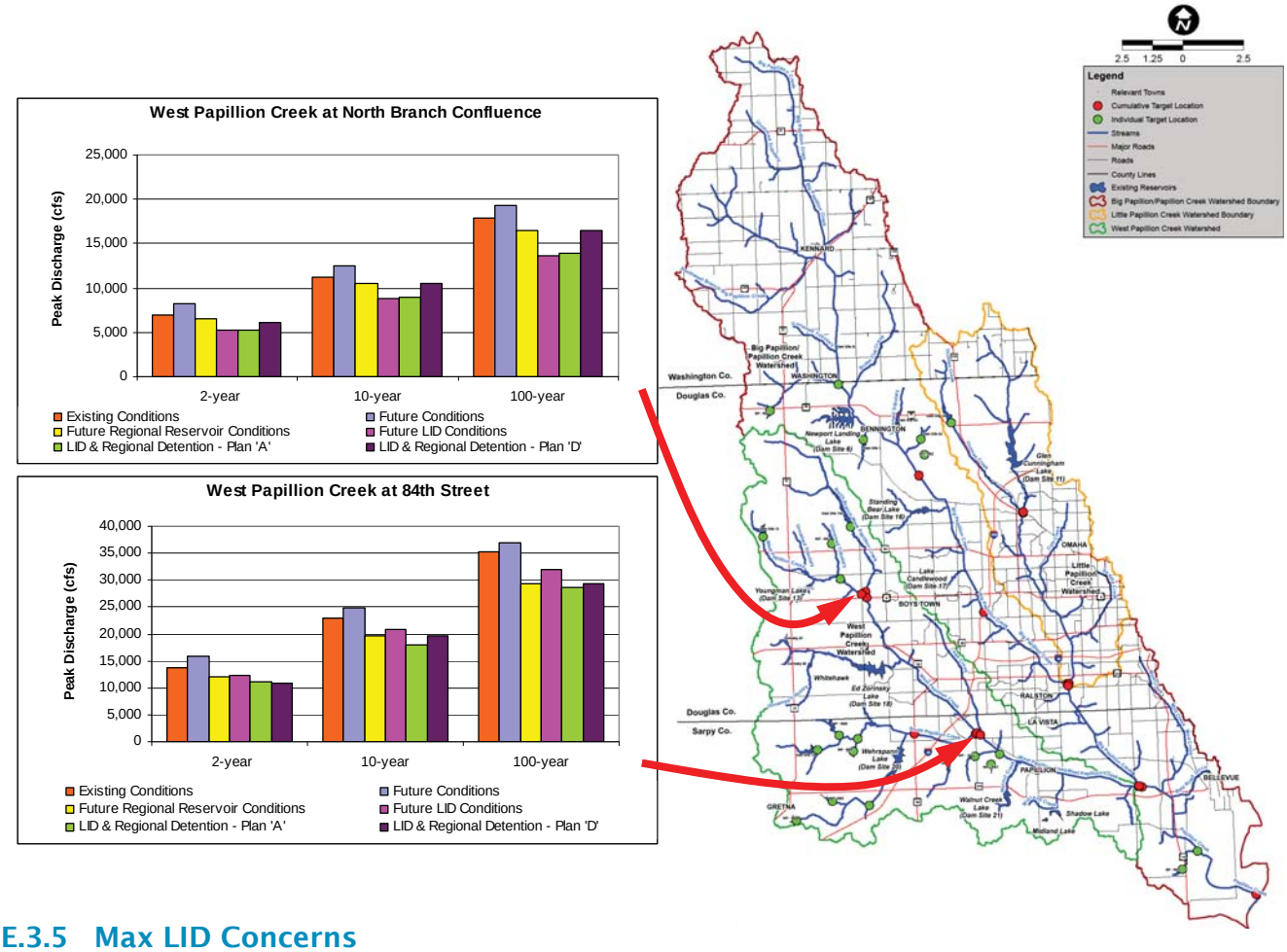


Figure E-9 Peak Flow Reduction Results - Examples for West Papillion Creek



E.3.5 Max LID Concerns

During refinement of the Plan, concerns were raised in a joint meeting with PCWP and development representatives over the concept of using Max LID in Douglas and Sarpy Counties for Combination Plans A through C. The following summarizes the discussion:

- Because Max LID would be implemented at a local, on-site, scale, the potential for controlling stormwater runoff from existing development would be limited. Max LID would only require control of stormwater runoff from the contributing area of the individual development; management of stormwater runoff from the surrounding drainage areas that may flow through the site would not be required.
- Acceptance of Max LID techniques by the Federal Emergency Management Agency (FEMA) for purposes of flood insurance is currently unknown. If Max LID techniques are not deemed acceptable by FEMA, potential reductions in flood insurance requirements provided through Max LID implementation would be unattainable.
- Preliminary Max LID costs did not include the intrinsic value of the additional land lost to development beyond that of basic WQ LID; therefore, the actual cost of Max LID was under estimated. For those areas not protected by regional detention, Max LID was also perceived by some as not providing enough additional flood protection to warrant the additional land consumption costs.

- It was recognized that there would be difficulties in sustainability relative to jurisdictional O&M responsibilities and available staffing resources for maintaining residential on-site detention ponds implemented with Max LID. The majority of O&M deals with sediment removal to maintain adequate peak flow detention volume.
- Max LID involving permeable paving in commercial/industrial areas was judged by the engineering community to be initially prone to structural and operational failures due to the present inexperience of local contractors and lack of adequate, customized design standards for the various products and installation procedures.
- City planning staff commented that desired development densities may be difficult to sustain because of the higher land consumption requirements for Max LID. Development representatives also stated that decreasing lot sizes may not be acceptable within the current depressed development market.
- The City of Omaha has already implemented a performance standard of capturing the first 0.5 inches of net runoff for all storms from new development sites. PCWP members recognized the need for an additional criterion of 2-year storm control with a "no net increase" from existing conditions provision in order to realize the full benefit of a WQ LID approach to water quality.
- Washington County's current policies require a 90% reduction in peak flow rates relative to a native grass baseline condition. To achieve this 90% reduction, Washington County's policies suggest the use of on-site LID flow reduction techniques in lieu of regional detention. It was recognized that this practice would approximate the performance goals of Max LID; therefore, Max LID or its equivalent is considered an acceptable peak flow reduction measure for Washington County. However, it was also recognized that population projections suggest less than 20% of Washington County within the Watershed will be developed by the year 2050. Therefore, Max LID in Washington County would require many decades beyond 2050 to achieve full downstream flood protection.

Because of comparable performance of Combination Plan D to the other combination scenarios and the elimination of Max LID concerns in Douglas and Sarpy Counties, Combination Plan D was selected to bring forward to elected officials and the public for review as the preferred Watershed Management Plan. Specific benefits of Combination Plan D include:

- application of water quality controls throughout the Watershed,
- strengthens water quality LID controls up through 2-year storm events,
- flexible implementation of flood control when and where needed,
- provides proven method of flood control recognized by FEMA,
- manageable level of structures requiring O&M, and
- maintains development densities and reduces urban sprawl.

E.4 Public Involvement

The PCWP has undertaken extensive public outreach and involvement to give interested parties, governmental jurisdictions, and the general public opportunities to comment and actively participate in the development of the Watershed Plan. The PCWP contracted with Issues Management Solutions (IMS) to address public awareness and public information needs. HDR provided technical materials to IMS to support outreach activities that included:

- Preparing new and revised Partnership informational materials [fact sheets, PowerPoint presentation, display boards, media updates, and website enhancements (www.papiopartnership.org)];

- Providing one-on-one briefings to elected officials;
- Holding small group presentations to service clubs, professional organizations, neighborhood associations, and other stakeholders; and
- Providing updates to local TV news and newspaper staff.

A public official's meeting was organized by P-MRNRD on February 2, 2008 to provide elected officials an opportunity to preview the preliminary results of the engineering study and presented Combination Plan A, which was the only combination plan available at that time. Thirty elected officials and over 50 members of the general public attended the meeting.

The Partnership scheduled and organized seven public outreach open houses from February 19 through March 6, 2008 to build awareness, increase understanding, and provide opportunities for feedback on the Stage IV study results on flood protection and water quality improvement options for the Watershed. The open houses were attended by 162 citizens and government leaders.

A second public official's meeting, organized in the form of a workshop by the PCWP, was held on February 14, 2009 to provide the elected officials a briefing on the PCWP's updated recommendations on a Watershed Management Plan, Implementation Plan, and revised Stormwater Management Policies. Seventeen elected officials and 50 members of the general public attended the workshop.

E.5 Watershed Management Plan

The Watershed Management Plan integrates water quality and peak flow reduction strategies.

E.5.1 Watershed Management Plan Map

The long-term Watershed Management Plan map for full build-out conditions is depicted in Figure E-10. Note that the map also delineates "3:1 + 50-foot" creek setback (buffer) areas in keeping with updated PCWP stormwater management policies. The Plan should remain flexible. LID technologies and experience will continue to evolve and development goals, rates of land consumption, funding availability, and the economy in general will continue to change, so stormwater management approaches may likewise change over time.

E.5.2 Structural Components of Plan

The structural components of the Plan eligible for cost sharing include the construction of regional detention and water quality basins in Douglas and Sarpy counties and the implementation of Max LID in Washington County as depicted in Figure E-10. Table E-3 summarizes the estimated cost for such structural components for full build-out conditions. The total cost for all projects is estimated to be approximately $464 million in 2010 dollars, which is the target year for completing requisite implementation measures for a Watershed Management Fee system.

Figure E-10 Watershed Management Plan for Full Build-Out Conditions

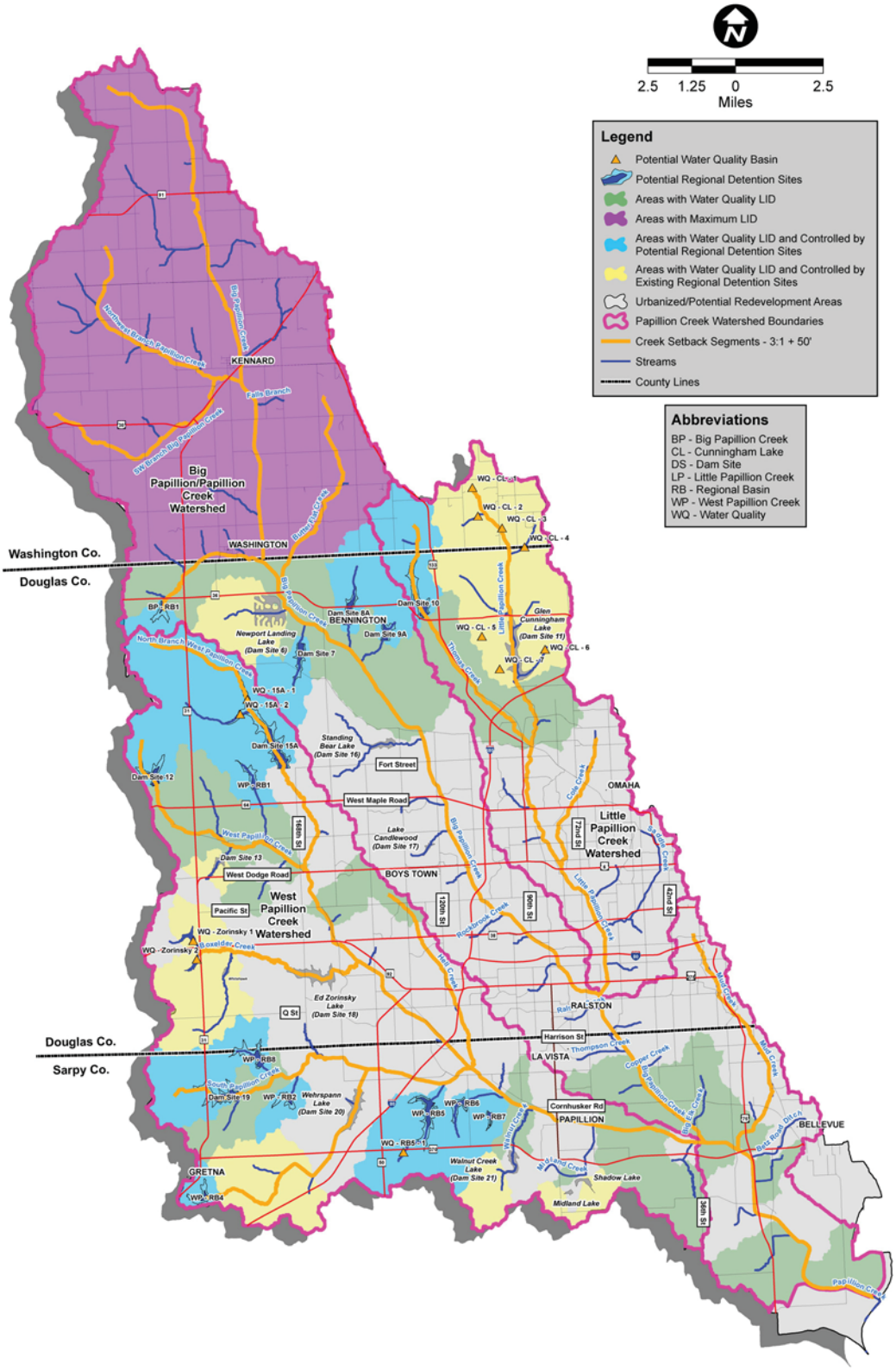


Table E-3 Watershed Management Plan Structural Projects for Full Build-Out Conditions

Structure[1]	Stream Reach	Approx. Location & Planning Jurisdiction	Drainage Area (Acres)	Est. Normal Pool Area (Acres)	2010 Est. Capital Cost ($ Millions)
Regional Detention Basins					
DS 7	Trib to Big Papillion	168th & Bennington Road; Bennington & Omaha	1,600	47	$ 12.2
DS 8A	Trib to Big Papillion	144th St. & Bennington Road; Bennington	1,850	75	$ 14.8
DS 9A	Trib to Big Papillion	132nd & Bennington Road; Omaha	1,280	38	$ 9.5
DS 10	Thomas Creek	120th & Bennington Road; Omaha	2,950	97	$ 21.4
DS 12	West Papillion Creek	216th & Fort Streets; Douglas Co. & Omaha	1,670	70	$ 20.3
DS 15A	North Branch West Papillion Creek	168th & Fort St.; Omaha	7,100	215	$ 47.9
DS 19	South Papillion Creek	192nd & Giles Road; Sarpy Co.	2,750	100	$ 21.2
BP-RB1	Trib. to Big Papillion	216th St. & Hwy. 36; Douglas Co.	703	20	$ 10.8
WP-RB1	Trib. to West Papillion	180th & Fort St.; Omaha	864	24	$ 11.7
WP-RB2	Trib. to South Papillion	180th & Giles Road; Sarpy Co.	679	21	$ 11.2
WP-RB4	Trib. to South Papillion	204th & Schram Road; Gretna	563	16	$ 10.2
WP-RB5	Trib. to South Papillion	126th & Cornhusker Road; Papillion	3,310	88	$ 24.6
WP-RB6	Trib to Unnamed West Papillion Trib.	114th & Cornhusker Road; Sarpy Co.	1,260	32	$ 10.4
WP-RB7	Trib to Unnamed West Papillion Trib.	108th & Cornhusker Road; Sarpy Co.	450	12	$ 4.8
WP-RB8	Trib. to South Papillion	180th & Harrison St.; Douglas & Sarpy Co.	1,470	45	$ 11.2
				Regional Detention Subtotal	$ 242.2
Water Quality Basins					
WQ- CL-1	Upstr. Existing Cunningham Lake	Washington County	740		$ 11.9
WQ- CL-2	Upstr. Existing Cunningham Lake	Washington County	845		$ 12.3
WQ- CL-3	Upstr. Existing Cunningham Lake	Washington County	790		$ 11.9
WQ- CL-4	Upstr. Existing Cunningham Lake	Washington County & Omaha	915		$ 12.7
WQ- CL-5	Upstr. Existing Cunningham Lake	Omaha	470		$ 8.2
WQ- CL-6	Upstr. Existing Cunningham Lake	Omaha	510		$ 8.5
WQ- CL-7	Upstr. Existing Cunningham Lake	Omaha	200		$ 6.3
WQ -RB5-1	Upstr. Proposed Reg. Det. WP-RB5	Sarpy County	770		$ 11.9
WQ-15A-1	Upstr. Proposed DS 15A	Omaha	3,000		$ 15.8
WQ-15A-2	Upstream of Proposed Dam Site 15A	Omaha	2,500		$ 15.8
WQ-Zorinsky 1	Upstr. Existing Zorinsky Lake	Omaha	1,660		$ 9.5
WQ-Zorinsky 2	Upstr. Existing Zorinsky Lake	Omaha	1,000		$ 8.9
				Water Quality Basins Subtotal	$ 133.7
				Max LID in Washington County (57,200 acres) Subtotal Cost[2]	$ 88.1
				Total Estimated Cost for Watershed Management Plan for Full Build-Out Conditions	$ 464.0

Notes:

1 Abbreviations: DS= dam site; Trib. = Tributary; BP=Big Papillion Creek Watershed; WP= West Papillion Creek Watershed; RB= regional detention basin; WQ= water quality basin; CL= Cunningham Lake; and Upstr. = Upstream.

2 Costs reflect full build-out conditions that will occur well beyond 2050; whereas other structural projects may be completed by approx. 2050. Estimated Max LID for Washington County by 2050 is approx. 11,365 acres at a total cost of $17.5 million in 2010 dollars. Structural costs estimated to be $1,400/acre in 2008 dollars and. $1,540/acre in 2010 dollars. Maximum LID in Washington County does not include land costs.

E.5.3 Financial Framework

Capital costs for potential regional detention basins will have to be funded from:

- Home builder and commercial/industrial developer Watershed Management Fees at the time of building permits.
- Mill levy revenues from the P-MRNRD.
- Supplemental bonding revenues, meaning tax-supported general obligation bonds or revenue bonds from stormwater utility fees.

At present, the P-MRNRD lacks general obligation bonding authority, and the other PCWP members lack the full authority to implement a stormwater utility fee system. Both of these supplemental funding mechanisms would require approval from the Nebraska Legislature. In the absence of supplemental funding beyond the revenue generated from Watershed Management Fees and the P-MRNRD's current mill levy, it will not be possible to implement the potential projects within the desired schedule (prior to platting build-out in Douglas and Sarpy Counties); or, perhaps, some projects may never get implemented. Otherwise, the P-MRNRD would have to raise its mill levy, the City and county PCWP jurisdictions would have to utilize their own taxing authority, and/or a much higher percentage of private funding will be required.

A fundamental financial assumption used herein is that assessed valuations (that drive mill levy revenues) and construction costs will both equally track with the rate of inflation. Another assumption was that requisite underlying revenue generation mechanisms in the form of ordinances, resolutions, inter-local agreements, bonding authority, etc. will be secured by the close of 2010.

The development market, particularly housing, may remain off-pace for several more years. Therefore, the reality of the current situation is that Watershed Management Fees must be reasonable enough as to not further suppress the market.

The basic financial framework needed for capital construction projects is as follows (see Chapter 6 for details):

- Water Quality LID
  - Applied by the development
  - Costs borne by the development (not eligible for cost sharing)
- Maximum LID
  - Applied by the development
  - Costs for on-site detention portion eligible for public cost sharing (applicable to Douglas and Sarpy Counties only)
  - Cost based on difference between Max LID and Water Quality LID
  - Costs in Washington County will be financed outside of this financial framework
- Regional Detention and Water Quality Basins
  - Applied/constructed by P-MRNRD and public partners
  - Costs include land acquisition
  - Prioritize and construct up to 15 regional detention and 12 water quality basins
- Public funds and fees pay for:
  - Max LID (detention component only)
  - Regional detention
  - Water quality basins

- Try to achieve approximately 2/3 public and 1/3 private cost sharing overall for the scheduled period commensurate with previous PCWP discussions with the development community.
- Private cost share fee collected at time of building permits.
- A Watershed Management Fund needs to be created and earmarked solely for capital improvements projects related to water quality and flood protection improvements. P-MRNRD would be the logical choice for the designated fund manager because of its inter-jurisdictional authority.
- Implementation of cost sharing and fees targeted to begin in 2011.
- Re-evaluate Watershed Management Plan every 3 years to adjust to market conditions, financial constraints, and inter-related planning issues within targeted sub-basins.
- Fee multipliers are to be based on surface runoff potential based on imperviousness over equivalent gross acres of land development area relative to Single Family Residential land use. For example, commercial/industrial parcels are estimated to have 1.5 times as much surface runoff potential as single family residential on an equivalent gross acre basis (the area bounded by the development). Therefore, the calculated Commercial/Industrial fee would be 1.5 x $2,625 per gross acre for single family residential = $4,000 per gross acre, rounded up. Table E-4 summarizes the four land use categories and key assumptions for the initial fee calculations.

Table E-4 Land Use Categories and Initial Fees for Years 2011 to 2013

Fee Category	Initial Fee Amounts	Surface Runoff Multiplier	Comments
Single Family Residential (also includes low-density multi-family up to 4-plexes)	$750 per lot	1.0 (basis for other fee categories)	• Assumed typical lot density of 3.5 dwelling units per gross acre • Equivalent initial fee cost per gross acre = $750 per lot x 3.5 D.U. per gross acre = $2,625 per gross acre in 2010 dollars.
High-Density Multi-Family Residential (beyond 4-plexes)	$3,300 per gross acre	1.25	
Commercial/Industrial	$4,000 per gross acre	1.5	
Residential Estates	$1,400 per gross acre	0.5	Rural large lot residential parcels

E.5.4 Revenue Requirements

Estimated costs for potential new detention basins, water quality basins, and Max LID as shown in Table E-3 will be subject to an unknown amount of inflation. For the purpose of construction cost details presented in Chapter 5, costs have been inflated according to the cost estimating publication *2008 RS Means Sitework Construction Cost* using construction indices corrected to Omaha and using the 2008 Federal Discount Rate = 4.875%. For cash flow details, see Chapter 5.

E.5.5 Other Financial Considerations

The remaining action items that should be targeted for completion by the close of 2010 to solidify and implement financial requirements of the Plan are as follows:

- Secure stakeholder consensus for Program Projects (first 3 years following program initiation) and for the Watershed Management Fee framework.
- Identify probable capital funding sources such as P-MRNRD mill levy, jurisdictional cost sharing, and seek Nebraska Legislature bonding authority. It is noted that Washington and Douglas Counties object to the P-MRNRD obtaining bonding authority.
- Identify O&M funding responsibilities, make long-term cash flow projections for O&M revenue requirements, and seek authority from the State Legislature to implement a stormwater utility fee system for O&M needs.
- It should be noted that a typical stormwater utility fee system inherently provides incentives (fee credits) for any property owner that provides approved enhanced stormwater management. For example, property owners may elect to install approved lot-level rain gardens or other surface runoff reduction measures, thereby proportionately reducing the fee charged to that parcel.
- Conduct administrative actions to obtain formal approvals of updated Stormwater Management Policies (which include a subset of policies for a financial framework) and secure approval for local enabling legislation, including ordinances, resolutions, and interlocal agreements.

E.6 Implementation Plan

The Implementation Plan includes structural and non-structural elements. The structural portion of the Implementation Plan consists of Program Projects[8] whose construction would be initiated in the first 3 years (assumed to be 2011-2013). The non-structural elements include defining the supporting initial administrative, financial, and local regulatory requirements. The following sub-sections describe the high priority action items for implementing the Watershed Management Plan.

E.6.1 Non-Structural Components

Non-structural elements to be completed prior to the close of 2010 include:

- Adopt local ordinances, resolutions, and interlocal agreements to implement the Plan.
- Provide minimum design standards for WQ LID and Max LID requirements.
- Establish an earmarked stormwater capital fund fee system and define interlocal flow-of-funds mechanisms.
- Accurately estimate probable capital costs and revenue streams to fund the Program Projects to ensure that an adequate, positive fund balance will exist at the end of the initial 3-year period.
- Derive planning-level cash-flow requirements for remaining near-term and long-term projects to provide an updated basis for bonding requirements.
- Annual O&M costs and implementation requirements should be established to cover both near-term and long-term needs.

[8] This terminology is the same used by the City of Omaha for its Sanitary Interceptor Sewer program.

E.6.2 Structural Components – Program Projects

Table E-5 lists the Program Projects and Figure E-11 shows the corresponding generalized regional detention and water quality basin locations and estimated acres of WQ LID within Douglas and Sarpy Counties and Max LID in Washington County within the Upper Big Papillion Creek Watershed for the first 3 years. The regional detention basins listed are considered high priority for implementing significant peak flow reduction as soon as possible to mitigate the existing flooding threats.

Table E-5 Watershed Management Plan Program Projects for Years 2011-2013

Structure[1]	Approx. Location & Planning Jurisdiction	Drainage Area (acres)	2010 Estimated Capital Cost ($ Millions)
WP- RB5	126th & Cornhusker Road; Papillion	3,310	$ 24.6
WQ-RB5-1	Upstream of WP-RB5; Papillion and Sarpy County	770	$ 11.9
DS-15A	168th & Fort Streets, Omaha	7,100	$ 47.9
WQ-15A-1	Upstream of DS 15A; Omaha	2,500	$ 15.8
WQ-15A-2	Upstream of DS 15A; Omaha	3,000	$ 15.8
WQ-Zorinsky 1	Upstream of Zorinsky Lake; Omaha	1,660	$ 9.5
WQ-CL-6	Upstream of Cunningham Lake; Omaha	510	$ 8.5
	Regional Detention and Water Quality Basins Subtotal Cost		**$ 134.0**
	Max LID in Washington County (930 acres)[2]		**$ 1.4**
	Total Estimated Cost for Implementation Plan		**$ 135.4**

Notes:

1 Abbreviations: WP= West Papillion Creek Watershed; RB= regional detention basin; WQ= water quality basin; DS= dam site; and CL= Cunningham Lake

2 Max LID in Washington County does not include land costs

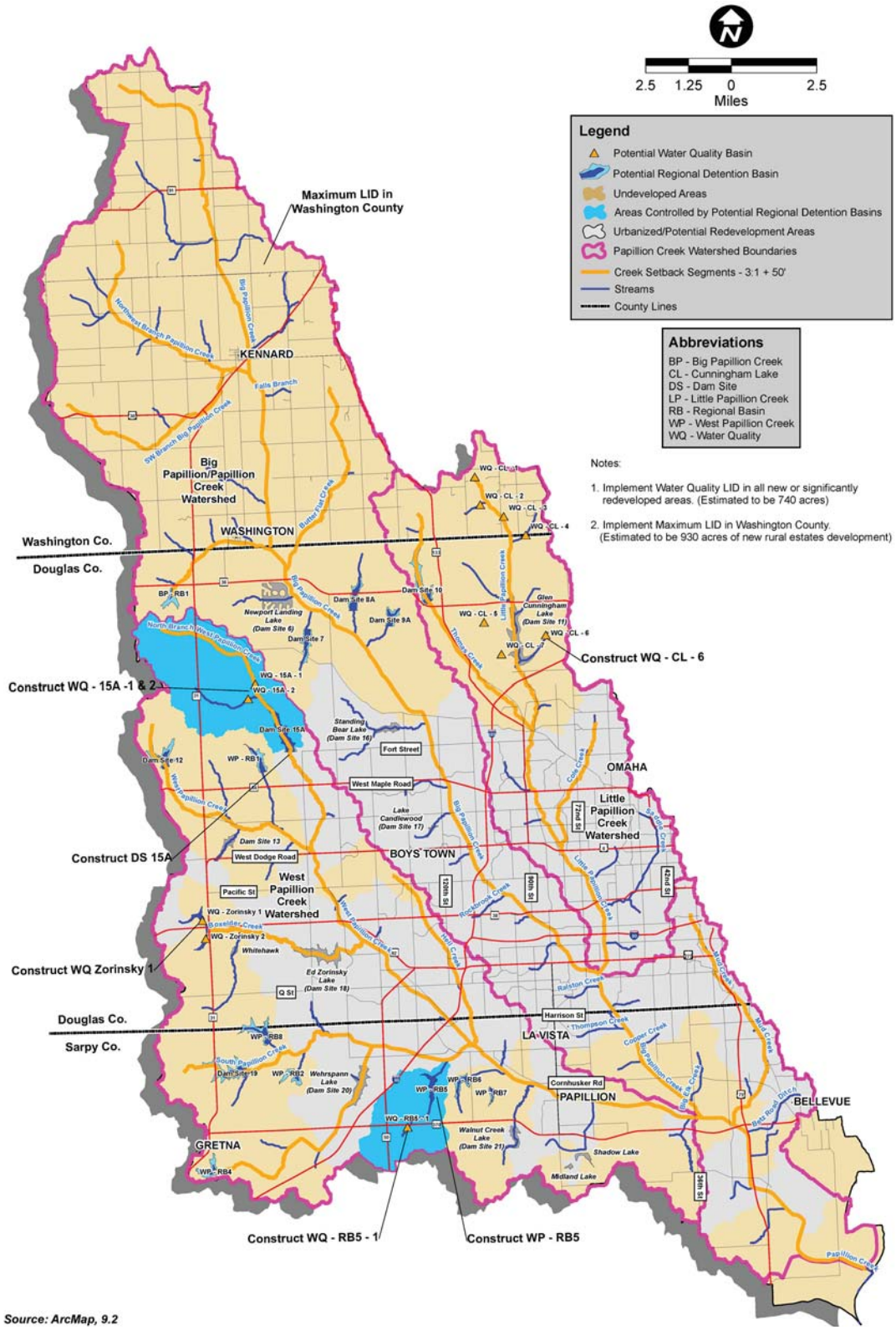



Figure E-11 Implementation Plan – Structural Element (Years 2011-2013)