JULY 2024

WATERSHED PLAN AND ENVIRONMENTAL IMPACT STATEMENT

FOR CART CREEK SITE 1 OF THE NORTH BRANCH OF THE PARK RIVER WATERSHED

Park River Joint Water Resource District

Walsh and Pembina Counties, North Dakota

United States Department of Agriculture

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Watershed Plan & Environmental Impact Statement
For
Cart Creek Site 1
of the
North Branch of the Park River Watershed

Pembina, and Walsh Counties, North Dakota

Prepared By:
U.S. Department of Agriculture, Natural Resources Conservation Service
In Cooperation With:
U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and
Park River Joint Water Resource District

AUTHORITY

The watershed work plan was prepared, under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended, and the Regional Conservation Partnership Program Project (16 U.S.C. Chapter 58, Subchapter VIII).

ABSTRACT (Fly Sheet)

Flooding in the North Branch Park River Watershed has historically resulted in frequent damages for residents of Walsh and Pembina Counties. Flooding results in significant damages to crop land, structural damages within the community of Crystal and rural areas, and public and private infrastructure damages. The area also contributes to the Red River of the North, which is an international water that flows into Manitoba, Canada, ultimately out letting into Lake Winnipeg. The Red River experiences significant flood risk and nutrient loading issues. International governmental organizations (Red River Basin Commission and the International Joint Commission) have adopted international water management plans to address Red River issues. The Preferred Alternative consists of a multiple purpose structure that will provide both flood prevention and watershed protection. The flood prevention purpose of the Preferred Alternative is to temporarily retard floodwaters to reduce damages within the North Branch Park River Watershed. The watershed protection purpose of the Preferred Alternative is to reduce nutrient loading on downstream water courses through implementation of a 133.6-acre biomass harvest area, to restore 470.8 acres of cropland and prairie to wetland with perennial vegetation in the temporary flood pool (including a managed 133.6-acre biomass harvest area), to enhance 18.5 acres of existing wetlands, restore 36.3 acres of upland, and protect 3.9 acres of existing upland. This results in a 529.5-acre block of wetland and upland wildlife habitat from the implementation of the Preferred Alternative. Implementation of the Preferred Alternative will demonstrate a commitment to flood damage reduction and water quality objectives defined in internationally developed regional water resource plans. The total cost to install the Preferred Alternative is $12,228,700, of which $9,661,000 would be provided through federal funds. The remainder ($2,567,700) would be provided from other funding sources.

COMMENTS AND INQUIRIES

Comments and inquires received by January 26, 2024 were addressed in the Final Watershed Plan-EIS, available online at: [https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/north-dakota/north-branch-park-river-watershed.](https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/north-dakota/north-branch-park-river-watershed)

Printed copies of the Final Watershed Plan EIS are available at the Pembina County Water Resource District 308 Court House Dr #5, Cavalier, ND and the Walsh County Water Resource District 600 Cooper Ave Grafton, ND.

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Summary (OMB Fact Sheet)

Summary Watershed Plan – Environmental Impact Statement Document for:	
Name of Watershed:	North Branch Park River Watershed
County and State:	Pembina, Cavalier & Walsh Counties, North Dakota
Congressional District:	North Dakota At-Large Congressional District
Authorization:	The Watershed Project Plan is authorized under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended and the Regional Conservation Partnership Program Project (16 U.S.C. Chapter 58, Subchapter VIII). The Watershed Project Plan was prepared per policies and guidelines contained in the Natural Resource Conservation Service (NRCS) National Watershed Program Manual (NWPM 2014) and National Watershed Program Handbook (NWPH 2014).
Sponsors:	Park River Joint Water Resource District
Proposed Action:	Cart Creek Site 1 will be a multi-purpose, off-channel, dry dam with a temporary flood storage capacity of 2,593 ac-ft, requiring construction of 2.6 miles of earthen embankment and associated spillways. A diversion weir will be constructed in Cart Creek and existing road ditches will be enlarged to route high flows to the dam from Cart Creek. Surface water runoff and existing road ditches south of Cart Creek and west of the dam will be re-routed into the dry dam site via construction of new inlet structures and culverts designed to recreate natural sheet flow conditions. Within the temporary flood pool, 133.6 acres of shallow retention basins with water control structures and subsurface drainage will be constructed for the purpose of phosphorus removal through biomass harvest. Within the temporary flood pool, 470.8 acres of wetlands will be restored (inclusive of the 133.6-acre managed shallow retention basins), 18.5 acres of wetlands will be enhanced, 36.3 acres of upland wildlife habitat will be restored, and 3.9 acres of existing upland wildlife habitat will be protected. This ultimately results in 529.5 acres of high-quality wildlife habitat from the installation of the project, protected through easements for a minimum of 50-years from the date of construction.
Purpose for Action:	The purposes of the proposed action are flood damage reduction and watershed protection.
Need for Action: *(Flood Prevention)*	The North Branch Park River Watershed incurs $1,733,000 in average annual flood damage as a result of 4,485 acres of cropland inundation and damage to roads, buildings, and other property. The 100-year flood inundates 136 structures, including the community of Crystal, ND. The watershed annually contributes 36,412 lbs. of phosphorus and 197,533 lbs. of nitrogen to the Red River, for which U.S. agreed to nutrient objectives at the international border have not been achieved. Historic loss of wetland and upland habitat within the Red River Basin threatens multiple species.

Description of Preferred Alternative:	The Preferred Alternative entails construction of a multi-purpose, off-channel, dry dam with a drainage area of 33.8 square miles, embankment length of 2.6 miles, maximum height of 17.3 feet, and average height of 9.7 feet. The dam will provide 2,593 acre-feet of temporary flood storage at the auxiliary spillway crest elevation and inundate 466-acres for a duration of less than a week during flood events. The dam will be classified as a high hazard dam due to downstream structures. Within the temporary flood pool, 133.6 acres of shallow retention cells will be constructed and managed via water control and biomass harvest for removal of incoming nutrient loads. Water will be held in those cells via closed control structures from spring through early fall, to allow growing vegetation to uptake dissolved phosphorus. Water will be drained through control structures and via a pumped subsurface drainage system to allow vegetation to be cut, baled, and removed from the site prior to the first frost in 2 out of each 3 years. The project will also result in restoration of 470.8 acres of wetlands, enhancement of 18.5 acres of existing wetlands, restoration of 36.3 acres of upland wildlife habitat, and protection of 3.9 acres of upland wildlife habitat. The construction of the diversion channels used to convey flows to the site will involve more than 410,000 cubic yards of excavation. The embankment constructed for flood protection consists of placement of more than 390,000 cubic yards of fill material. Dam and diversion feature construction will entail more than 450,000 cubic yards of excavation and approximately 440,000 cubic yards of fill material. Construction of interior features includes approximately 12,900 feet of interior embankment berms, perforated patterned drain tile across 133.6 acres, two water control structures, a pump station, and 303.0 acres of seeding of perennial vegetation.
Resource Information:	**Latitude and Longitude:** 48.667533 N, 97.807269 W.
	Eight-Digit Hydrologic Unit No.: 09020310
	Climatology and Topography: The climate within the project area is continental and characterized by large variances in temperature, both on a seasonal and daily basis. Precipitation ranges from low to moderate, and air flow through the region creates windy conditions. In general, topography is steeper in the western and central portions of the study area, with moderating slopes to the east. The steepest slopes within the study area are near Pembina County and Cavalier County line, where several coulees exist and rapidly drop runoff from the upper portions of the watershed (west) to lower portions of the watershed (east)
	Watershed Size (acres): 164,761-acres
	Land Uses (acres): According to the Multi-Resolution Land Characteristics Consortium, 2019 National Land Cover Database (NLCD 2019): ▪ Cultivated Crops - 75% or 125,149-acres ▪ Pasture/Hay – 10% or 16,083-acres ▪ Deciduous Forest – 5% or 7,963-acres

	▪ Developed, Open Space – 3% or 4,765-acres ▪ Grassland/Herbaceous – 2% or 3,038-acres ▪ Woody Wetlands – 2% or 2,470 ▪ Emergent Herbaceous Wetlands – 1% or 2,116-acres The remaining land use cover types each account for less than 1% of the project area.
	Land Ownership: Private (97.5%) State-Local (2.5%) Federal (0%)
	Population and demographics: According to the U.S. Census Bureau, American Community Survey (2020), the population within the project area is 1,559 individuals. The per-capita income for the project area is $34,748, which is below the associated County and State per-capita income. Approximately 25% of the individuals in the project area are considered persons in how-income households. The population includes approximately 94% white individuals as the predominate race; the predominant minority group is Hispanic at 4%.
	Relevant resource concerns identified through Scoping: <u>Soils</u> Soil Resources (Erosion, Salinity) Prime and Unique Farmland, and Farmland of Statewide Significance <u>Water</u> Water Quantity Water Quality Wetlands Riparian Areas Floodplain Management International Water Management Plans <u>Air</u> Emissions Fugitive Dust <u>Habitat</u> Natural Areas <u>Plants and Animals – Wildlife and Listed Species</u> Fish and Wildlife Threatened and Endangered Species Migratory Birds Invasive Species

	Human Land Use Environmental Justice and Civil Rights Cultural Resources and Historic Properties Social Issues and Public Health and Safety
Alternative plans considered:	Two final alternatives were formulated and considered as reasonable alternatives in this Watershed Plan-EIS; the No-Action alternative and the Preferred Alternative. Multiple alternatives were preliminarily considered based on ability to meet the purpose of action and technical feasibility. Preliminary alternatives included structural and non-structural measures that fit into five separate categories: 1) No-Action, 2) Reduce Runoff Volume, 3) Increase conveyance capacity, 4) Increase temporary storage, and 5) Protection/ Avoidance. Preliminary alternatives were evaluated based on opportunity for positive water quality and habitat measures to address watershed protection purposes of the action.
Brief description of components of each alternative:	The No-Action Alternative assumes that flood damages and opportunities to address water quality and habitat would continue to occur as experienced under the existing condition. The Preferred Alternative installs a multipurpose structure that provides both flood prevention and watershed protection. Flood prevention would be provided through a 2,593 acre-feet of temporary flood storage. The temporary flood storage would be provided through construction of an off-channel earthen dam impounding water on 560 acres of currently flood prone cropland. Flood waters would be diverted into the off-channel earthen dam via two diversion structures on the Cart Creek and Pembina County Drain 28. Several small culverts would be installed through the township road on the west side of the impoundment location to allow localized (non-diverted) runoff to enter the off-channel earthen dam. The inlet structures and culverts through the township road are designed to simulate sheet/rill flow across the flood pool to restore hydrology to historic wetlands within the flood pool. The project will result in restoration of 470.8 acres of wetlands, enhancement of 18.5 acres of existing wetlands, restoration of 36.3 acres of upland wildlife habitat, and protection of 3.9 acres of upland wildlife habitat.
Mitigation measures for alternatives:	The Preferred Alternative will result in permanent loss of 2.13 acres of wetlands caused by fill placement. An additional 2.96 acres of wetlands are temporarily impacted by excavation, that would return to equivalent function post-installation of the project. Permanent losses are mitigated via restoration of historic wetlands currently in cropland, drained through a subsurface pattern tile drainage system on the north portion of the temporary flood pool. The Preferred Alternative will close the tile system to allow for groundwater discharge at the ground surface rather than management through the in-place drainage system. Additionally, the Preferred Alternative includes earthwork and new inlet drainage structures to restore hydrology to historic sloped wetlands.

	Overall, the project will result in a net gain of 468.7 acres of wetlands, as well as functional improvements to the quality of 18.5 acres of existing wetlands.
Project costs:	PL 83-566 funds: $9,661,000-- 79%
	Other funds $2,567,700 -- 21%
	Total $12,228,700 -- 100%
Project costs continued:	Construction: $8,189,000
	Engineering: $1,830,000
	Real property rights: $1,924,700
	Project administration: $269,000
	Annual Installation: $438,500
	Annual O&M (non-Federal): $17,400
	TOTAL COSTS: $12,228,700 (Average Annual Costs: $455,900)
Project benefits:	Monetary floodwater benefits: $193,545 (Average Annual)
	Flood prevention benefits of the Preferred Alternative are reduced flooding on crop land, reduced structural impacts to agricultural and other buildings, reduced overland flood flows, and reduction in the 100-year flood at Crystal, ND. Peak flow rates of the 10-year and 100-year events are reduced by 64.0% and 65.5%, respectively, on Cart Creek immediately downstream of the earthen dam. Further downstream at the community of Crystal, ND, the 10-year event and 100-year event peak flow rates are reduced by 20.4% and 28.2%, respectively. The acres and duration of inundated cropland is reduced, resulting in $31,650 of average annual damages to cropland. Damages to structures will be reduced by $154,460 of average annual damages, including agriculture buildings, residences, private industry, and public buildings. The reduction of damages is inclusive of the community of Crystal, ND. Flood impacts to rural infrastructure are reduced by $12,420 in average annual damages. International objectives for flood prevention set forth by the RRBC (Red River Basin Commission) are furthered through the installation of the Preferred Alternative. The 2,593 acre-feet of flood storage would contribute toward the 20% flow reduction strategy on the Red River of the North through distributed storage throughout the Red River Basin. This strategy is critical to attaining the internationally adopted flood protection goals for the Red River Basin. Watershed protection benefits of the Preferred Alternative include reduced nutrient loading within Cart Creek and the North Branch Park River downstream of the confluence with Cart Creek. Immediately downstream of the earthen dam, annual loading related to total phosphorus, total nitrogen, and total suspended solids are reduced by 66%, 73%, and 42%, respectively. The Preferred Alternative would result in restoration of 470.8 acres of wetlands, enhancement of 18.5 acres of existing wetlands, restoration of 36.3 acres of upland wildlife habitat, and protection of 3.9 acres of upland wildlife habitat. The net result of these restorations and enhancements is a 529.5 acre block of

	combined wetland and upland wildlife habitat to benefit migratory waterfowl and other birds, and other non-migratory resident wildlife species (both game and non-game species). International objectives for nutrient reductions established by the RRBC and the IRRB (International Red River Board) are furthered through the installation of the Preferred Alternative. Annual load reductions to total phosphorus and total nitrogen will contribute toward the established total phosphorus and total nitrogen objectives at the U.S. Canadian border of 0.15 mg/L and 1.15 mg/L, respectively. Ultimately, reductions in nutrient loading will contribute towards slowing the rate of eutrophication of Lake Winnipeg at the outlet of the Red River in the North in Manitoba, Canada.
	Number of direct beneficiaries (Onsite-Offsite): There are more than 400 different landowners near and downstream of the Preferred Alternative that would benefit from flood damage reduction provided by the site according to Walsh and Pembina County parcel data. This includes residences in the city of Crystal, ND (**Figure C-2 Appendix C**) and land owned by agricultural producers within the North Branch Park River Watershed.
	Benefit to Cost Ratio: 0.4
	Funding schedule (budget year + 2): Federal funds: $9,661,000 Non-federal funds: $2,567,700
	Period of analysis: 52-years
Project life:	50-years

Environmental effects, impacts (include context and intensity):	• Inundated cropland acres reduced by 8.3% during the 10-year event.
	• 100-year flow rate at Crystal, ND reduced by 28.2%
	• Flows at the outlet of the North Branch reduced by 7.3% during the 100-year event.
	• 2.13 acres of wetlands permanently lost due to placement of fill.
	• 2.96 acres of wetlands temporarily impacted due to excavation.
	• Restoration of 470.8 acres of upslope wetlands.
	  o 133.6 acres managed for biomass harvest.
	  o 71.5 acres of crop land currently tile drained.
	  o 57.7 acres of crop land.
	  o 208.0 acres of prairie land.
	• Enhancement of 18.5 acres of existing wetlands.
	• A 529.5-acre block of mixed upland/wetland wildlife habitat.
	• 66% Total Phosphorus Reduction
	• 73% Total Nitrogen Reduction
	• 42% Total Suspended Solids Reduction

Major conclusions	The Preferred Alternative provides a unique opportunity to meet multiple objectives including flood damage reduction, nutrient load reduction, wetland restoration, and wildlife habitat improvements. The nutrient load reduction component contributes to the International Joint Commission agreement for phosphorus and nitrogen reductions on the Red River at the international border crossing. The flood retention component of the project contributes to the Red River Basin Commission goal of 20% flood reduction on the mainstem Red River. Wetland restoration components of the project contribute to

	reversing the loss of critical habitat in the Prairie Pothole Region. In a region where agricultural production potential is high, these opportunities are rare.
Areas of controversy/ Controversial issues:	N/A
Issues to be resolved:	N/A
Evidence of Unusual Congressional or Local Interest	N/A
Compliance:	Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes

1 Purpose and Need for Action

1.1 Purpose and Need

The purposes of the proposed action are to provide flood damage reduction and watershed protection within the North Branch Park River Watershed. The watershed needs that will be addressed include reducing annual flood damages, improving surface water quality, and restoring wildlife wetland and upland habitat.

A major problem identified within the North Branch Park River Watershed is damages to agricultural land, public and private infrastructure, and the community of Crystal, ND from flood flows along Cart Creek and along the North Branch Park River downstream of the Cart Creek confluence. Another major issue is the quantity of nutrients, phosphorus most critically, in the Red River; nutrient concentrations consistently exceed the internationally agreed to objective at the international border crossing and non-point sources in the North Branch Park River Watershed contribute to that problem. Also, a significant concern is continued loss of wetlands and associated upland wildlife habitat as a result of agricultural development. See **Figure B-1** and **Figure C-23** in **Appendices B & C** showing the project location.

The need for action is supported by the following facts:

1) The lack of existing flood flow management results in damages and reduced yields for crop land along Cart Creek and the North Branch Park River downstream of the Cart Creek confluence. With nearly 80% of the average annual inundated cropland acres occurring during the 10-year and less rainfall events, the 10-year flood represents the locally acceptable level or risk for agricultural land by the Sponsoring Local Organization. Estimated annual flood damages to agricultural crops is $876,300.
2) A total of 136 structures are inundated during the 100-year flood event. These structures are a combination of residential structures, agricultural and commercial properties, and public buildings. There are an estimated $770,800 expected annual flood damages for these structures and their contents.
3) Several Federal Emergency Management Agency (FEMA) disaster declarations have also been made as a result of flooding in Walsh and Pembina Counties in 2004 ($1,328,597), 2005 ($1,066,234), 2006 ($1,341,510), 2009 ($6,351,242), 2010 ($1,301,357), 2011 ($2,341,778), and 2013 ($4,225,516). Monetary values in parenthesis represent total obligated FEMA funds combined for each County.
4) Approximately 11,793 acres within the North Branch Watershed, and along the Park River mainstem downstream of the North Branch Watershed, are within the FEMA regulatory 100-year floodplain. There are an estimated 227 structures impacted.
5) Overtopping of roadways within the planning watershed result in an estimated $79,500 in annual flood damages. These damages are primarily associated with repair of the driving surface.

6) In May of 2013, voluntary evacuations were ordered for the community of Crystal, ND due to flooding concerns. Temporary flood control measures were also constructed to protect structures within the community.
7) Flood flows along Cart Creek, primarily in Thingvalla, Park, and Crystal Townships, frequently break out of the channel and flow overland. These break out flows result in erosion of topsoil from agricultural land.
8) The Park River is a contributor to the Red River of the North, which is an international water that flows into Canada near Pembina, ND. Flooding along the Red River is of international significance, as damages are incurred by the U.S. states of Minnesota and North Dakota, and the Canadian province of Manitoba. The Red River Basin Commission (RRBC), through the Long Term Flood Solutions Report (LTFS) (Red River Basin Commission, 2011), has identified and internationally adopted flood protection objectives for economics and communities throughout the Red River Basin. One of the key strategies within this report is to provide tributary flood storage distributed throughout the Red River Basin in order to attain a 20% flow reduction on the Red River mainstem.
9) Non-point source contributions from within the watershed result in nutrient loading of water courses throughout the watershed. Non-point source nutrient loading at the confluence of the North Branch with the Park River mainstem are estimated at 36,412 pounds per year of total phosphorus, 197,533 pounds per year of total nitrogen, and 12,752 tons per year of total suspended solids.
10) Nutrient loading in the Red River Basin is of international significance. The Red River of the North discharges into Lake Winnipeg in Manitoba, CA. Nutrient loading is a contributor to recent trends toward the eutrophication of Lake Winnipeg. While the Red River only contributes 10-15% of the water by volume, its estimated to contribute 60% of the total phosphorus to Lake Winnipeg. Since 1994, water quality monitoring of the Red River at the U.S. Canadian border has indicated an increasing trend in nitrogen and phosphorus levels coming from the U.S. In response to this, the RRBC and the International Red River Board (IRRB) have adopted total phosphorus and total nitrogen load objectives at the U.S. Canadian border of 0.15 mg/L and 1.15 mg/L, respectively. This represents a total phosphorus load reduction goal of approximately 50% (Red River Basin Commission, 2017).
11) The Prairie Pothole Region (PPR) in the northcentral Great Plains is one of the most threatened waterfowl habitats in the U.S. and the Red River Valley is one of the largest artificially drained landscapes in the world. Between 50% and 80% of North American ducks breed in the PPR, and waterfowl production is closely associated with the number and quality of wetlands and surrounding grasslands.

1.2 Flood Prevention

Flooding in the planning watershed is a persistent problem for area residents. Flood damages are experienced on cropland, public and private infrastructure, and structures throughout the watershed, with large impacts to the community of Crystal, ND.

1.2.1 Agricultural Crop Damages

Agriculture is a major component of the local economy within the watershed, with crop production being the primary focus of agricultural activity. The primary crops grown in the region include spring wheat, soybeans, corn, sugar beets, and potatoes. Effective water management to reduce flooding is critical to the productivity of cropland in the watershed. Flooding of crops within the watershed leads to reduced revenue as a result of late plant yield loss, partial and/or total plant loss, replanting costs, and additional operating costs. The magnitude of damages is dependent on the seasonal timing of flooding and the duration for which each crop is inundated. **Table 1-1** below provides information on inundation of flooding within the watershed for the 2 through 500-year recurrence intervals. **Table 1-2** provides an example of how the duration of inundation can vary throughout the rainfall event. The example provided in **Table 1-2** is for the 10-year event, which provides a representation of the level of risk generally targeted for non-federal flood control projects focused on benefitting cropland. Cropland areas that are inundated for a longer duration will have higher damages than areas that are flooded for a short period of time.

Maps of total inundation extents for the 2-year through the 500-year events are available in **Figure C-1.1** through **Figure C-1.7** within **Appendix C**. Inundation extents are shown for existing conditions and for the Preferred Alternative. The area on **Figure C-1.1** through **Figure C-1.7** shown as red represents the inundation for the existing conditions – or no-action scenario – that extends beyond the inundation extent produced with the Preferred Alternative in-place. Therefore, any areas shown as blue would be inundated for both the existing condition scenario and the scenario with the Preferred Alternative in-place. Areas shown as red are only inundated for the existing conditions scenario.

Table 1-1: Inundated Lands Summary

Flood Event	Total Inundated Acres	Cropland* Inundated Acres	Average Annual Inundated Cropland Acres
2-year	5,871	3,905	1,953
5-year	8,471	5,920	1,184
10-year	10,870	7,970	797
25-year	14,252	10,974	439
50-year	17,084	13,543	271
100-year	19,660	15,905	159
500-year	25,468	21,303	43
	Annual Average Inundated Cropland		*4,845*

Table 1-2: 10-Year Flood Event Inundation/Duration Summary

Duration of Inundation	Total Inundated Acres	Cropland* Inundated Acres
0 – 24 hours	2,790	2,204
24 – 48 hours	2,212	1,630
48 – 72 hours	1,616	1,140
72 – 96 hours	1,144	847
96 – 120 hours	625	461
> 120 hours	2,483	1,688

Estimated from National Agricultural Statistics Service (NASS) Dataset GIS data layer

1.2.2 Infrastructure Damages

Infrastructure susceptible to flood damages within the study area primarily consists of roadways and stream crossings. Roads throughout the study area overtop at varying magnitudes of flooding. Overtopping roadways often result in damage to the driving surface, embankment damage, and road washouts, particularly at culvert locations. **Table 1-3** provides the linear feet of road overtopping that occurs during the 2-year through 500-year flood events.

Table 1-3: Roadway Overtopping Summary

Flood Event	Unpaved Roadway (Lineal Feet)	Paved Roadway (Lineal Feet)
2-year	4,788	720
5-year	15,859	1,343
10-year	26,825	1,615
25-year	41,855	2,535
50-year	55,084	5,827
100-year	72,411	8,754
500-year	112,198	20,346

1.2.3 Structure Damages

A total of 136 flooded structures are within the 100-year flood inundation extents. Impacted structures are concentrated in the community of Crystal, ND. Affected structures consist of 37 residential structures (homes and garages), 49 agricultural structures, 37 grain storage containers, 10 commercial structures, and three institutional structures. Based on input from area agricultural producers and residents, the average annual estimated flood damages to structures and contents is $770,800. For a more detailed look at how the average annual estimated flood damage to structures was developed, refer to **Appendix D-4**, which also contains inundation maps showing the locations of the structures used to develop the damages.

Maps that show total inundation for both the existing conditions scenario (blue and red) and the scenario with the Preferred Alternative in-place (blue) are available in **Figure C-1.1** through

Figure C-1.7 within **Appendix C**. Those figures also show impacted critical structures as green and yellow dots. Critical structures indicated on **Figure C-1.1** through **Figure C-1.7** include residential structures, agricultural outbuildings or warehouses, and commercial buildings; structures impacted in the City of Crystal are indicated in **Figure C-2**. The yellow dots represent structures that are removed from inundation with the Preferred Alternative in-place. The green dots represent structures that would be inundated under both the existing condition scenario and with the Preferred Alternative in-place.

1.3 Watershed Protection

Water quality and wildlife habitat are both of concern within the North Branch Park River watershed. Limited opportunity is available to provide benefit to either at a large scale and should be investigated when a multipurpose opportunity is presented.

1.3.4 Water Quality

Non-point surface water runoff from cropland, particularly during spring snowmelt events, and erosion from within the watershed results in nutrient loading of water courses throughout the study area. Non-point source nutrient loading at the confluence of the North Branch with the Park River mainstem is estimated at 39,400 pounds per year of total phosphorus, 197,500 pounds per year of total nitrogen, and 12,800 tons per year of total suspended solids. The Cart Creek tributary from Section 13 of Thingvalla Township downstream to its confluence with the North Branch Park River is listed as impaired for fish and other aquatic biota under the U.S. Environmental Protection Agency's (EPA) 303(d) list.

1.3.5 Wildlife Habitat

While the Prairie Pothole Region (PPR) in the northcentral Great Plains is one of the most threatened waterfowl habitats in the U.S., the Red River Valley is one of the largest artificially drained landscapes in the world. Between 50% and 80% of North American ducks breed in the PPR, and waterfowl production is closely associated with the number and quality of wetlands and surrounding grasslands. Preservation and restoration of available habitat is critical to ensuring waterfowl habitat is available to the continent's waterfowl populations. Wetlands and surrounding grasslands also provide critical habitat for many other game and non-game species in the region.

The availability of large contiguous blocks of prairie habitat is limited within the planning area. High crop production potential, and the resulting comparatively high land values to other areas within the PPR, are financially prohibitive when attempting to enhance and create wildlife habitat in the planning area. In general, prairie habitats are generally limited to smaller fragmented blocks of habitat, typically in areas where crop production is difficult.

1.4 International Concerns

The Park River is a tributary to the Red River. The Red River Basin is an international, multi-jurisdictional watershed of approximately 45,000 square miles, with 80% of the Basin contained within the United States, and the remaining 20% of the Basin located in Canada. International agreements have been established for both flood damage reduction and water quality improvement objectives.

1.4.6 Flood Damages

Flooding along the Red River is of international significance, as damages are incurred by the U.S. states of Minnesota and North Dakota, and the Canadian province of Manitoba. The identified and internationally adopted flood protection objectives for the Red River Basin that are applicable to the North Branch Park River Watershed are listed in **Table 1-4** below.

Table 1-4: RRBC LTFS Level of Protection Goals for the Red River Basin

Area Protected	Estimated Recurrence Level (Minimum Recommended)
Cities/Municipalities [1, 2]	200-year
Rural residences & farmsteads [1, 2]	100-year
Agricultural cropland: Summer flood	10-year
Transportation Critical transportation system and emergency service links [2, 3]	200-year

[1] Protection for urban areas, critical infrastructure, cities, rural residences, and farmsteads should all have appropriate freeboard (i.e., contingency or risk and uncertainty allowance) with any projects designed to provide the specified level of protection.
[2] If a flood of record has occurred which exceeds the specified level of protection goal, the flood of record should be used in place of the specified level of protection goal.
[3] The critical transportation systems should be maintained passable during a flood of the described level of protection to assure safe and reliable transportation and provision of emergency services.
Includes Fargo-Moorhead, Grand Forks-East Grand Forks, and Winnipeg.

The LTFS report specifies that attainment of level of protection goals should consider a basin-wide perspective. A key component of this basin-wide perspective is to reduce the magnitude of flood flows through a concept that involves implementation of flood water retention to address localized concerns. The LTFS report defines a framework referred to as the Basin-Wide Flow Reduction Strategy (BFRS), which provides recommendations for tributary flood flow and volume reductions in order to attain a 20% flow reduction on the Red River mainstem. These recommendations are provided with flow reduction on the Red River mainstem as their objective; they are not intended to dictate local water management within each tributary. The BFRS relies on local water management to consider flood water retention as an alternative for consideration when studying methods to alleviate a localized flood risk.

1.4.7 Water Quality

The Red River of the North discharges into Lake Winnipeg in Manitoba, CA where excess nutrient loading is a contributor to ongoing eutrophication of Lake Winnipeg. Increases in runoff, nutrient loads, and warming temperatures since the 1990s have resulted in degraded water quality and extensive algal blooms, with subsequent negative consequences to fisheries, recreation, and lake ecology. While the Red River contributes only 10-15% of runoff to the lake by volume, monitoring records indicate that it contributes an estimated 60% of the total phosphorus to Lake Winnipeg (McCullough, 2012). While the floods of the 1990s did increase runoff volume from the Red River Basin, even when removing those effects via statistical analysis the USGS analysis illustrated in the following charts indicates concern with the increasing trend in phosphorus (IJC, 2020).

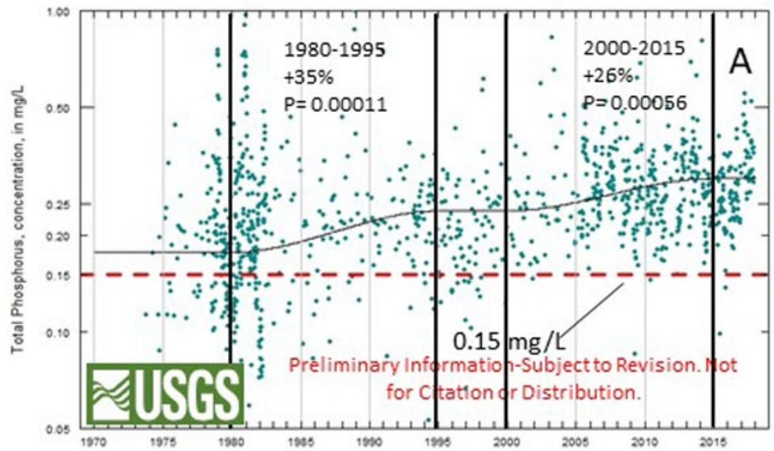

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Chart 1-1: Flow Averaged Trends in Phosphorus, Red River at International Border

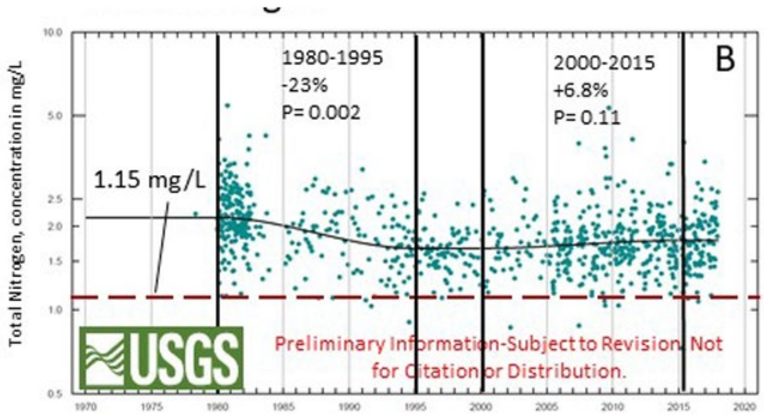


Chart 1-2: Flow Averaged Trends in Nitrogen, Red River at International Border

The Boundary Waters Treaty (BWT) was signed in 1909 to adjudicate conflicting interests on rivers and lakes along the international border between the U.S. and Canada. Article IV of the BWT states that "boundary waters or waters flowing across the boundary shall not be polluted to the injury of health and property of the other". The International Joint Commission was established as an independent and objective advisor to the two governments to prevent and resolve disputes therefore their sub-entities in the Red River, the International Red River Board and Red River Joint Commission have been engaged in scientific studies, stakeholder group meetings, and negotiations for over a decade on Red River nutrient impacts on Lake Winnipeg. The result was adoption of total phosphorus and total nitrogen load and concentration objectives at the U.S. Canadian border. The dashed red lines illustrate the agreed to concentration objectives of 0.15 mg/L for phosphorus and 1.15 mg/L nitrogen (IJC, 2020) versus measured concentrations since 1970 at the USGS gauge on the Red River at the border crossing. Of particular concern is the increasing trend in phosphorus.

2 Scope of the Environmental Impact Statement

Systematic scoping was used to identify problems within the watershed, and to rate their significance. The list of possible concerns was initially presented to the public during the February 17, 2016 public meeting in Mountain, ND. This meeting provided an opportunity to discuss several concerns within the watershed, and also allowed the general public to rate the level of concern for various considerations.

The initial concerns, in accordance with Title 390 - National Watershed Program Manual, 501.24.B. and Title 390 – National Watershed Program Handbook, 606.24.B.(4) and 606.18, that were presented and discussed during the public meeting are listed below:

- National Economic Development (NED)
- Air quality
- Cultural Resources
- Ecologically critical areas
- Endangered and threatened species
- Environmental justice and civil rights
- Essential fish habitat
- Fish and wildlife (including coordination requirements)
- Floodplain management
- Forest resources
- Invasive species
- Land use
- Migratory birds
- Natural areas
- Parklands
- Prime and unique farmland, and farmland of statewide significance
- Public health and safety
- Regional water resource plans (including coastal zone plans)
- Riparian areas
- Scenic beauty
- Scientific resources
- Sole source aquifers
- Social issues
- Soil resources
- Water quality
- Water resources
- Waters of the United States, including special aquatic sites
- Wetlands
- Wild and scenic rivers
- Delayed planting
- Prevented planting
- Crop damages from prolonged inundation
- Road damages
- Culvert and bridge wash outs
- Field erosion/deposition
- Breakout flows to Willow Creek/Drain 67
- Community impacts
- Channel erosion/deposition
- Transportation disruptions
- Business/Commerce disruption

Input on these concerns was solicited from the public to determine the locally perceived issues within the North Branch Park River Watershed. The comments generally indicated several concerns within the Watershed related to flooding. The following flood related concerns were the predominant concerns noted by the public:

- Culvert and Bridge Washouts
- Field Erosion/Deposition
- Channel Erosion/Deposition
- Road Damages
- Floodplain Management
- Land Use
- Soil Resources
- Prevented Planting
- Riparian Areas
- Delayed Planting

After completing public scoping in 2016, the interagency project team discussed the concerns that were identified by the public. These concerns were used to further refine a list of resource concerns within the North Branch Park River Watershed. Each of the concerns was ranked based on their relevance to the project objectives, as defined in the Purpose and Need for Action section. The results of this scoping process are included in Table 2-1. Potential resource concerns that, after scoping, were found to be of low or no relevance to the project were eliminated from further review.

In 2022, a NRCS National Headquarters review determined the need to upgrade from an Environmental Assessment to an Environmental Impact Statement due to potential benefits to the Red River and Lake Winnipeg located across the international border as well as the fact congressional authorization of the watershed plan is required. A Notice of Intent to prepare an EIS was published to the Federal Register on December 14, 2022 and a second Public Scoping Meeting on the project was held on February 23, 2023. The stakeholder list, public invitational materials, and scoping comments and responses are included in **Appendix A** from both scoping meetings. Environmental concerns included Soil Salinity, Water Quality, Water Quantity, Wetlands, Wildlife Habitat and Floodplain Management. The majority of the concerns were Human concerns and included Landuse (and compensation), Benefit/Cost ratio (capital), Operation and Maintenance (Labor & Capital) and Public Health and Safety. Additional concerns that were not previously identified in the original 2016 public scoping meeting were added to this document and are noted by an asterisk in Table 2-1.

Table 2-1: Scope Table and Evaluation of Identified Concerns

Item/Concern * indicates new concern identified in EIS Scoping in 2023	Relevance to the Proposed Action		Rationale * Additional Rationale based on EIS Scoping in 2023
	Yes	No	
SOILS			
Soil resources - Sheet and Rill Erosion - Alluvial shale erosion/deposition* -Soil Salinization*	X		The PTMapp estimate of erosion for the watershed is 0.46 tons/acre. Alluvial shale has been identified as eroding in some channel locations and depositing in other channel locations, including deposition in culverts. *Alternatives may have both positive and negative affects to soil salinity levels. Areas converted to deep-rooted vegetation will reduce salinity levels. Areas adjacent to channels may accumulate salts if not well maintained.
Prime and unique farmland, and farmland of statewide significance	X		The Farmland Conversion Impact Rating for the proposed project site was estimated as 104.85 out of a possible 200 by the NRCS.
WATER			
Water resources	X		It is intended that the preferred alternative will improve flood risk management within the planning area and positively affect the water resources.
Wetlands	X		Wetland resources will be both negatively and positively impacted by the proposed action.
Riparian areas	X		Riparian corridors exist adjacent to Cart Creek, North Branch Park River and tributaries, and wetland complexes. Due to over-incised channel conditions, flood flows do not access the floodplains during natural bankfull events, therefore floods generate higher shear stress and greater bank erosion. Impacts of the project to riparian resources will depend on alternative features considered.
Wild and scenic rivers		X	There are no wild and scenic river designations within the project area.
Sole source aquifers and groundwater resources		X	There are no EPA designated Sole Source Aquifers within the planning area. Groundwater resources within the planning area include the Edinburg and Icelandic aquifers in the southern and northern (respectively) portions of the planning area. Groundwater resources was not identified as a resource concern to project planning stakeholders. Given the temporary nature of the proposed inundation and the underlying soils, no significant increase in infiltration to the ground water system is anticipated.
Water quality	X		The proposed alternative will provide a water quality benefit by reducing downstream nutrient loading. This nutrient load reduction will provide a regional benefit along both the Park and the Red Rivers as well as an international benefit in terms of helping to meet nutrient load targets at the border.
Floodplain management	X		Designated floodplains exist throughout the project planning area.
Regional water resource plans	X		The project is part of a larger planning effort to increase flood resilience within the Red River Valley.

Item/Concern * indicates new concern identified in EIS Scoping in 2023	Relevance to the Proposed Action		Rationale * Additional Rationale based on EIS Scoping in 2023
	Yes	No	
International Concerns	X		The North Branch Park River is included within the Red River of the North basin. There are specific water quality goals established at the international border. The Preferred Alternative will result in an incremental improvement for nutrient loading at the border.
			AIR
Air quality*	X		The National Ambient Air Quality Standards (AAQS) (40 CFR 50), set by the Environmental Protection Agency (EPA), as directed under the Clean Air Act, define standards for six criteria air pollutants. The North Dakota Department of Environmental Quality(NDDEQ), Division of Air Quality has the responsibility to ensure the ambient air quality in North Dakota is maintained in accordance with the levels established by the state and federal AAQS and the Prevention of Significant Deterioration of Air Quality Rules. The EPA developed National Ambient Air Quality Standards (NAAQS) for the criteria pollutants to protect public health and welfare. To determine whether an area meets the NAAQS, air monitoring networks have been established and are used to measure ambient air quality and determine attainment areas. NDDEQ operates and maintains a network of ambient air quality monitoring sites throughout the state; the nearest air quality monitoring station is in Fargo, Cass County, North Dakota. Neither state nor federal standards were exceeded at any of the monitoring sites throughout the state according to the North Dakota Ambient Air Quality Monitoring Program 2023 Annual Report (North Dakota Environmental Quality, Division of Air Quality, 2019). The Planning Area is designated to be in attainment or unclassifiable (to be considered in attainment) for all NAAQS (U.S. Environmental Protection Agency, data current as of July 31, 2019). The project site is several hundred miles from Federal Land Management air quality monitoring sites such as Voyageurs National Park in Minnesota or Lostwood National Wildlife Refuge in western North Dakota. Visibility data from these sites is not applicable to the project. There are no Protected Visual Environments or Class 1 Wilderness areas close to the project area. Wet Deposition air quality data (data derived from precipitation analysis) is available from Icelandic State Park for several parameters. Three parameters have increasing trends – Ammonium, Calcium and Magnesium ions. These ions are not criteria pollutants of concern. The project is non-mechanical and does not involve any permanent air polluting infrastructure. Temporary use of heavy machinery for construction and maintenance on the project is not anticipated to significantly affect or change air quality in the region however the EPA has advised impacts from construction are relevant resource concerns for Fugitive Dust and Tailpipe Emissions.
			HABITAT
Natural areas		X	There are no designated natural areas located within the watershed.

Item/Concern * indicates new concern identified in EIS Scoping in 2023	Relevance to the Proposed Action		Rationale * Additional Rationale based on EIS Scoping in 2023
	Yes	No	
Ecologically critical areas		X	There are no ecologically critical areas designated within the project area.
Essential fish habitat		X	There are no designated essential fish habitat areas within the project area.
Scientific resources		X	There are no scientific resources within the project area.
Forest resources		X	Limited timber areas in the project area, Forest resources are along the escarpment of the North Branch Watershed, however no impacts are anticipated.
<u>PLANTS AND ANIMALS – WILDLIFE AND LISTED SPECIES</u>			
Fish and wildlife	X		There have been 27 fish species identified as characteristic to the Park River. There have also been 30 species of conservation priority identified in the area, 3 birds, 5 mammals, 16 fish and 6 mussels. The design has included an effort to minimize any likelihood of fish being diverted to the detention area. Similarly, no negative impacts to any of the other species of conservation priority are anticipated.
Endangered and threatened species	X		The US Fish and Wildlife Service's Information Planning and Conservation System indicates there is no designated critical habitat in the project area, but two federally listed species, the Whooping Crane and the Northern Long-eared Bat, may be present within the vicinity of the project area. There is no identified critical habitat for the Whooping Crane present in the project area. No critical habitat has been designated for the Northern Long-eared Bat. .
Migratory birds	X		North Dakota is located within the Central Flyway. The project is located within the Prairie Pothole Region which is an important breeding area and a significant contributor to continental Waterfowl Populations. The US Fish and Wildlife Service has identified eight species of migratory birds of particular conservation concern (See **Table 3-9**). This project is unlikely to negatively impact any of these species. The project will positively impact other migratory species by providing wetland habitat for migrating waterfowl and possibly for local production of migratory waterfowl.
Invasive species	X		Zebra mussels are an invasive species of particular concern in North Dakota and have been found throughout Red River tributaries upstream to the first vehicular bridge crossing. There are 13 species of noxious weed identified within North Dakota at the state level. Pembina and Walsh Counties have identified three additional noxious weeds within their jurisdictions. Dutch Elm disease has also been confirmed in every county of North Dakota and is likely present in the project area. A list of species is included in Section 3.5.12.
<u>HUMAN</u>			
Land use	X		Flooding on agricultural lands is currently a significant concern. Preservation of the local agricultural economy by ensuring lands remain in agricultural production is a priority. Limited land use change will result from this proposed project other than positively impacting the agricultural uses that already exist.
Environmental justice and civil rights	X		Screening did not identify any negative impact to any specific population as a result of the proposed project. No environmental justice communities would be adversely impacted by the project.

Item/Concern * indicates new concern identified in EIS Scoping in 2023	Relevance to the Proposed Action		Rationale * Additional Rationale based on EIS Scoping in 2023
	Yes	No	
Cultural resources	X		A Class III Archaeological and Cultural investigation (**Appendix D-10**) was conducted and resulted in no discovery of cultural resources or properties eligible for the National Register of Historic Places within the APE. Therefore, there no cultural resource concerns for the project that would delay action on undertaking.
Social issues and Public Health and Safety	X		Public health and safety is currently compromised during times of flooding. Flooding presents a major public safety risk within the study area; some instances include culverts and ditches plugged with sediment or snow, and road overtopping causing erosion and closures*. There have been frequent claims through FEMA disaster declarations related to road damages during flood events. Additionally, direct impacts occur from flooding within the City of Crystal, ND and indirect impacts to other communities in the Watershed.
Scenic beauty / Visual		X	There are no designated scenic sites within the watershed planning area. Limited natural, undisturbed landscape exists within the project area as the planning area is primarily agricultural with smaller rural communities. Visual resources or scenic beauty is not a resource concern for this project.
Parklands		X	There are no state or federal parklands identified within the planning area. There may be local parks within cities located throughout the planning area. Parklands are not a resource concern for this project.

3 Affected Environment

This section describes pertinent physical, ecological, economic, and social information for the planning area. This will provide the context for determining the effects of alternatives in later sections. Each of the relevant concerns identified during the scoping process described in the previous section is described in more detail in the following sections.

3.1 Soils

3.1.1 Soil Resources

The eastern portion of the project is located within the Lake Agassiz Plain, which includes the Glacial Lake Agassiz Basin, Sand Deltas, Beach Ridges, and Saline Areas. The western portion of the project area is located within the Northern Glaciated Plains, most specifically the Drift Plains of that region (Bryce, Sandra A., et al.). Most of the region is covered by silt and clay deposits consistent with a lake bottom. Beach ridges scattered throughout the valley mark the former shoreline of the giant Lake Agassiz, at various periods of time. The valley rises 500 feet over a bedrock escarpment to mark the natural boundary of the Red River Valley (North Dakota Game and Fish Department (6)). The general topography within the area consists of steeper slopes in the western and central portions of the project area, with moderating slopes further east. Prairie potholes located within the project area provide natural water resources management because of their ability to absorb rainfall and snow melt runoff. The watershed is generally characterized by moderate slopes in Cavalier and western Walsh and Pembina Counties, with slopes flattening in eastern Walsh and Pembina Counties.

USDA / NRCS geospatial soil survey data which was used to assess the project area. There are 258 unique soil types within the project area; those most predominant types within the project area are tabulated below (**Table 3-1**).

Other soil characteristics that characterize a landscape include hydric soils and the soil erodibility factor (the "K" factor). A total of 7% of the soils within the planning area have 0% hydric status, 70% of the project area is comprised of soils with low hydric ratings (1-32%). A total of 6% are 33-65% hydric, 11% are 66-99% hydric; and less than 1% of the soils are classified with a 100% hydric status, as depicted in **Figure C-3** within **Appendix C**.

The K factor indicates the erodibility of materials less than 2 millimeters in size. Values of K across the project area range from 0.02 to 0.49 (the maximum K-factor value is 0.69), with higher values indicating greater susceptibility to erosion. Approximately 96% of the soils in the project area are ranked with a K factor of 0.2-0.38. The highest ranked soils, i.e. those most susceptible to erosion, are located heavily throughout the watershed (see **Figure C-4**).

According to the USDA / NRCS Soil Surveys for Walsh, Pembina and Cavalier counties, there 258 soil map units within the planning area. The most predominant soil map units are Glyndon silt loam (23% of area), followed by Barnes-Svea (5%). Soils within the watershed are dominated generally by fine silts and loams which are representative of the Lake Agassiz flat valley. Soils within the planning area are as summarized in the table below.

Table 3-1: Soil Map Units within planning area (U.S. Department of Agriculture).

Map Unit Name	Acres in AOI	Percent of AOI
Glyndon silt loam	37,930.00	23.01%
Barnes-Svea loams	8,630.60	5.23%
Waukon loam	8,167.30	4.95%
Bearden silty clay loam	8,044.70	4.88%
Hamerly-Tonka complex	6,912.80	4.19%

Note: Of the 210 unique soil types in the project area, only those most predominant types are tabulated above.
Source: USDA, NRCS, SSURGO Database, *STATSGO2* data, accessed Oct 2017.

3.1.2 Prime and Unique Farmland, and Farmland of Statewide Significance

Under the Federal Farmland Protection Policy Act (FPPA), lands that are determined to be Prime Farmland, Unique Farmland, or Land of Statewide or Local Importance are protected from unnecessary conversion to other uses. The intent is to minimize the impact that Federal decisions have on the unnecessary or irreversible conversion of farmland to nonagricultural uses. The USDA SSURGO soils database was used to estimate farmland designation within the planning extents. Farmland designations within the planning area are presented graphically in **Figure C-5**, within **Appendix C** and summarized in **Table 3-2**, below:

Table 3-2: Farmland designations within Planning area

Farmland Designation	Acres	% of Planning area
All Areas Prime Farmland	88,994	54
Prime Farmland if Drained	24,507	15
Farmland of Statewide Importance	10,143	6
Not Prime Farmland	41,118	25
Total	**164,762**	**100**

The planning area is predominantly classified as prime farmland (54%). Approximately 15% is classified as prime farmland, if drained, 6% is farmland of statewide importance, and 25% is not classified as farmland.

3.1.3 Alluvial Soils

Alluvial soils were deposited by surface water; they can be found along rivers, in floodplains, stream terraces, and current ditches. Alluvial soils are made up of the soils from the watershed, which as described in 3.1.1; surface soils include large amounts of loam, plus material from bedrock outcrops, and glacial erratic materials. Loam includes variety of sizes, including sand, silt, and clay. The shallowest bedrock material is the Pierre Shale formation (Arndt, 1975). Glacial erratic material is larger than sand, and include gravel, cobbles, and boulders. Sediment transport is largely tied to flood events, where the force of moving water dislodges and suspends particles or pushes them as bedload along the bed of a flowpath, i.e. rill, gully, creek, stream, or river.

Within the watershed, alluvial soils that have been identified as the largest concern include shale originating from tributaries which formed from the flowpaths of glacial runoff. This runoff cut deeply through the glacial moraine into the Pierre Shale Formation. This material deposits at anthropogenic features and lower stream reaches as slopes flatten. The glacial moraine is located just west of Hwy 32, which has higher slopes than on east side of the highway; the break in slope generally follows Hwy 32. Shale is very erodible, even though it is considered a bedrock geologic formation, due to its soft nature with flat bedding layers. When shale material is in the stream being transported as bedload, subsequent weathering occurs causing reducing of material sizes. Recent flood events have exposed and caused significant erosion of shale throughout the watershed, with the stream reaches extending from Hwy 32 (Mountain) and ~5 miles west as critical stretches. Erosion causes instabilities as the stream inverts cut down, causing subsequent widening and high sediment transport. The increased sediment loads are prone to deposition when stream slopes flatten, or other low velocity areas, i.e. in and around ditches, culverts, and bridges. Deposition in stream, ditch, or culvert areas can cause expanded overbank flows, overtopping of roads, and filled culverts. The critical reach of deposition identified at public meetings extends from Hwy 32 (Mountain) and ~2 miles east. Deposition in Cart Creek and tributaries including multiple culverts and channels along this 2-mile reach, specifically the tributary where the channel capacity is limited causing deposition in the channel and adjacent fields along County Road 3 (88^{th} St. NE).

3.1.4 Soil Salinity

Soil salinity has been identified in the environment. The weathering of minerals in the shale bedrock is the source of salts in Red River Valley soils. Calcium, sodium and magnesium water soluble sulfates, are known to concentrate in some areas due to the horizontal and upward net movement of water. The water table is sometimes close enough to the surface that capillary rise and evapotranspiration can bring salts into the rooting zone and sometimes to the soil surface itself. Ditch salinity is commonly noticeable on aerial photography in this area, **Figure C-6** within **Appendix C.** This exists because the compaction under a road or drain does not allow surface water or groundwater to move in its natural direction; the water stacks up (recharge) and capillary rise moves the water and dissolved salts to the surface (discharge). Surface salinization risk was evaluated with the Web Soil Survey Surface Salt Concentration Report (**Figure C-7 Appendix C**). This report incorporates multiple factors including water table, depth to saturation, and electrical conductivity to arrive at a risk rating by soil map component. Soils in the planning area were most commonly rated as low risk, however a significant area does show a risk and some areas are mapped as high risk or saline soils.

3.2 Water

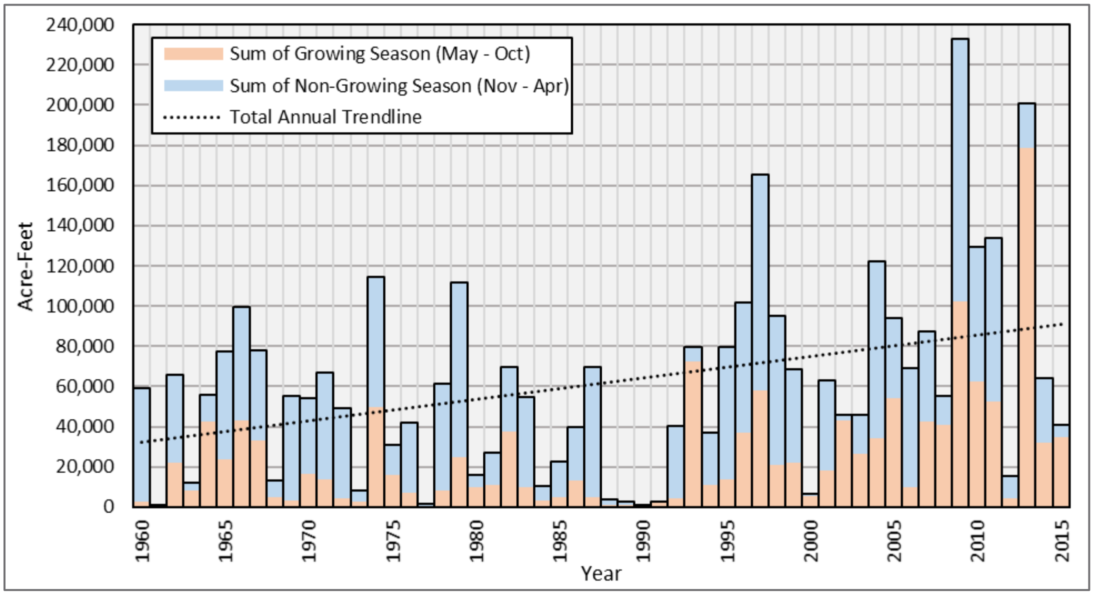
3.2.5 Water Quantity

The project area includes the northern/northwestern portion of the Park River watershed. The Park River is one of several tributaries to the Red River (HUC09020308) and is located within the Red River Basin in northeastern North Dakota. Within the project area there are approximately 168 miles of streams and river; approximately 85 miles of that encompass the North Branch of the Park River, and another 83 miles of Cart Creek and its tributaries (**Figure C-8**). Wetlands are detailed separately under Section 3.2.7. There are limited lakes. Wetlands are sporadic throughout the landscape and are more predominant in the central and western portions of the project area.

The reoccurring flood conditions result in impacts to the water resources within the project area. Flooding results in an increased potential for channel instability and channel erosion and deposition, most particularly in the eastern portion of the project area.

Several trends related to the magnitude and frequency of flooding in the North Branch Park River Watershed have been observed through review of available gaging data. Review of USGS Gage 05090000 (Park River at Grafton, ND) suggests increases in both runoff volume and magnitude of flows. This gage is located just downstream of the North Branch Park River confluence, and, while it includes the Middle Branch and South Branch tributaries, trends are expected to remain similar throughout the watershed. **Chart 3-1** presents the annual runoff yield between 1960 and 2015 as observed from daily flow information at United States Geological Survey (USGS) Gage 05090000. Annual runoff yields illustrated in **Chart 3-1** suggest total runoff has increased over this period. Additionally, annual runoff observed during the growing season has increased. This appears to substantiate landowner comments that crop damages associated with flooding within the watershed have become more frequent in recent history.

Chart 3-1: Annual Runoff Yield (USGS Gage 05090000 Park River at Grafton, ND)



3.2.6 Water Quality

The North Dakota Department of Health (NDDOH) currently recognizes 295 public lakes and reservoirs. Of the 295 public lakes and reservoirs recognized as public waters, only 200 lakes and reservoirs are specifically listed in the state's water quality standards as classified lakes and therefore are assigned beneficial uses. The remaining 95 lakes and reservoirs, while included in the state's estimate of total lake acres, are not considered classified waters and are not assessed in the State's Water Quality Assessment Report (NDDH 2019). These waterbodies are assigned the Class 4 fisheries classification. The Section 303(d) list includes waterbodies not meeting water quality standards and waterbodies identified needing TMDL studies within the project area.

Of the streams and lakes assessed within the project area, portions of the North Branch of the Park River, and Cart Creek are listed as impaired. Additional details are provided in **Table 3-3**. A map showing the impaired reaches is also available in **Figure C-9** within **Appendix C**. **Appendix D-7** provides estimates of current nutrient and sediment loading in Cart Creek.

Table 3-3: Section 303(d) impaired waters within the planning area, 2016 reporting year (North Dakota Department of Health, Final, April 26, 2019).

Water Body Name		ID Number	Size	Use Support	Affected Designated Use	Impairment
Park River; North Branch from confluence with a tributary near Highway 32, downstream to		ND-09020310-037-S_00	27.63	Not Supporting	Fish and Other Aquatic Biota	Combination Biota / Habitat Bioassessments

Water Body Name		ID Number	Size	Use Support	Affected Designated Use	Impairment
confluence with Cart Creek						
Park River; North Branch from a tributary near Milton, ND, downstream to its confluence with a tributary near Highway 32.		ND-09020310-039-S_00	15.66	Fully Supporting, but Threatened	Fish and Other Aquatic Biota	Fishes Bioassessments and Benthic-Macroinvertebrate Bioassessments
Cart Creek; Cart Creek from its confluence with a tributary 2 miles east of Mountain, ND, downstream to its confluence with the North Branch Park River		ND-09020310-044-S_00	36.32	Not Supporting	Fish and Other Aquatic Biota	Fishes Bioassessments and Benthic – Macroinvertebrate Bioassessments

Source: NDDH, North Dakota 2018 Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads, Final April 26, 2019.

3.2.7 Wetlands

The National Wetland Inventory (NWI) was used to identify wetlands within the planning area. The NWI does not represent a wetland delineation for regulatory purposes, and typically only comprises a portion of actual wetlands in eastern ND but offers a “first glance” at potential wetland resources within an area. NWI identified wetlands within the planning area are shown in **Figure C-10** within **Appendix C**.

Based on NWI data, there are approximately 2,415-acres of wetlands within the planning area. Many of these identified wetlands have been modified (ditched, drained, cultivated) over the years to accommodate agricultural production. The eastern reaches of the planning area contain very few wetlands. The western portions of the planning area contain more wetlands, which appear isolated on the landscape (pothole wetlands). The central portions of the watershed include several coulees that rapidly drop runoff from the upper watershed in the west to the lower watershed in the east. This central coulee area contains the largest frequency of wetlands within the planning area. Wetland type summaries are presented in **Table 3-4**, below.

At field wetland delineation was conducted to identify existing wetlands in the vicinity of Alternative 2, which is summarized in Appendix D-7: Aquatic Resource Delineation Report. Results indicate that there are 17 wetland areas (30.72 acres). Those include wetlands located on three existing 30-year USDA Wetland Reserve Program (WRP) Easements and include both wetland and upland habitat; a total of 227.9-acres were enrolled in easements in 2010 and 2012.

Alternative 2 was designed to avoid any construction impacts within the existing WRP easements; silt fence would be installed around the boundary to ensure no construction traffic occurs on the easements. Alternative 2 would enhance existing wetlands on the easements, as described above, due to restoration of natural hydrology. In addition, the overall wildlife habitat value of the WRP easements will be improved due to increased adjacent habitat value. NRCS determined that modifications to hydrology within the easements will have no negative effect on existing wetland function or plant species given the low duration of inundation proposed with the dry dam. Time for the flood pool to fully drain ranges from approximately 7-days for the 2-year flood event to 15-days for the 100-year flood event. The O&M Plan for the PL-566 project would extend protection for the WRP easements 50-years from the date of construction.

Table 3-4: Wetlands within planning area, based on NWI.

Wetland Type	Acres in Planning area
Freshwater Emergent Wetland	2,085.6
Freshwater Forested / Shrub Wetland	207.2
Freshwater Pond	122.6
Total	**2,415.4**

Source: USFWS, *National Wetlands Inventory* (NWI) dataset (2016). https://www.fws.gov/wetlands/.

3.2.8 Riparian Areas

Riparian areas occur at the interface between land and a watercourse (river, stream, or tributary) or water body. Typical examples include flood plains and stream banks. They are distinctly different from surrounding lands because of unique soil and vegetation characteristics that are strongly influenced by the presence of water. Within the planning reach there are approximately 160 miles of stream and river and associated riparian corridor within the project area. Riparian areas within the planning area are relatively narrow throughout the North Branch Park River, Cart Creek and their tributaries.

Much of the Cart Creek tributary is considered a "perched" channel, meaning the adjacent floodplain slopes away from the Cart Creek channel. Floodplain access along the Cart Creek north of Crystal, ND often leads to overland flows in a southeasterly direction until re-entering the Cart Creek and North Branch south of Crystal, ND.

Streams typical of this region generally access adjacent floodplains at the 1.5-year recurrence flood event. The North Branch west of Pembina County Road 12 and Cart Creek west of 132nd Avenue NE currently has floodplain access ranging from the 5-year and 100-year flood events indicating an incised channel in these regions. Reduced access to a vegetated floodplain causes increased channel velocities resulting in bank erosion, continued incision, and increased sediment deposition further downstream where channel slopes moderate.

3.2.9 Floodplain Management

Communities within the project area participate in the National Flood Insurance Program (NFIP). Floodplain maps and designations are developed by the FEMA. The current Digital Flood Insurance Rate Map (DFIRM) identifies Special Flood Hazard Areas that are regulated through the participating community's floodplain ordinance. These areas are subject to inundation by the 1% annual chance flood and are designated as zones A, AE, AH, AW, AR A99, V, or VE. The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of being equaled or exceeded each year. The Base Flood Elevation is the water-surface elevation resulting from the 1% chance flood.

Figure C-11 in **Appendix C** provides a map showing the designated FEMA Flood Zones within the planning area. Pembina and Walsh Counties have had floodplain areas mapped, whereas Cavalier County remains largely unmapped. Areas within the study area that have been mapped are designated as Zone A, AE, and as areas with 0.2% Annual Chance of Flood Hazard (U.S. Department of Homeland Security). The project area is predominately mapped as Zone A, with the City of Crystal including Zone AE (see **Figure C-11**).

3.2.10 International Water Management Concerns

3.2.10.1 Flood Damages

Flooding along the Red River and its tributaries is a prolonged issue for the region. Over the course of the 20th century, an increase of 20% in precipitation produced 300% higher annual discharge in the Red River. Mobilization of phosphorus is more strongly correlated to peak flow events than mean discharge (McCullough, 2012). Climate predictions indicate 10-20% further increase is likely for 20-year recurrence precipitation events over the next three decades in this region (IPCC, 2014). Substantial damages are often experienced during periods of excessive runoff. Impacts experienced along the Red River mainstem are a result of combined tributary sub watershed contributions. Since the flood of 1997, severe flooding has been observed to occur on a more frequent basis. In response to this, the Red River Basin Commission began development of the *Long-Term Flood Solutions* report, adopted in 2011 (Red River Basin Commission, 2011). This report was developed with broad input from local, state, and federal officials to provide recommendations for acceptable levels of flood risk within the Red River Basin. One of the key strategies adopted was a goal of a 20% reduction in peak flows on the Red River through development of 1.5 million acre-feet of retention in priority areas of the U.S. portion of the Basin. This strategy relies on peak flow reductions through local, independently driven initiatives to solve local flood problems throughout the Red River Basin.

3.2.10.2 Water Quality

The project is part of a larger scale approach to water resources management within the Red River Basin. The Red River Basin is a multi-jurisdictional 45,000 square mile watershed, with 80% of the Basin located within the United States and the remaining 20% within Canada. The Boundary Waters Treaty was signed in 1909 to prevent and resolve disputes over the use of the waters shared by Canada and the United States and to settle other transboundary issues. The treaty established the International Joint Commission (IJC) to help the two countries carry out its provisions. As specified in Article IV, "waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other." The Treaty established the IJC, under which the International Red River Board operates. Multi-national water quality objectives were agreed to by both governments in 1969 for the Red River at the border, with numerical standards for total dissolved solids, dissolved oxygen, chloride, sulphate, and E.coli. Later agreements made between the two countries through the IJC set numerical standards for other constituents. The Red River at the international boarder has consistently exceeded those standards.

The Red River discharges to Lake Winnipeg, the world's tenth largest freshwater lake which supports many people, uses and needs. Lake Winnipeg, unfortunately, is also one of the world's most eutrophic lakes, and in 2013 was designated Threatened Lake of the Year by the Global Nature Fund. Since the 1990's there has been continual expansion of blue-green algae (cyanobacteria) in the lake. Research suggests that eutrophication, as well as the blooms, are tied to increased phosphorus loadings from higher rates of fertilization (related to conversion from wheat to corn/soybean rotations) and more frequent and intense spring floods in the basin. The annual and seasonal riverine nutrient loads are very strongly dependent on river discharge, particularly coming from the Red River. Spring runoff from the Red River (typically occurring in April) contains twice the nitrogen load as all other months and sources combined (Mayer, 2012).

3.3 Air

The National Ambient Air Quality Standards (NAAQS) (40 CFR 50), set by the Environmental Protection Agency (EPA 2023), as directed under the Clean Air Act, define standards for six criteria air pollutants. The North Dakota Department of Environmental Quality(NDDEQ), Division of Air Quality has the responsibility to ensure the ambient air quality in North Dakota is maintained in accordance with the levels established by the state and federal NAAQS and the Prevention of Significant Deterioration of Air Quality Rules. The EPA developed National Ambient Air Quality Standards (NAAQS) for the criteria pollutants to protect public health and welfare.

The EPA recommends establishing the existing environment for air quality and Air Quality Related Values (AQRV's) to obtain a baseline from which alternatives can be judged. An AQRV is a resource identified by the Federal Land Manager (FLM) for one or more federal areas that may be adversely affected by a change in air quality. The resource may include a specific scenic, physical, biological, ecological or recreational resources identified by the FLM. The existing environment includes not only the values for the 6 criteria pollutants (Ozone, Particulate Matter (both 2.5mm and 10 mm), Sulfur Dioxide, Lead, Nitrogen Dioxide and Carbon Monoxide), but also visibility and resources sensitive to deposition (wet deposition for Nitrogen and Sulfur). Several federal agencies conduct air quality monitoring as well as the ND Department of Environmental Equality (NDDEQ).

3.3.11 Related Values for Criteria Pollutants

NDDEQ operates and maintains a network of ambient air quality monitoring sites throughout the state; the nearest air quality monitoring station is in Fargo North Dakota; however this station does not record all parameters. Data from other state and federal monitoring sites was utilized to obtain a complete baseline for existing air quality. These other sites included Bismarck, ND; Theodore Roosevelt National Park (north unit) in western ND; Lostwood National Wildlife Refuge in Burke County ND; Hiddenwood National Wildlife Refuge near Ryder ND; Voyagers National Park, MN; Red Lake Nation, MN; and Icelandic State Park, Pembina County ND. Design Values for the six criteria pollutants are summarized in Table 3-5. A design value is a mathematically determined pollutant concentration at a particular site that must be reduced or maintained at or below the National Standard (NAAQS) to assume attainment. There were no monitoring sites where the Design Value exceeded the NAAQS standard. No non-attainment areas were documented (EPA 2022 Design Value Interactive Map epa.gov).

Table 3-5: EPA Design Values for Air Quality Pollutants

Criteria Pollutants	NAAQS Threshold	Fargo, ND	Lostwood NWR, ND	Hiddenwood NWR, ND	Teddy Roosevelt National Park, ND (North Unit)	Bismarck, ND	Voyagers National Park, MN	Red Lake Nation, MN
Ozone (8-hr) ppm	70	58	55	53	56	no data	55	24
Particulate Matter 2.5 mm (Annual) µg/m²	12	8.3	6.4	6.3	5.4	7.7	4.7	6.2
Particulate Matter 2.5 mm (24-hr) µg/m²	35	32	23	24	22	28	16	24
Particulate Matter 10 mm (24-hr) µg/m²	150	no data	0	no data	no data	0	no data	no data
Sulfur Dioxide (1-hour) ppb	75	4	17.5	6.7	3.7	7.3	15.8	no data
Lead NAAQS (3 months) µg/m²	0.15	no data	no data	no data	no data	no data	no data	no data
Nitrogen Dioxide (1-hr) ppb	100	32.2	11	9.5	10.5	9.7	35.9	no data
Nitrogen Dioxide (Annual) ppb	53	3.72	1.65	1.63	1.49	4.39	4.5	no data
Carbon Monoxide (8-hr) ppm	9	no data	no data	no data	no data	0.8	no data	no data

3.3.12 Trends and Visibility

Interagency monitoring programs evaluate air quality conditions and trends for Particulate Matter (2.5mm), Ozone, Visibility, Nitrogen deposition and Sulfur deposition in Class 1 areas which include national parks. The closest national parks are Theodore Roosevelt National Park in ND and Voyagers NP in Minnesota. In both parks, for 10-year average data from 2012 – 2021, the condition for all of the parameters was “fair”, with the exception of Sulfur deposition which was rated “good”. Trends for all of the parameters in both parks was considered Relatively Unchanged for all parameters (USDI NPS 2023).

3.3.13 Deposition

Existing deposition was characterized by utilizing the National Atmospheric Deposition Program’s National Trends Network (NTN)(2023). Deposition data is available from precipitation data collected from 1988- 2023 at Icelandic State Park in central Pembina County. The NTN Wet Deposition Summary for the park indicates a downward trend in Nitrate and Sulfate deposition. The Ammonium Ion trend has been increasing in this time period. Potential sources of ammonium include livestock manure, synthetic fertilizer and automobile exhaust.

3.3.14 Carbon Emissions

Uptake of atmospheric carbon has been observed to be substantially greater in perennial crops compared to annual crops. Growing season net ecosystem CO_2 exchange has been observed to be 556 g C m^{-2} yr^{-1} in perennial crops compared to 89 g C m^{-2} yr^{-1} in annual crops (Kim et al., 2022). The difference in equipment emissions between non-irrigated cropland and unfertilized grass cover for Pembina county is 0.07 tons CO_2 $acre^{-1}$ yr^{-1} (COMET, 2024).

3.4 Habitat

The North Branch Park River watershed is located within the eastern extents of the Prairie Pothole Region (PPR). Habitat consisting of mixed upland and wetland grass habitats provide habitat of international significance for ducks, geese, shorebirds, and other migratory birds. Resident species of birds and mammals also rely on prairie natural areas throughout the year. While the importance of habitat in this region is critical to birds and other wildlife, the planning extent is primarily cultivated, thus limiting available habitat.

Large, contiguous blocks of grassland habitat are limited across the planning area. This is a result of, in part, comparatively high crop production and land values to other areas of the PPR. Most grassland habitat available is fragmented, and often in locations where farming isn't practical.

3.5 Plants and Animals – Wildlife Listed Species

3.5.15 Fish and Wildlife

The project area is located within the *Tallgrass Prairie* habitat type of North Dakota, which is also known as the Red River Valley. Predominant natural vegetation characteristic of this habitat type includes various grasses and forbs (North Dakota Game and Fish Department (2)). Typical vegetation and wildlife found in Tallgrass Prairie habitat are tabulated below (**Table 3-6**). Though, it should be noted that a majority of the native/natural land cover in this region has been altered for agricultural production (see Section 3.6.18 *Land Use*), so these native vegetative species are a minority within the project area. Fish species found in the Park River watershed include communities typical of warm water streams and many species found in the connected waters of the Red River of the North drainage area. There are 51 typical fish species present within the North Dakota/western portion of the Red River Basin, 27 fish species have been identified characteristic to Park River (**Table 3-6**) (Goldstein, 1995).

Table 3-6: Vegetation and Wildlife Characteristic of Tallgrass Prairie Habitat of North Dakota

Vegetation and Wildlife	Species
Grasses	Big bluestem, Switchgrass, Indiangrass, Prairie dropseed, Slender wheatgrass, Porcupine grass, Mat muhly, Fescue sedge, and Meadow sedge
Forbs	Western prairie-fringed orchid, Blue-eyed grass, Meadow anemone, Prairie cinquefoil, Wild licorice, Prairie blazing star, Tall goldenrod, Black-eyed Susan, and White sage

Vegetation and Wildlife	Species
Birds	Mallard, blue-winged teal, red-tailed hawk, American kestrel, ring-necked pheasant, killdeer, Eastern kingbird, Western kingbird, American crow, common yellowthroat, clay-colored sparrow, vesper sparrow, Savannah sparrow, Henslow's sparrow, Western meadowlark, and brown-headed cowbird
Mammals	Northern short-tailed shrew, white-tailed jackrabbit, snowshoe hare, Franklin's ground squirrel, thirteen-lined ground squirrel, Northern pocket gopher, plains pocket gopher, Western harvest mouse, deer mouse, Northern grasshopper mouse, prairie vole, meadow vole, meadow jumping mouse, Western jumping mouse, coyote, red fox, raccoon, badger, striped skunk, white-tailed deer, and moose
Reptiles/Amphibians	American toad, Great Plains toad, Northern leopard frog, chorus frog, tiger salamander, plains garter snake, and common garter snake
Fish	Northern pike, Carp, Longnose dace, Blacknose dace, Creek chub, Fathead minnow, Bluntnose minnow, Common shiner, River shiner, Sand shiner, Bigmouth Buffalo, Quillback, White sucker, Channel catfish, Brown bullhead, Black bullhead, Tadpole madtom, Trout-perch, Brook stickleback, Freshwater drum, Rock bass, Black crappie, Yellow perch, Walleye, Sauger, Blackside darter, Johnny darter,

Sources: North Dakota Game and Fish Department, Wildlife Conservation: Tallgrass Prairie (Red River Valley), accessed Oct 4 2017: https://gf.nd.gov/wildlife/habitats/tallgrass; and, Goldstein, R.M., US Geological Survey, Water-Resources Investigations Report 95-4047: *Aquatic Communities and Contaminants in Fish from Streams of the Red River of the North Basin, Minnesota and North Dakota*, 1995, p. 16-17.

3.5.15.1 Species of Conservation Priority

The North Dakota Game and Fish Department (NDGFD) prepared the *State Wildlife Action Plan* (SWAP) (2015), which represents the state's strategy for preserving fish and wildlife resources for the foreseeable future (North Dakota Game and Fish Department (SWAP), 2015). The SWAP focuses on "species of greatest conservation need" and includes 47 bird, 2 amphibian, 9 reptile, 21 mammal, 22 fish, 10 freshwater mussel, and 4 insect species. Each species is given a priority designation based on conservation need. *Level I* species are those having a high level of conservation priority because of declining status in North Dakota or across their range; or have a high rate of occurrence in North Dakota, constituting the core of the species breeding range, but may be at-risk range wide. *Level II* species are those having a moderate or high level of conservation priority. *Level III* species are those having a moderate level of conservation priority but believed to be peripheral or non-breeding in North Dakota. There are 36 *Level I* species, 44 *Level II* species, and 35 *Level III* species within the state.

The North Branch Park River watershed is included within the Red River Valley and tributaries focus area presented in the SWAP (SWAP, p. 82). The project area is also partially located within the Sand Deltas and Beach Ridges (SWAP pp.36, 42). Key species of conservation priority potentially found within this area are tabulated in the table below.

Table 3-7: Species of Conservation Priority within the SWAP Red River and Tributaries Focus Area

Animal (# of species)	Species	North Dakota Species of Conservation Priority
Birds (3)	Bald Eagle	Level II
	Red-headed Woodpecker	Level I

Animal (# of species)	Species	North Dakota Species of Conservation Priority
	Black-billed Cuckoo	Level I
Mammals (5)	River Otter	Level II
	Northern Long-eared Bat	Level I
	Little Brown Bat	Level I
	Big Brown Bat	Level I
	Gray Fox	Level III
Fish (16)	Northern Pearl Dace	Level I
	Silver Chub	Level II
	Northern Redbelly Dace	Level II
	Trout-perch	Level II
	Chestnut Lamprey	Level III
	Silver Lamprey	Level III
	Largescale Stoneroller	Level III
	Hornyhead Chub	Level III
	Pugnose Shiner	Level III
	Blacknose Shiner	Level III
	Carmine Shiner	Level III
	Finescale Dace	Level III
	Yellow Bullhead	Level III
	Logperch	Level III
	River Darter	Level III
	Burbot	Level II
Mussels (6)	Threeridge	Level II
	Wabash Pigtoe	Level II
	Mapleleaf	Level III
	Black Sandshell	Level II
	Creek Heelsplitter	Level I
	Pink Heelsplitter	Level II
	Creeper	Level III

Source: North Dakota Game and Fish Department, *State Wildlife Action Plan*, 2015, p. 82, accessed Oct 2 2017: https://gf.nd.gov/sites/default/files/publications/swap-2015_0.pdf.

3.5.16 Threatened and Endangered Species

The Endangered Species Act (ESA) directs all Federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. North Dakota has 12 species listed as threatened (likely to become an endangered species in the near future) or endangered (in danger of extinction now) via the ESA (North Dakota Game and Fish Department, Threatened and Endangered Species). North Dakota does not have a state threatened or endangered (T&E) species list. Only those species listed by the ESA of 1973, as amended, are considered T&E in the state. The USFWS has primary oversight of T&E species.

The project area was evaluated to assess the potential presence of federally listed species by obtaining a list of species and other resources such as critical habitat under the USFWS jurisdiction that are known or expected to be on or near the project area through the USFWS online Information Planning and Conservation System (IPaC) program (U.S. Fish and Wildlife Service (1), accessed Oct 3 2017). According to the IPaC results, there is no designated critical habitat in the project area, but the following federally listed species may be present within the vicinity of the project area (**Table 3-8**). Descriptions of these listed species and their presence in relation to the project are provided below.

Table 3-8: Threatened and Endangered Species

Species	Status	Designated Critical Habitat
Mammals		
Northern Long-eared Bat *(Myotis septentrionalis)*	Threatened	No critical habitat has been designated for this species
Birds		
Whooping Crane *(Grus americana)*	Endangered	There is final designated critical habitat for this species. The project is located outside the critical habitat.

Source: USFWS, *Information for Planning and Consultation* (IPaC), *IPaC Resource List*, accessed Sept 25 2019: https://ecos.fws.gov/ipac/.

3.5.17 Migratory Birds

North Dakota is located within the Central Flyway, which includes Montana, Wyoming, Colorado, New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota (U.S. Fish and Wildlife Service). Migratory birds may use portions of the project area as resting grounds during spring and fall migration, as well as breeding and nesting grounds throughout the summer. This area of North Dakota is also within the U.S. portion of the Prairie Pothole Region, which makes the state an important breeding area and a significant contributor to continental waterfowl populations.

According to the USFWS, *Information for Planning and Consultation* (IPaC) system, migratory bird resources that might be affected by activities in the project area are listed in **Table 3-9**. The birds listed are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern list or warrant special attention in the project location. Note: this is not a list of every bird you may find in the planning area, nor does this list guarantee that every bird on this list will be found in the planning area. Certain birds are protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940. Any activity that results in the take (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of migratory birds or eagles is prohibited unless authorized by the USFWS.

Table 3-9: Migratory Bird Treaty Act protected species that may be found within the planning area.

Bird Species		Breeding Season
Bald Eagle	*Haliaeetus leucocephalus*	Breeds Dec 1 to Aug 31
Black-billed Cuckoo	*Coccysux erythropthalmus*	May 15 - October 10
Bobolink	*Dolichonyx oryzivorus*	May 20 - July 31
Lesser Yellowlegs	*Tringa flavipes*	Breeds elsewhere
Nelson's Sparrow	*Ammodramus nelsoni*	May 15 - September 5
Red-headed Woodpecker	*Melanerpes erythrocephalus*	May 10 - September 10
Willet	*Tringa semipalmata*	Breeds Apr 20 to Aug 5

Source: USFWS, *Information for Planning and Consultation* (IPaC), *IPaC Resource List*, accessed Sept 25 2019: https://ecos.fws.gov/ipac/.
Note: this migratory bird list only includes species of particular priority concern and is not representative of all birds that may occur within the project area.

3.5.18 Invasive Species

An "invasive species" is defined as a species that is not native to the ecosystem under consideration and whose introduction causes or is likely to cause harm to the economy, environment, or human health. This includes plant and animal species along with other organisms such as microbes. Human actions are the primary means of invasive species introductions (North Dakota State University).

3.5.18.1 Aquatic Nuisance Species

According to the NDGFD, Zebra Mussels are present within the entire length of the Red River, including tributaries upstream to the first vehicular bridge or crossing (North Dakota Game and Fish Department (4)). Therefore, zebra mussels can be assumed to be present in at least the lower reaches of the Park River but may not be present within the planning area.

3.5.18.2 Noxious Weeds

Data on occurrence of noxious weeds within the watershed is not available. However, there are 13 noxious weeds identified within North Dakota (listed below) (Rodney G. Lym and Andrea J. Travnicek, North Dakota State University, 2015). These state noxious weeds are enforced by all cities and counties in the state. Counties and cities have the option of adding additional weeds to a list for enforcement only in their jurisdiction. Cavalier, Pembina, and Walsh counties have additional designated noxious weeds within their jurisdictions as presented in **Table 3-10**.

- Absinth Wormwood
- Canada Thistle
- Dalmation Toadflax
- Diffuse Knapweed
- Houndstongue
- Leafy Spurge
- Musk Thistle
- Palmer amaranth
- Purple Loosestrife
- Russian Knapweed
- Saltcedar
- Spotted Knapweed
- Yellow Toadflax

Table 3-10: North Dakota County and City Listed Noxious Weeds

County	Noxious Weed
Cavalier	Common tansy, false chamomile
Pembina	Common tansy, kochia
Walsh	False chamomile

Source: North Dakota County and City Listed Noxious Weeds (revised May 2019), accessed Sept 26 2019: https://www.nd.gov/ndda/plant-industries/noxious-weeds and https://www.nd.gov/ndda/sites/default/files/resource/2019%20May%20-%20City%20County%20Noxious%20Weeds%20List.pdf.

3.5.18.3 Invasive Species that Impact Trees

According to North Dakota State University, there are seven invasive tree pest threats within North Dakota (Emerald Ash borer, Asian Longhorned Beetle, Gypsy Moth, Dutch Elm Disease, Sudden Oak Death, Oak Wilt, and Thousand Cankers Disease of Black Walnut) (North Dakota State University, last updated May 18, 2017). Of these, only Dutch elm disease has been confirmed within every county of the state. Therefore, Dutch Elm disease is present within the project area (Jared M. LeBoldus, et al., North Dakota State University, 2013).

3.6 Human

3.6.19 Land Use

Historic and current land use trends within the project area were assessed by reviewing aerial photography, local zoning ordinances, relevant comprehensive land use plans, the Multi-Resolution Land Characteristics Consortium, 2019 National Land Cover Database (NLCD), USDA, National Agricultural Statistics Service, CropScape (2016) data, and preliminary hydraulic conditions modeling results.

According to the NLCD, the land use within the planning area is primarily cultivated crop (75%), with Pasture/Hay the next highest density land use at almost 10% (U.S. Department of Agriculture, 2012) (**Figure C-12**). Cultivated land is typically planted in a rotation of a range of crops, including wheat, sugar beets, soybeans, dry beans, barley, and canola. Based on the National Agricultural Statistics Service Cropland Data (2014), agriculture products are varied throughout the planning area, as shown in **Figure C-13** within **Appendix C** and summarized in **Table 3-12**. The other land uses identified within the planning area represent a very small percentage of the remaining land area and are summarized in **Table 3-11** shown below:

Table 3-11: NLCD 2019 Classification Land Uses within Planning Area

NLCD 2019 – Cover Type	Acres	% of Total Land Area
Cultivated Crops	125,149	75.91%
Hay/Pasture	16,083	9.76%
Deciduous Forest	7,963	4.83%
Developed, Open Space	4,765	2.89%

NLCD 2019 – Cover Type	Acres	% of Total Land Area
Herbaceous	3,038	1.84%
Woody Wetlands	2,470	1.50%
Emergent Herbaceous Wetlands	2,116	1.28%
Developed, Low Intensity	1,357	0.82%
Evergreen Forest	661	0.40%
Mixed Forest	556	0.34%
Developed, Medium Intensity	388	0.24%
Shrub/Scrub	159	0.10%
Developed, High Intensity	90	0.05%
Open Water	45	0.03%
Barren Land	22	0.01%
TOTAL	164,862	

Table 3-12: USDA, National Agricultural Statistics Service, CropScape - Cropland Data Layer (2016)

Crop Type	Acres	% of Total Land Area
Spring Wheat	48,329.42	29%
Soybeans	22,265.34	14%
Canola	16,350.75	10%
Dry Beans	12,454.67	8%
Grass / Pasture	10,628.66	6%
Deciduous Forest	8,880.44	5%
Other Hay / Non Alfalfa	8,336.53	5%
Potatoes	7,550.78	5%
Developed / Open Space	7,194.91	4%
Herbaceous Wetlands	5,461.37	3%
Sugarbeets	4,611.60	3%
Corn	3,626.46	2%

Source: USDA, National Agricultural Statistics Service, CropScape - Cropland Data Layer (2016), accessed February 22 2018: https://nassgeodata.gmu.edu/CropScape/.

3.6.19.1 Local Zoning Ordinances

There are five incorporated cities within the project area. These cities include Crystal, Hoople, Milton, Mountain and Osnabrook (**Table 3-13**).

Walsh County has adopted a Comprehensive Plan (Walsh County (ND), 1994) and enforces zoning and land use regulations to promote public health, safety, morals, public convenience, general prosperity, and public welfare of Walsh County. Cavalier County has also adopted zoning regulations (Cavalier County Board, adopted April 16, 2002).

Table 3-13: Incorporated Cities within the Project Area

Community	Status (year founded)
Crystal	1879
Hoople	1898
Milton	1887
Mountain	1884
Osnabrook	1903

3.6.20 Environmental Justice and Civil Rights

U.S. Census Bureau and U.S. Environmental Protection Agency Environmental Justice data was obtained to develop an understanding of the demography of the project area. Demographic statistics for the project area were generated by using Census block group data from the Census Bureau's ACS (American Community Survey) 2017-2021 5-year Summary. Any census block group that is incorporated into the project area was included in its entirety, therefore demographic data for the project area is only an estimate. The affected environment includes the block groups encompassing the Valley Edinburg School district, as this district includes a population that attends middle school in the City of Crystal which may benefit from the project. The planning area is comprised of the following seven census block groups: 380199511003, 380679506001, 380679505001, 380999581002, 380679506002, 380999583001 and 380999581001 encompassing portions of Cavalier, Pembina and Walsh Counties (**Figure C-14, Appendix C)**

The population within the project area is approximately 1559 individuals, of which 94% of the population is white (includes those who identify as more than one race), with the predominant minority being classified as Hispanic (4%) (**Table 3-14**). The planning area is predominantly rural; the area includes the small communities of Crystal, Mountain, Hoople, Edinburg and others. The planning area does not include the largest cities withing the 3-county area.

Table 3-14: Demographic Statistics within the North Branch Park River Planning area

Location	Population (2020)	Per-Capita Income (2017-2021; in 2021 dollars)	Persons in low-income households (%)	Predominant Race (2023 est.)(white includes those who indicated more than one race)	Predominant Minority (2023 est.)
North Branch Park River Planning area	1,559	$34,748	25%	White, 94%	Hispanic 4%
Cavalier County*	3706	$46,435	24%	White, 94%	Hispanic or Latino, 2.6%
Pembina County*	6763	$36,328	25%	White, 93%	Hispanic or Latino, 4%
Walsh County*	10,438	$35,032	30%	White, 91%	Hispanic or Latino, 12%

Location	Population (2020)	Per-Capita Income (2017-2021; in 2021 dollars)	Persons in low-income households (%)	Predominant Race (2023 est.)(white includes those who indicated more than one race)	Predominant Minority (2023 est.)
North Dakota*	779,261	$37,343	24%	White, 83%	American Indian and Alaska Native, 5.3%

Source: https://www.census.gov/quickfacts/fact/table/ND,US/PST045222 and https://www.epa.gov/ejscreen

As recommended by the US EPA, the presence of minority populations was determined by conducting both the Fifty Percent analysis and the Meaningfully Greater analysis in concert. The reference community chosen for the analysis was Pembina County. Other reference communities were considered, such as the State of North Dakota and Walsh and Cavalier Counties. The rationale for choosing Pembina county was that the scale, influence and location were most appropriate for analysis. The population demographics for the State and Walsh county would have masked the demographics in the planning area, while the location in Cavalier county was too dissimilar because of the large differences in soils, geology and flood prone landscape position.

3.6.19.1 Fifty Percent Analysis: The percent of People of Color within the individual census block groups did not exceed 50% of the population in those groups. Likewise, the percent of People of Color within the Affected Environment did not exceed 50%. Therefore, no minority populations were detected using the Fifty Percent Analysis.

3.6.19.2 Meaningfully Greater Analysis: A threshold of 10% exceedance was determined to be reasonable and subjective when comparing the reference community with the block group geographic units. The purpose of this analysis was to determine whether the percent of People of Color in individual block groups was Meaningfully Greater than the percent of People of Color in the reference community (Pembina County). Two block groups exceeded the 10% threshold for People of Color. Both blocks, 38099581001 (Walsh/Hoople) and 380679505001 (Pembina/St. Thomas), had a People of Color population that was 40% greater than the reference community. When looking more closely at demographic data, this difference can be attributed to the Hispanic population within this groups.

Table 3-15: Data Used for Identifying Minority Populations using U.S. EPAs 50% and Meaningfully Greater Analysis Methods

Geographic Unit	Total Population	Population of People of Color	% People of Color	Does the % People of Color Exceed 50%? Y/N	% Difference of People of Color Compared with Reference Community	Is the % People of Color Meaningfully Greater (by 10% or more) than the Reference Community
Affected Environment (portions of Pembina, Walsh and Cavalier Counties)	1559	140	9%	No	NA	NA

Geographic Unit	Total Population	Population of People of Color	% People of Color	Does the % People of Color Exceed 50%? Y/N	% Difference of People of Color Compared with Reference Community	Is the % People of Color Meaningfully Greater (by 10% or more) than the Reference Community
Reference Community – Pembina County	6912	691	10%	No	Equal	Equal
380679506002 (Pembina Co. includes Crystal/Mountain, ND)	733	44	6%	No	-40%	No
380679506001 (Pembina Co. includes Hensel, ND)	582	47	8%	No	-20%	No
380199511003 (Cavalier Co. includes MIlton/Osnabrock, ND)	644	26	4%	No	-60%	No
380999583001 (Walsh Co, includes Hoople, ND)	732	102	14%	No	40%	Yes
380999583001 (Walsh Co., includes Edinburg/Adams/ Fairdale, ND)	595	18	3%	No	-70%	No
380999581002 (Walsh Co. Includes Fordville/Pisek, ND)	642	45	7%	No	-30%	No
380679505001 (Pembina Co, Includes St. Thomas, ND)	322	45	14%	No	40%	Yes

Potential environmental justice concerns which may affect some populations disproportionately were assessed by running the EPA's EJ Screen Community Reports for each of the 7 block groups. The EPA has identified 13 environmental indicators which are analyzed with data combined from low income and people of color statistics. The EJ Screen also calculates a Supplemental Index that combines demographic statistics of low income, linguistically isolated, less than high school education, percent unemployed and low life expectancy. The 13 environmental indicators include: Particulate Matter, Ozone, Diesel Particulate Matter, Air Toxics Cancer Risk, Air Toxics Respiratory Hazard Index, Toxic Releases to Air, Traffic Proximity, Lead Paint (pre-1960's housing), Superfund Proximity, RMP (Risk Management Plan) Proximity, Hazardous Waste Proximity, Underground Storage Tanks and Wastewater Discharge. The US EPA suggests agencies use an 80th percentile as a starting point when identifying geographic areas that may warrant further consideration, analysis, or outreach. Values using the Supplemental Index were generally slightly higher than the EJ Index Alone and are included in **Table 3-16**. Two indicators exceeded the 80th percentile – Lead Paint and RMP Proximity.

Table 3-16: Statistics for EPA EJ Screen Supplemental Index (Percentile of Occurrence)

Environmental Indicators	State or National	380679506002 (Pembina Co, incl Crystal/Mountain, ND)	380679506001 (Pembina Co. includes Hensel, ND)	380199511003 (Cavalier Co. includes MIlton/Osnabrock, ND)	380999583001 (Walsh Co, includes Hoople, ND)	380999583001 (Walsh Co., includes Edinburg/Adams/ Fairdale, ND)	380999581002 (Walsh Co. Includes Fordville/Pisek, ND	X380679505001 (Pembina Co, Includes St. Thomas, ND)
Particulate Matter	ND	64	58	59	68	40	69	68
	U.S.	5	5	5	6	4	6	6
Ozone	ND	2	2	1	9	3	9	8
	U.S.	7	6	8	9	6	9	8

Environmental Indicators	State or National	380679506002 (Pembina Co, incl Crystal/Mountain, ND)	380679506001 (Pembina Co. includes Hensel, ND)	380199511003 (Cavalier Co. includes MIlton/Osnabrock, ND)	380999583001 (Walsh Co, includes Hoople, ND)	380999583001 (Walsh Co., includes Edinburg/Adams/ Fairdale, ND)	380999581002 (Walsh Co. Includes Fordville/Pisek, ND	X380679505001 (Pembina Co, Includes St. Thomas, ND)
Diesel Particulate Matter	ND	28	25	10	43	16	44	41
	U.S.	3	3	3	5	2	5	4
Air Toxics Cancer Risk	ND	0	0	0	0	0	0	0
	U.S.	2	2	3	2	1	2	2
Air Toxics Respiratory Hazard Index	ND	0	0	0	0	0	0	0
	U.S.	2	1	2	2	1	2	1
Toxic Releases to Air	ND	14	15	0	17	0	14	26
	U.S.	0	2	0	2	0	0	3
Traffic Proximity	ND	8	22	11	11	0	0	19
	U.S.	0	4	0	0	0	0	4
Lead Paint (Pre-1960's Housing)	ND	67	73	**87**	**80**	71	**82**	58
	U.S.	59	59	70	63	55	64	52
Superfund Proximity	ND	61	55	58	64	46	65	53
	U.S.	0	0	0	0	0	0	0
RMP (Risk Management Plan) Proximity	ND	14	44	**84**	14	66	27	13
	U.S.	23	58	78	23	62	70	22
Hazardous Waste Proximity	ND	8	5	5	17	6	21	10
	U.S.	0	0	0	0	0	0	0
Underground Storage Tanks	ND	0	31	33	22	32	31	0
	U.S.	0	0	0	0	24	0	0
Wastewater Discharge	ND	0	0	0	44	0	0	62
	U.S.	0	0	0	48	0	0	64

The EJ Screen Community Reports also includes values for variables individually (i.e. not combined with demographics in an index). Some of these individual variables may be of interest to the project including two groups that exceeded the 80th percentile for Limited English-Speaking Households. Other variables that occurred frequently were human health related – heart disease and cancer occurrences. The aging population demographics were also noticeable as populations over age 64 typically exceeded the 70th percentile. The block groups with the greatest Flood Risk are downstream of the project and includes the communities of Crystal, Hoople, and St.Thomas. Other potential environmental justice factors noted in the reports include the presence of five schools, 11 places of worship, 11 water dischargers and 1 Brownfield. Impaired Waters were noted for all of the block groups.

3.6.21 Cultural Resources and Historic Properties

To provide initial screening information as the large suite of potential project alternatives were evaluated, a Class I Literature Search was conducted by McFarlane Consulting, LLC to identify all recorded historic properties within the watershed area. Historic and environmental contexts were also reviewed to identify areas likely to contain cultural materials. The Class I file search was completed using both the National Park Service's National Register of Historic Properties as well as the ND State Historic Preservation Office's database. The Class I file search identified 2

National Register of Historic Places (NRHP), 11 architectural structures, 46 historic structures, 16 historic cemeteries, and 18 archaeological sites within the North Branch Park River watershed.

Following selection of the preferred alternative project site, a Class III Cultural Resources Survey was completed in April of 2020 by the Natural Resource Conservation Service. Additional survey was completed in May of 2023 and the Class III Cultural Resource Survey and Class I Literature search were revised. The survey resulted in no discovery of cultural resources or properties eligible for the National Register of Historic Places within the APE. There was a structure identified from review of topographic data within the APE, however, that structure was determined to be a manmade berm with no historic value. Additionally, an unknown structure was identified from a historic map in the northeast portion of the APE. That structure was determined to be the remains of a farmhouse. A number of artifacts were scattered across a wide area within the APE. The land where the remains of the farmhouse were located has been plowed through several times over the years which results in a lack of site integrity. The ground disturbance precludes any meaningful interpretation of the site or artifacts. For additional information on the cultural resources survey conducted, refer to **Appendix D-10**.

3.6.22 Social Issues

Socioeconomic status within the project area was reviewed on a county level, and the analysis included Walsh, Pembina, and Cavalier counties in North Dakota, when data was available. Employment within this three-county region from 2001 to 2019 is presented in **Table 3-17**. The total number of jobs in this region has decreased by 4.3% since 2010. Government and service-related jobs have decreased over that same 10-year span while non-service related jobs have increased slightly. **Chart 3-2** shows how non-service related, service related, and government jobs have varied over the last 20 years.

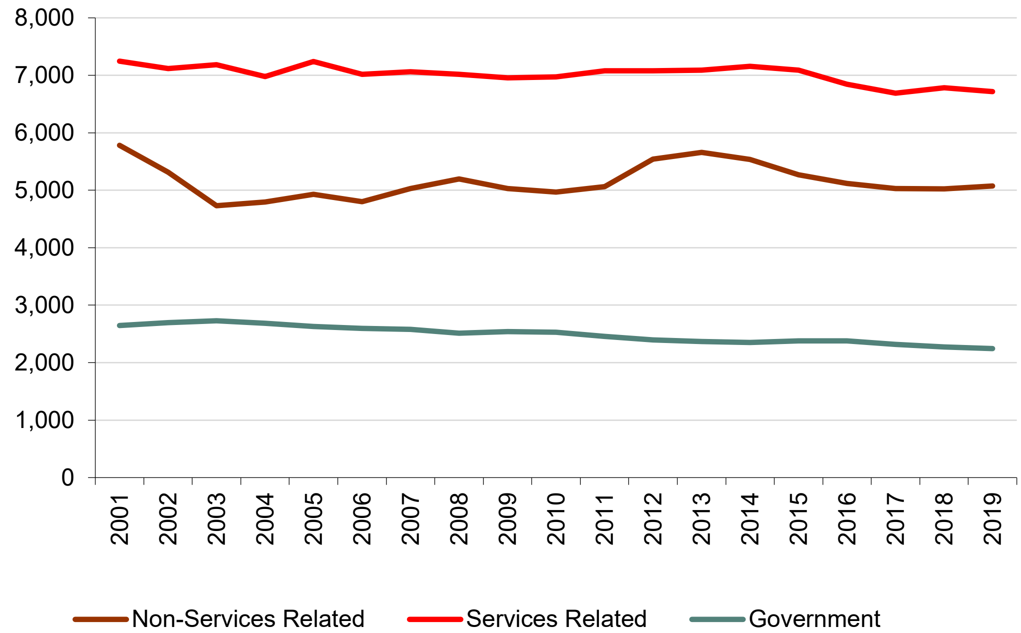
Table 3-17: Employment by Industry, 2001-2019

	Number of Jobs in 2001 (% Total)	Number of Jobs in 2010 (% Total)	Number of Jobs in 2019 (% Total)	Change from 2010-2019 (% Change)
Total Employment	17,191	16,001	15,320	-681 (-4.3%)
Non-Services Related	5,782 (33.6%)	4,971 (31.1%)	5,076 (33.1%)	105 *(2.1%)*
Farm	2,894 (16.8%)	2,472 (15.4%)	2,375 (15.5%)	-97 (-3.9%)
Agricultural services, forestry, fishing	289 (1.7%)	298 (1.9%)	329 (2.1%)	31 (10.4%)
Mining (including fossil fuels)	28 (0.2%)	145 (0.9%)	287 (1.9%)	142 (97.9%)
Construction	815 (4.7%)	913 (5.7%)	739 (4.8%)	-174 (-19.1%)
Manufacturing (incl. forest products)	1,756 (10.2%)	1,143 (7.1%)	1,346 (8.8%)	203 (17.8%)
Services Related	7,246 (42.1%)	6,973 (43.6%)	6,719 (43.9%)	-254 (-3.6%)

	Number of Jobs in 2001 (% Total)	Number of Jobs in 2010 (% Total)	Number of Jobs in 2019 (% Total)	Change from 2010-2019 (% Change)
Utilities	60 (0.3%)	52 (0.3%)	34 (0.2%)	-18 (-34.6%)
Wholesale trade	798 (4.6%)	934 (5.8%)	899 (5.9%)	-35 (-3.7%)
Retail trade	1,592 (9.3%)	1,418 (8.9%)	1,273 (8.3%)	-145 (-10.2%)
Transportation and warehousing	657 (3.8%)	767 (4.8%)	887 (5.8%)	120 (15.6%)
Information	271 (1.6%)	256 (1.6%)	206 (1.3%)	-50 (-19.5%)
Finance and insurance	299 (1.7%)	332 (2.1%)	385 (2.5%)	53 (16.0%)
Real estate and rental and leasing	236 (1.4%)	270 (1.7%)	325 (2.1%)	55 (20.4%)
Professional and technical services	302 (1.8%)	321 (2.0%)	304 (2.0%)	-17 (-5.3%)
Management of companies	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Administrative and waste services	476 (2.8%)	379 (2.4%)	366 (2.4%)	-13 (-3.4%)
Educational services	45 (0.3%)	42 (0.3%)	45 (0.3%)	3 (7.1%)
Health care and social assistance	711 (4.1%)	672 (4.2%)	626 (4.1%)	-46 (-6.8%)
Arts, entertainment, and recreation	156 (0.9%)	168 (1.0%)	172 (1.1%)	4 (2.4%)
Accommodation and food services	751 (4.4%)	628 (3.9%)	491 (3.2%)	-137 (-21.8%)
Other services, except public admin.	892 (5.2%)	734 (4.6%)	706 (4.6%)	-28 (-3.8%)
Government	2,647 (15.4%)	2,528 (15.8%)	2,245 (14.7%)	-283 (-11.2%)

Source: Headwater Economics, A Profile of Socioeconomic Measures: Walsh County, ND: Pembina County, ND; Cavalier County, ND. Accessed Feb 22 2018: https://headwaterseconomics.org/tools/economic-profile-system/#measures-report-section

Chart 3-2: Employment by Major Industry Category



Source: Headwater Economics, A Profile of Socioeconomic Measures: Walsh County, ND: Pembina County, ND; Cavalier County, ND. Accessed August 23 2021: https://headwaterseconomics.org/tools/economic-profile-system/#measures-report-section.

The U.S. Department of Labor, Bureau of Labor Statistics (BLS) quarterly census of employment and wages data, was utilized to characterize the public and private employment characteristics of the project area. This data is available on a county level. The majority of the project is located in Pembina County, with smaller portions located in Cavalier and Walsh counties. This assessment was done by assessing the Pembina County statistical data as it best represents the project area (**Table 3-18**). Private entities represent approximately 77% of the commerce within Pembina County. Economics in the project area will be further assessed by a separate report and incorporated into this document as that information is developed.

Table 3-18: Pembina County 2017-2020 Annual Averages of Employment and Wages

Pembina County 2017-2020 Annual Averages - Private					
Summary Change Table	**Annual Establishments**	**Annual Average Employment**	**Total Annual Wages (US dollars)**	**Annual Average Weekly Wage**	**Annual Wages per Employee (US dollars)**
2017 Levels	340	2,733	$120,980,290	$851	$44,262
2020 Levels	332	2,683	$128,708,824	$923	$47,978
Level Change From 2017 to 2020	-8	-50	$7,728,534	$72	$3,716
Percent Change From 2017 to 2020	-2.40%	-1.8	6.4%	8.5%	8.4%

Pembina County 2017-2020 Annual Averages - Private					
Pembina County 2017-2020 Annual Averages - Federal Government*					
2017 Levels	16	228	$19,955,521	$1,683	$87,524
2020 Levels	19	226	$20,707,369	$1,764	$91,727
Level Change From 2017 to 2020	3	-2	$751,848	$81	$4,203
Percent Change From 2017 to 2020	18.8%	-0.9%	3.8%	4.8%	4.8%

Note: Data is available at a county level. Pembina County best represents the project area since the portions of the project in Walsh and Cavalier counties is minority.
*Statistics for state and local government were not readily available.
Source: U.S. Department of Labor, Bureau of Labor Statistics, *Quarterly Census of Employment and Wages*, accessed August 23 2021: https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables.

3.6.23 Public Health and Safety

Flooding is the most persistent public health and safety concern in the watershed. Recent flooding has caused roads to be overtopped, and in some instances severe erosion making the road impassable. Shale sediment concerns identified in Section 3.1.3 amplify the transportation safety due to sediment deposition blocking culverts and ditches, leading to decreased capacity and increased roadway overtopping. Snow filling culvert, bridges, and ditches also blocks full capacity and increases roadway overtopping. People in automobiles trying to pass on a roadway being overtopped by floodwaters are at risk of being washed downstream. Roadways overtopped and eroded also cause risks to drivers attempting to pass, when the road is compromised.

According to the EPA, *Cleanups in My Community* online database, there is one Brownfield cleanup location within the project area, located within the City of Mountain (U.S. Environmental Protection Agency, accessed Oct 10 2017). Based on the review of information provided by the EPA, this site, listed as the ND Community Center, is listed for air contaminates. No other details were provided. Public health and safety services within the project area include county sheriff, local police, and fire departments, along with hospital facilities.

The project area is served by the local County Sheriff departments (Walsh, Cavalier and Pembina County Sheriff's Departments), although there are no law enforcement centers located within the planning area. There are five fire stations within the planning area, in the cities of Osnabrock, Mountain, Crystal, Hoople, and Milton.

There are no hospitals within the planning area; however, there are four hospitals near the planning area including the Cavalier Community Hospital, 6 miles northwest in the City of Langdon, the First Care Health Center, approximately 9 miles to the south within the City of Park River, Unity Medical Center in Grafton, and Pembina County Memorial Hospital, located in Cavalier. There are two nursing homes, the Osnabrock Community Living Center in the City of Osnabrock, and the Borg Pioneer Memorial Home in the City of Mountain, that are located within the planning area.

A 500-year event for both existing and proposed conditions was modelled, and the elementary school in Crystal, ND would be at risk of flooding in both scenarios.

4 Alternatives

4.1 Formulation Process

The initial phase of the development of alternatives was a review of a comprehensive list of strategies that represent categorized types of alternatives. The goal of the strategy evaluation was to narrow the scope of preliminary alternative review through the acceptance or elimination of strategies based on limited technical evaluation and practical considerations. To aid in this review, strategies were categorized into five generalized groups.

1. **No-Action** involves forecasting watershed conditions if no alternative plan is selected.
2. **Reduce runoff volume** involves structural and non-structural practices that result in reductions in the excess runoff during rainfall events.
3. **Increase conveyance capacity** provides additional hydraulic capacity within the watershed at known damage locations.
4. **Increase temporary flood storage** provides additional flood storage within the watershed, typically through structural measures that would maximize available flood storage.
5. **Protection/Avoidance** measures include structural and non-structural practices that would reduce damages to land, structures, and infrastructure.

Practical considerations when evaluating alternative strategies included local financing, environmental concerns, and the ability of the SLO to implement. In addition to the practicality considerations, several hypothetical scenarios were evaluated using hydrologic and hydraulic models to determine if a reasonable potential to meet the Purpose and Need existed. This review resulted in the following strategies being selected for preliminary alternative identification:

- No-Action
- Floodwater Diversion around Crystal, ND (Increase Conveyance Capacity)
- On-Channel Impoundment (Increase Temporary Flood Storage)
- Set-Back Levees (Increase Temporary Flood Storage)
- Off-Channel Impoundment (Increase Temporary Flood Storage)

The strategies identified in the Initial Strategy Evaluation were used to preliminarily identify alternatives exemplifying these strategies. A range of alternatives were then identified and analyzed to determine their potential to attain the objectives from the Purpose and Need. This phase of alternative investigation consisted of a review of the existing conditions, hydrologic and hydraulic models, available topographic field survey data, LiDAR topographic data and other readily available geospatial information. Refer to **Appendix D-2** for additional information on the Preliminary Alternative Screening.

4.2 Alternatives Eliminated from Detailed Study

4.2.1 Strategies Eliminated

During the initial phase of formulating alternatives, various strategies were identified and preliminarily evaluated. Additional information on the strategies that were evaluated is provided in **Appendix D-2**. The following strategies were eliminated due to logistics and/or the inability to meet the Purpose and Need.

4.2.1.1 Reduce Runoff Volume

Strategies for reducing runoff involve implementation of activities that would effectively reduce runoff volume to be more consistent with an undisturbed condition. In agricultural areas, these types of strategies often involve implementation of conservation practices such as soil health, nutrient management, riparian buffers, filter strips, wetland restoration, and conversion of cropland to pasture/grazing land. Cost share assistance is available to producers interested in voluntarily installing these types of conservation practices through the USDA EQIP and CSP programs and the ND Department of Environmental Quality 319 program. In addition, USDA Wetland Reserve Easement and Conservation Reserve Program may be utilized for 30-year easements (ND state law prohibits perpetual conservation easements). A preliminary analysis was completed during alternative screening to estimate the effects of the entire study watershed being converted to perennial vegetation. While a significant reduction in runoff volume is achievable and would result in reduced nutrient loads and increased wetland/upland wildlife habitat, eliminating production agriculture within the entire watershed is not feasible. Therefore, this approach was eliminated from further consideration.

4.2.1.2 Increase Conveyance Capacity

The general approach of increasing conveyance capacity to eliminate inundation of adjacent cropland was also examined. However, preliminary hydraulic modeling completed using the Hydrologic Engineering Center – River Analysis System (HEC-RAS version 5.0.3) hydraulic modeling software showed it is extremely difficult to provide relief using this approach without causing an increase in flooding issues further downstream. Further channelizing the river would be unlikely to decrease overall nutrient export from the watershed and would cause a reduction in wildlife habitat, therefore this alternative would not contribute to the watershed protection purpose. Therefore, this approach was eliminated from further consideration.

4.2.1.3 Reduced Bridge/Culvert Capacity

Culvert sizing is a technique that can be used to control runoff rates. By appropriately sizing road and drainage system culverts throughout a sub-watershed or watershed, the flow rates can be regulated to better suit downstream channel capacities. Excess water is temporarily detained upstream of culverts. Increased duration of flood inundation on cropland could increase dissolved phosphorus runoff and there would be no change to wildlife habitat. Attenuation of flooding provided by reduced crossings is dependent on storage capacity upstream of roads which may be limited. Additionally, North Dakota Century Code provides Stream Crossing Standards that do not allow culvert sizes to be reduced beyond identified minimums, therefore this alternative is not feasible.

4.2.1.4 Wetland Restoration/Creation

Created or restored wetlands are typically implemented primarily to attain a natural resource and/or habitat objective. Wetlands developed for natural resource and/or habitat objectives can provide temporary flood storage. Temporary flood storage is considered beneficial if the topography allows for levels to be managed to provide a reasonable assurance that flood storage is available when needed without adversely impacting other objectives. Preliminary analysis indicated a potential to reduce flooding, particularly during the 10-year event. (see *Screening of Alternatives for Detailed Review* in **Appendix D-2**). Cost share assistance is available to producers interested in voluntarily restoring or creating wetlands through the USDA EQIP and CSP programs. In addition, USDA Wetland Reserve Easement and Conservation Reserve Program may be utilized for 30-year easements (ND state law prohibits perpetual conservation easements). Clearly, this alternative would contribute to the wildlife habitat component of the watershed protection purpose. Soils within natural wetlands in the Red River Basin can quickly become oversaturated with phosphorus from upstream sources (unless managed through biomass removal), however, therefore this alternative would not contribute to nutrient reduction goals. Phosphorus removal on natural wetlands would not be allowed under USDA conservation programs, given that eliminates needed wildlife cover going into winter. Due to logistics and lack of local citizen support, the ability of the SLO to successfully implement on the scale required and maintain sufficient locations is limited, given that land rights are typically secured through a voluntary easement program.

4.2.1.5 Meter Runoff

Drain tile and culvert sizing can be used to store runoff within the existing landscape. Runoff would be stored in existing depressions within the watershed consisting of agricultural fields bounded by existing roads. Culverts at the outlet of the depressions would be sized or drain tile outlets closed so that runoff is stored for a short time reducing flood impacts to downstream agricultural lands. Modifications to culvert sizes would still have to adhere to requirements outlined in the North Dakota Century Code which may not allow for sufficient storage within each depression. Additionally, this alternative would require the re-sizing of culverts at hundreds of township road crossings which would be difficult to implement in a timely manner. This alternative would likely increase damages on agricultural land which does not meet the Purpose and Need of the project. It would not contribute to the watershed protection goals of the project. Therefore, this alternative was eliminated from further consideration.

4.2.1.6 Riparian Corridor Restoration

Existing riparian corridors could be restored and protected to enhance geomorphic conditions and reduce flooding beyond the restoration extents. From a flood damage reduction standpoint, restoration of a degrading channel would allow for more frequent access to a vegetated floodplain to reduce downstream flow rates. Incised channels can be modified to reduce channel conveyance for increased floodplain connectivity. Setback levees are often required to keep break out flows contained within the riparian corridor. This alternative could provide significant wildlife habitat improvements and would provide some nutrient reduction benefits through decreased frequency and duration of cropland flooding. The SLO has indicated that the ability to implement such an approach in a timely manner on the scale analyzed through the sensitivity analysis discussed in **Appendix D-2** is limited, and the strategy is not practical due to the logistics associated with local acceptance of the project. The lack of local acceptance would have a high probability of an inability to generate local funding.

4.2.1.7 Levees

Levee systems are typically constructed to contain the natural floodwaters and can be used to protect communities, rural farmsteads, and cropland. If a levee system encroaches on the natural floodplain, the system can result in increased flows, and downstream flooding must be considered and mitigated. As with setback levees, consideration for drainage of land directly adjacent to the levee is critical. In many urban settings, this results in large lift stations being installed to lift water over the levee during floods. Levees for the community of Crystal are not practical due to the proximity of structures and building sites to Cart Creek. Ring levees around farmsteads were not considered for an individual alternative, because they would not adequately meet the objectives in the Purpose and Need. While the ring levees would help reduce flood damages to infrastructure, they would not address flood damages associated with agricultural lands, would not contribute to watershed protection goals, and would not reduce peak flows downstream of the North Branch Park River Watershed.

4.2.1.8 Flood Warning Systems

Flood warning and emergency response systems begin with long- and short-term forecasts of flood potential, and the advanced warning can provide time for sandbagging, earthen levee construction, or other emergency protection methods, and ultimately evacuation, if necessary. Available timing between flood warning issuance and actual flood conditions is critical to ensure emergency response can be coordinated. The watershed protection purpose would not be met by this alternative. This approach is not a practical solution for the North Branch Park River. During the 10-year event, there is an approximate 2.5-day lag between the peak rainfall intensity and the peak inflow to the Park River mainstem. This is not sufficient time to implement temporary measures to meet objectives defined in the Purpose and Need. Therefore, this alternative was eliminated from further evaluation due to logistics.

4.2.1.9 Floodplain Easements

Flood easements could be acquired to compensate landowners to no longer operate on flood prone areas. (Emergency Watershed Protection Program, etc.) Floodplain easements would be required on the areas with inundation longer than 24-hours for the 10-year, 4-day event to meet the objectives defined in the purpose and need. This would require the purchase of easements on approximately 10,500-acres. Clearly, this alternative would contribute to the wildlife habitat component of the watershed protection purpose. Soils within natural wetlands in the Red River Basin can quickly become oversaturated with phosphorus from upstream sources (unless managed through biomass removal), however, therefore this alternative would not contribute to nutrient reduction goals. The ability of the SLO to implement such an approach would be limited due to lack of local citizen support and logistics associated with land acquisition.

4.2.1.10 Dams West of Hwy 32 on Unnamed Creeks

Distributed dams on unnamed creeks west of Hwy 32 were analyzed for storage and peak flow reduction prior to initiation of the NRCS watershed planning effort. The analysis was completed and summarized in 2015 Letter to Stakeholders (**Appendix E**). Ten dams were analyzed, named West 32 1-A, 1-B, 1-C, 2-A, 2-B, 2-C, 3-A, 4-A, 4-B, and 4-C. The storage in runoff ranged from 0.29 to 1.11 inches, and 27 to 439 acre-ft. The sites storage was limited due confined landscape shape; since the valley is narrow the runoff volume generally filled available storage on rising limb of hydrographs, leaving minimal storage during the peak and similar downstream peak flows as existing conditions. The resulting peak flow reduction ranged from ~10 to 15% at 84th Street NE, for 10, 25, 50, and 100-year frequency events, respectively. There would be very minor reductions in nutrient loads due to the small reductions of frequency and duration of cropland flooding downstream and no identified wildlife benefits. This alternative was eliminated due to inability to effectively meet the purpose and need of the project, however installation of small sediment control dams could be cost shared through the USDA EQIP program if there were willing landowners. Alternatively, a local Sponsor could initiate a watershed plan with a focus on sediment management rather than flood control.

4.2.2 Milton Dam

Milton Dam is a potential on-channel dam located on the North Branch Park River near the community of Milton, ND. The embankment would be located near the headwaters of the North Branch Park River approximately 1.6 river miles upstream of the ND Highway 66 crossing and would have a contributing watershed of 45 square miles. The dam would be constructed as an earthen embankment with an outlet structure designed to attenuate flood flows. The resulting pool would inundate riparian and vegetated floodplain habitat upstream of the embankment. Preliminary modeling results indicated approximately 114-acres of inundation for the 10-year event and 148-acres for the 100-year event. At maximum inundation for the 10-year and 100-year events, 1,559 acre-feet (0.7 inches) and 2,249 acre-feet (0.9 inches) of flood storage would be provided. A location map of Milton Dam is provided in **Appendix D-2**.

The impacts of the proposed Milton Dam were analyzed for the 10-year and 100-year rainfall events. This analysis indicated flow reductions immediately downstream of the dam along the North Branch Park River. For example, at ND Highway 32 on the North Branch Park River, 55% and 25% reductions in peak flow were observed for the 10-year and 100-year events, respectively. However due to the location of the impoundment site within the watershed, no changes to peak flow were observed for indicated damage locations in the Cart Creek Sub-watershed. At the North Branch outlet (including breakout flows) peak flows were reduced by 10% and 9% for the 10 and 100-year events, respectively. There would be very minor reductions in nutrient loads due to the small reductions of frequency and duration of cropland flooding downstream and no identified wildlife benefits. Milton Dam was removed from consideration for further study because of its limited ability to meet the objective in the Purpose and Need related to the North Branch Park River outlet and its inability to meet the objective in the Purpose and Need related to the Cart Creek Sub-watershed.

4.2.3 Cart Creek Impoundment Site 2

Cart Creek Impoundment Site 2 would consist of three proposed flood pools located in Thingvalla and Gardar Townships, Pembina County. This area has flatter topography adjacent to floodplain escarpment. This flatter topography allows for flood storage to be provided with reasonable embankment heights. Flood Pool 1 is located in the east half of Section 32, Thingvalla Township, and consists of an earthen embankment along the north, east, and south sides of the east half of Section 32. Flood Pool 2 is located primarily in Section 5 of Gardar Township, and a small portion in Section 8 of Gardar Township. Flood Pool 2 consists of an earthen embankment that would be constructed around the north, east, and south sides of the impoundment. Flood Pool 3 is located in the west half of Section 9 of Gardar Township and consists of earthen embankment that would be constructed around the north, east, and south sides of the west half of Section 9. A site map for Cart Creek Impoundment Site 2 is provided in **Appendix D-2**.

Inflows would be split between Flood Pools 1 and 2 from the upstream watershed. Excess inflows not stored within Flood Pool 2 would be allowed to overflow into Flood Pool 3. Flow splits and overflows would be regulated through a series of hydraulic control structures. In total, Cart Creek Impoundment Site 2 would have a drainage area of 17.8 square miles and would provide 3,800 acre-feet (4 inches) of flood storage. The drainage area is primarily located west of ND Highway 32. All three flood pools would require a total estimated area of 852-acres. Both FSA CRP and NRCS WRP acreages are present in Flood Pools 1 and 2.

Cart Creek Impoundment Site 2 was preliminarily analyzed for the 10-year and 100-year events. Approximately 436-acres and 648-total acres would be inundated within Flood Pools 1, 2, and 3 for the 10-year and 100-year events, respectively. The drainage area regulated by Cart Creek Impoundment Site 2 contributes primarily through an unnamed intermittent tributary that outlets into the Cart Creek in Section 4 of Crystal Township, Pembina County. As such, no flow reduction benefit is realized further upstream on Cart Creek where damages were indicated east of Mountain, ND. The site does provide an opportunity to reduce flooding further downstream and at Crystal, ND. At Crystal, ND, peak flow rates are reduced by 20% for the 10-year event and 31% for the 100-year event. At the outlet of the North Branch Park River Watershed (including overland flow), peak flow rates are reduced by 7% for the 10-year event and 8% for the 100-year event. A wetland delineation was not completed at the site, but it is possible that significant wildlife habitat benefits (including wetland restoration) could have been realized from the alternative. Given it has a smaller upstream drainage area the nutrient reduction potential from this site is lower than that of the preferred alternative.

Cart Creek Impoundment Site 2 was eliminated from further consideration after a review of available soils data suggested that the geologic conditions may not be conducive to storing floodwaters. Also, Cart Creek Impoundment Site 2 produced minimal flood reduction along the Cart Creek east of Mountain, ND. For these reasons, Cart Creek Impoundment Site 2 was eliminated from further consideration.

4.2.4 Floodwater Diversion Around Crystal, ND

A proposed diversion channel diverting flows from Cart Creek west of 137th Ave NE around the community of Crystal, ND back into Cart Creek east of 138th Ave NE was considered. From Cart Creek west of 137th Ave NE, the proposed diversion channel would route flood flows south to an existing swale. The diversion channel would generally follow the swale alignment south and east until the quarter section line. The diversion channel would then route flows east through the railroad and 138th Ave NE into Cart Creek. In addition to the diversion channel, the structure near the diversion inlet on 137th Ave NE would be downsized to divert more flow into the channel, and a road raise along 137th Ave NE north of ND Highway 66 would be included. The channel would be designed to divert flows so that during a 100-year event there would be no structural impacts in and around the community of Crystal, ND. The channel would remain dry during periods of low flows. A location map is provided in **Appendix D-2**.

The diversion channel was analyzed for potential downstream impacts during the 10-year and 100-year events. At the identified reporting location in Crystal, ND the peak flow was reduced by 51% for the 10-year event and 64% for the 100-year event. Further downstream, at the ND Highway 18 crossing with Cart Creek (secondary reporting location), peak flows increased by 3% for the 10-year event and 26% for the 100-year event. At the outlet of the North Branch Park River Watershed (including overland flow), the peak flow for the 10-year event was reduced by 1%, and the peak flow rate for the 100-year event increased 9%. The alternative would not have contributed to the watershed protection goals of the plan. The diversion channel around Crystal was eliminated due to its very limited ability to meet the Purpose and Need.

4.2.5 Floodwater Diversion with Temporary Flood Storage

The diversion channel described in the previous section combined with upstream retention to serve as mitigation for potentially increased downstream flow rates was also considered. However, it was still not possible to reduce flooding downstream of Crystal while providing protection to Crystal using a diversion. Therefore, the diversion channel with upstream retention was also eliminated from detailed study.

4.3 Alternative Description

The screening process described in more detail in *Screening of Alternatives for Detailed Review* in **Appendix D-2** resulted in the identification of two potential alternatives for further consideration.

4.3.6 Alternative No. 1 – No-Action

The Alternative 1 – No-Action assumes that without NRCS financial assistance, implementation of flood damage reduction projects within the project watershed would be limited. Resource conditions are expected to remain relatively unchanged through the evaluation period of 50-years, therefore the frequency and magnitude of flood damages within the watershed will be consistent with the existing conditions.

Approximately 228-acres located in the Cart Creek Site 1 flood pool is enrolled in the CRP and the WRP easement programs. These easements currently consist of large stands of perennial vegetation that provide wildlife habitat and also water quality improvements. These programs are voluntary enrollment programs for eligible producers that have temporary easements dating from 10-years to 30-years. It’s conceivable that during the evaluation period that these acreages could be farmed after easement terms expire. It’s also conceivable that lands either within the Cart Creek Site 1 flood pool or elsewhere are enrolled into future programs. The EIS was written on the assumption that wildlife habitat would remain relatively unchanged during the 50-year evaluation period.

4.3.7 Alternative No. 2 – Cart Creek Site 1

The proposed Cart Creek Site 1 is an off-channel impoundment site constructed of an earthen embankment in Section 24 of Thingvalla Township (T160 R56). Floodwaters from the 33.8 square mile contributing area enter the site via direct drainage and two inlet structures. The earthen embankment is approximately 2.6 miles long with an average height of 9.7 feet. The embankment is routed to avoid impacts to the adjacent WRP easement. Once diverted into the site, floodwaters exit Cart Creek Site 1 via the principal spillway or the auxiliary spillway. The principal spillway consists of a low flow pipe and a riser tower. At the riser tower crest elevation there is 1,054 acre-feet of storage that would inundate 291-acres. The auxiliary spillway is an earthen ramp spillway. At the auxiliary spillway crest elevation, there is 2,593 acre-feet of storage that would inundate 466-acres. Within the temporary flood pool, 133.6 acres of shallow retention cells will be constructed via 12,900 feet of embankment.

Runoff will route into the impoundment area a north inlet spillway and channel from Cart Creek, a south inlet spillway from Pembina County Drain No. 28, and 36” diameter culverts through the township road west of the impoundment area for the local watershed. Flows from minor runoff events will enter the biomass harvest area prior to accessing the north spill-out inlet to the retention site. The inlet for the biomass harvest area will be set one foot lower than the inlet for the retention site and will be routed around the existing WRP easement via a perforated pipe within the township road right of way. Flows that exceed a 2-year event will discharge water into both the biomass harvest area and into the larger retention site. The south inlet to the site will first route into the biomass harvest area via an open spillway channel set one foot lower than the main spill-out inlet into the flood impoundment area.

Wetland vegetation will naturally dominate in the bottoms of the shallow retention cells, given the 1-2 feet of water that will remain present in them from spring runoff until late August/early September. As outlined in **Appendix D-7**, it is critical that vegetation be harvested prior to the first hard freeze to prevent nutrients from migrating out of the plant biomass and back into the soil. Opening the two water control structures will drain surface water via the 0.2 to 0.3% slope on the retention cell bottom. Perforated pattern drain tile will be installed across the entire 133.6-acre retention cells to allow for subsurface drainage as well, which will be managed via a pump with surface outlet to dry out the site to allow harvest operations. Vegetation will be cut, baled, and trucked to an offsite non-contributing area of the watershed; likely a feedlot operation. Water quality and soil nutrient monitoring will help to determine the frequency of harvest operations needed to ensure the underlying soil does not become oversaturated with phosphorus, but it is predicted that harvest 2 out of 3 years will be necessary to achieve that. Drought years, where there is limited water in the retention basin, will likely be the non-harvest years. The Sponsor may want to attempt trials with alternative vegetation or crops, rather than naturally establishing wetland vegetation (cattails) that will dominate the basins, which will be acceptable within the framework of the Operation and Maintenance agreement to determine how to most effectively operate the structure for phosphorus removal.

Restoration of natural wetland hydrology within the remainder of the flood pool will be accomplished through the design of the inlet structures, installation of culverts, and earthwork required for excavation areas made for borrow material for the dam and retention basin embankments. Detail on planned construction elements is provided in Section 5.2.5. Each inlet structure is designed to act as a spreader to restore shallow sheet flow across the areas outside of the retention cells, where wildlife habitat is the primary management goal. The east/west ditch flowing across the flood pool will also be plugged to eliminate lateral effect and minimize the occurrence of shallow channelized flow. The project will also involve plugging an existing perforated subsurface tile system in the northeast corner of the flood pool. All disturbed areas and existing cropland in the flood pool will be seeded to a mixed upland/wetland perennial vegetation mix. The short duration of inundation resulting from this project will not detrimentally impact the perennial vegetation in wetlands or uplands. During a 2-year event, 56% of the inundation occurs for less than 5 days. During a 10-year event 28% of the area is inundated for less than 5 days, and for a 100-year event 38% of the inundation occurs for less than 5 days.

Based on the characteristics of the impoundment site and the potential for downstream impacts resulting from a breach, Cart Creek Site 1 would be classified as a high hazard dam. The components of the site have been sized to meet NRCS guidance. Based on the hazard classification, the auxiliary spillway would not be activated during the passage of the 100-year event. Additional information about the site design and performance is available in **Appendix D-3**.

4.4 Summary and Comparison of Alternative Plans

Item or Concern	Alternative No. 1 - No-Action	Alternative No. 2 - Cart Creek Site 1
Measures to Address: • Flooding • Wildlife Habitat • Water Quality	• Continued periodic flood damages to agriculture, rural infrastructure, and Crystal, ND. • Water Quality to remain relatively unchanged. • Wildlife Habitat will remain relatively unchanged.	• Construction of a dry dam with temporary floodwater detention. • 529.5 acres of high-quality wildlife habitat will be created or enhanced, protected via easements for a minimum of 50 years from the date of construction. • Increased residence time to reduce impairments to water quality.
Installation Costs		
NRCS Contribution	$ 0	$ 9,661,000
SLO Contribution	$ 0	$ 2,567,700
Total	$ 0	$ 12,228,700
National Economic Development (NED) Account - Average Annual Costs		
Installation	$ 0	**$ 438,500 (Total)** *$ 326,900 (Flood Prevention)* *$ 111,600 (Watershed Protection)*
Operation, Maintenance, and Replacement	$ 0	**$ 17,400 (Total)** *$ 5,000 (Flood Prevention)* *$ 12,400 (Watershed Protection)*
Total Annual Costs	$ 0	**$ 455,900 (Total)**
Annual Benefits	$ 0	**$ 193,545 (Flood Prevention)** Note: Watershed protection benefits were not monetized but were quantified and are discussed in Section 5 of the EIS.

Item or Concern	Alternative No. 1 - No-Action	Alternative No. 2 - Cart Creek Site 1
Environmental Quality (EQ) Account		
Soils	• Erosion resulting from flooding will continue to persist. • Issues with shale deposition in existing channels, culverts, and fields between Hwy 32 extending 2 miles east will remain unchanged. • 6,093 acres of prime farmland will be inundated during the 10-year event.	• Streambank and bed erosion will be lower downstream of the project due to reduced peak flow rates; see Water Quantity section below for peak flow rate reductions. • Shale deposition issues upstream of the project site will remain unchanged. • Soils adjacent to ditches will be managed with CPS 610 criteria and considerations to prevent salinization. • Temporary impacts to soils during construction to be mitigated with best management practices. • Overall lower wind and water erosion at the project site given that 299 acres of existing cropland will be converted to perennial vegetation. • 5,585 acres of prime farmland will be inundated during the 10-year event (7.2% reduction). • Prime farmland ranked at 124.7/200 will be placed into perennial vegetation.
Water Quantity	• Flooding would continue to occur similar to the existing condition. • 4,069 acres of cropland on average would be annually inundated. • The planning area would continue to contribute equivalent flows to downstream flooding as the existing condition.	• Cropland inundation would be reduced by 769 acres (13.2%) for the 10-year event. • Peak flow rates would be reduced by 20.4% and 28.2% along the Cart Creek at Crystal, ND for the 10-year and 100-year events, respectively. • Peak flow rates would be reduced by 8.6% at the outlet of the Cart Creek. • Reduce peak flow rates at the North Branch outlet by 7.3% during the 100-year event.
Water Quality	86th Street NE: • 9,404 lbs./year Phosphorus Loading. • 51,017 lbs./year Nitrogen Loading. • 2,042 tons/year Sediment Loading. North Branch Outlet: • 36,412 lbs./year Phosphorus Loading. • 197,533 lbs./year Nitrogen Loading. • 12,752 tons/year Sediment Loading.	86th Street NE: • 3,795 lbs./year Phosphorus Loading. • 17,359 lbs./year Nitrogen Loading. • 1,267 tons/year Sediment Loading. North Branch Outlet: • 32,599 lbs./year Phosphorus Loading. • 182,089 lbs./year Nitrogen Loading. • 10,231 tons/year Sediment Loading.

Item or Concern	Alternative No. 1 - No-Action	Alternative No. 2 - Cart Creek Site 1
Wetlands	• 399.6-acres of historic upslope wetlands will remain in a non-hydric condition with no wetland function, a portion or all of which will be cropped now and into the future • 18.5-acres of wetlands will continue to exist with limited function, due to hydrology alterations.	• 2.13-acres lost through fill placement in delineated wetland areas. Wetland mitigation acreage would be purchased in fee-title with deed restrictions for permanent protection. • 2.96-acres temporarily impacted through excavation in existing ditches, which would be restored after implementation. • 470.8-acres of wetlands would be restored by re-establishment of sheet flow hydrology and removal of the in-place subsurface perforated tile drainage system. 262.7 -acres of wetlands are restored on existing cropland, to be converted to grassland. vegetation. • Net gain of 468.7-acres of wetlands due to restored hydrology and vegetation communities which would be protected for at least 50 years • 18.5-acres of wetland enhancement through re-establishment of natural hydrology. • Net increased wetland function of 70% - 100% (HGM FCU ranking). This is a result of hydrologic and vegetative restoration. • Other wetlands within the planning area would be enhanced.
Riparian Areas	Unchanged from the existing condition.	• Reduced peak flow rates downstream.
Floodplains	FEMA Regulatory 100-year Floodplains would remain unchanged.	• Floodplain development permit would be required for impacts to Zone A flood zones. • The 100-year peak flow rate at Crystal, ND would be reduced by 28.2%
Habitat	Unchanged from the existing condition.	• Large, contiguous block of mixed upland/wetland habitat would be created (529.5 acres).
Plants and Animals	Unchanged from the existing condition.	• Enhanced waterfowl and shorebird breeding for upland nesting species. • Enhanced habitat availability for resident wildlife species. • Temporary impacts during construction.
Land Use	Unchanged from the existing condition.	• 422 acres will be acquired and taken out of agricultural production for at least 50 years. • 227 acres that are currently not tilled would remain in perennial vegetation for at least 50 years. • 1,424 acres will be removed from flooding downstream. • Flood durations will be reduced on cropland within the remaining downstream floodplain.

Item or Concern	Alternative No. 1 - No-Action	Alternative No. 2 - Cart Creek Site 1
Cultural Resources	Unchanged from the existing condition.	• Risk of flood damage reduced for one cemetery located in the floodplain. • Risk of flood damage reduced for one archeological site located in the floodplain.
Social Issues and Public Safety	Flooding would continue to occur consistent with the existing conditions.	• Flood damages would be reduced within the watershed. Road overtopping risk will be lower; see Water Quantity section above for peak flow rate reductions. • Construction of a High Hazard Dam would create increased risk in the event of a failure.
Other Social Effects (OSE) Account		
Red River Basin International Commission Long Term Flood Solutions (LTFS)	• No contributions will be made to the Basinwide Flow Reduction Strategy. • Does not assist in attaining flood protection recommendations.	• Provides 2,593 acre-feet of flood storage towards the Basinwide Flow Reduction Strategy. • Assists in attaining flood protection recommendations for agriculture, rural infrastructure, and Crystal, ND. • Demonstrates US commitment to Internationally established goals for flood damage reduction in the Red River Basin.
Boundary Waters Treaty (IJC)	No contributions to getting Red River WQ into compliance at the International Border.	• Demonstrates US commitment to Boundary Waters Treaty obligations by reducing phosphorus and nitrogen delivery from the NB Park River to the Red River.

5 Environmental Consequences

This section provides the analytical basis for the comparisons of effects presented in the alternatives. This section will describe the economic, environmental, and social effects of each alternative. The relevant concerns identified in the scoping section are discussed in this section of the plan for each alternative.

5.1 Soils

5.1.1 Soil Resources

Effects on geology and soils would be significant if they would alter the lithology, stratigraphy, and geological structures that control groundwater quality, distribution of aquifers and confining beds, and groundwater availability; or change the soil composition, structure, or function – including prime farmland and other unique soils – within the project planning area.

5.1.1.1 Alternative 1 – No-Action

Under Alternative 1 – No-Action, continued effects of flooding will persist. The flooding and resulting break-out flows result in short-term topsoil erosion and sedimentation. Long-term vulnerability of soil health will persist to adjacent agricultural lands under this alternative. Failure to provide additional flood risk management will result in further potential issues with channel scour, erosion, sedimentation, short-term interruptions to regional agricultural production and long-term degradation of soil health and the overall vitality of agricultural lands.

5.1.1.2 Alternative 2 – Cart Creek Site 1

Alternative 2 is located at a transitional area from the steeper sloped Beach Ridge area upstream in the west, to the flatter, ancient Lake Agassiz flood plain, which is characterized by flat slopes and predominantly agricultural use lands. This alternative is located on lands currently set aside in conservation reserve programs under FSA CRP and NRCS WRP. According to the NRCS, Web Soil Survey data, a majority of the Alternative 2 site is 100% hydric with minor areas of 1-32% hydric with soil erodibility factor (K-factor) ranging from 0.24 in the proposed pool area to 0.17 at the south inlet, and 0.32-0.17 at the locations of the north inlet and diversion channel (**Figure C-15** and **C-16**). Predominant soil types within the footprint of Alternative 2 are listed below, all of which hold a Highly Erodible Land Class designation of 3, meaning they are Not Highly Erodible (Pembina, North Dakota, Highly Erodible and Potentially Highly Erodible Land Calculator Ver. 1.1, 5/20/88).

- Ryan-Fargo silty clays, 0 – 1% slopes
- Fargo silty clay, 0-1% slopes
- Glyndon silt loam, 0-2% slopes
- Neche silty clay, 0-1% slopes, occasionally flooded
- Dovray silty clay, 0-1% slopes
- Hegne silty clay, moderately saline, 0-1% slopes

Soils in the area are mostly derived from lacustrine sediments or alluvium from Cart Creek. They are fine textured and have seasonally high-water tables. These soils typically have saline or sodium-affected substratum. Under annual cropping, the salts have the potential to migrate with the water table into the rooting zone and negatively impact crop production. Converting the cropland to permanent cover, for at least the 50-year Operation and Maintenance agreement period, will likely reduce salinity issues that may occur under seasonal cropping. Permeant cover typically has a deeper rooting system than annual crops. It also utilizes a longer growing season. The deeper rooting system and longer growing season will allow the roots from the permanent cover to intercept the ground water and the associated soluble salts at a greater depth. This will keep the salts from migrating to the near surface and allow current salts in the upper rooting zone to be leached to a deeper depth.

Alternative 2 includes inlet and outlet channels which have the potential to pond water if not well maintained. Slow moving drains could cause an accumulation of salts as the capillary water rises and then evaporates. These salts could in turn affect adjacent crop germination, emergence and yield. Timely channel maintenance and crop management practices such as soil testing, crop variety selection, shallow tillage and tile drainage are planned as a part of the project to prevent negative impacts to adjacent cropland.

Alternative 2 will also provide long-term soil erosion and soil quality benefits. The seeding of cropland to permanent cover will reduce soil losses from wind and water erosion and improve organic matter levels over time. Soil pore space and soil pore depth will increase with deep rooted native prairie grasses, this will result in increased infiltration and water storage in the soil profile.

Alternative 2 is anticipated to result in short-term, direct impacts to soils from construction, which will be managed through use of BMPs to reduce and manage erosion and sedimentation from earth moving activities. Long-term, Alternative 2 would provide increased flood storage and reduce flashiness and downstream velocities as well as erosion and sedimentation on agricultural lands. This would benefit soil health and protect the productivity of agricultural lands.

Under Alternative 2, direct impacts to soil resources include: excavation required for the north and south inlets and diversion channels; earthwork to build the earthen embankment; and earthwork in the pool area (avoiding areas with existing perennial vegetation). Construction would require disturbance of approximately 180-acres. It is anticipated that any soil needed for construction would be balanced with on-site excavated soil. Upon construction, if characteristics of excavated soils do not fully meet the specifications of design for the embankment, additional soil resources would need to be borrowed from a nearby source.

Soils would be disturbed, vegetation would be cleared, and backfilling and grading would also be required during the short-term construction period. During construction there is increased erosion and sedimentation potential, which would be managed by use of BMPs during and immediately after construction. Post-construction monitoring would ensure successful reclamation of vegetated areas. Examples of construction BMPs include, but are not limited to, silt fencing, straw wattles, geotextile filters, water applications to disturbed soils to prevent wind erosion, and revegetation of disturbed areas as soon as possible after disturbance. Also, in compliance with Section 402 of the CWA, a national Pollutant Discharge Elimination System (NPDES), Construction Stormwater Permit and Stormwater Pollution Prevention Plan (SWPPP) would be required for this project. Compliance would require use of construction BMPs to minimize soil erosion.

During construction activities requiring significant earth moving (e.g., for inlets, diversion channels, and embankment), topsoil would be segregated from subsoil prior to excavation and any backfilling. Segregation of subsoils (e.g., heavy clays) would occur throughout construction in order to reclaim excavated soils for the embankment. Topsoil would be placed on top of the recovered subsoil. Disturbed areas along the diversion channels would then be reseeded with appropriate seed mixes. 152-acres required for the constructed components will be seeded to perennial vegetation, with an incorporated cover crop to secure the slopes. 497 acres would be developed as native upland/wetland prairie mix perennial vegetation within the flood pool. Significant benefits are anticipated with developing the proposed pool area this way (e.g., soil health, habitat resiliency) and minor impact is anticipated upon flood events with the maximum flood storage design of 10-days. Vegetation within the proposed pool areas would be perennial, consisting of mixed prairie wetland and upland species. Final design of the project will include detailed planning for revegetation, and balance optimal wildlife habitat

Building the embankment would require a 10-foot top width at elevation 983.2 feet with 4:1 slope with the maximum highest of 17.3-feet and average height of 9.7-feet. This embankment would facilitate the off-channel storage and create the temporary pool. The temporary pool area is designed to inundate the area with slow drainage out the principal spillway to Cart Creek with maximum inundation period of 10-days. There would be no permanent impacts to soil resources within the pool with the established perennial vegetative habitat in place.

During the short-term construction period, contractors would be required to follow standard BMPs and compliance measures to quickly contain any leaks or spills from construction equipment. If applicable, under 40 CFR Part 112, a spill response plan would be prepared in advance of construction by the contractor for areas of work where spilled contaminants could flow into water bodies.

No significant adverse impacts on soils would be anticipated with the implementation of BMPs.

5.1.2 Prime and Unique Farmland, and Farmland of Statewide Significance

5.1.2.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no effect on the size or distribution of prime farmlands, farmlands of statewide importance, or farmland of unique importance in the planning area. Farmlands in the planning area would continue to produce as in the past. Under this alternative, erosion and sedimentation issues associated with flooding would continue resulting in adverse impacts to soil resources. The project purpose and need would not be met as no additional protection to agricultural lands would be provided, and no action would be taken to reduce out-of-bank flooding which currently, adversely affects topsoil resources through erosion and sedimentation throughout the planning area.

5.1.2.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would offer long-term benefits to prime and unique farmland and farmland of statewide significance within the planning area by providing a flood risk management solution with increased water storage capacity on adjacent, flood-plagued lands. The USDA SSURGO soils database was used to estimate farmland designation within the planning extents. Reductions in inundated acres are presented in **Table 5-1**.

Table 5-1: Alternative 2: Prime and Unique Farmland, and Farmland of Statewide Significance

Alternative 2, Cart Creek Site 1 Flood Event	Total Inundated NRCS Farmland (acres)	Farmland of Statewide Significance (acres)	All areas are prime farmland (acres)	Prime Farmland if drained (acres)	Not prime farmland (acres)	% Change from Alt.1 to Alt.2	Acres Change from Alt.1 to Alt.2
2-year	5,161	81	2,838	920	1,321	-5.6%	-308
5-year	7,298	101	4,355	1,218	1,624	-6.2%	-481
10-year	8,961	114	5,581	1,475	1,791	-7.3%	-704
25-year	11,575	129	7,660	1,823	1,963	-8.1%	-1025
50-year	13,667	160	9,295	2,133	2,078	-7.3%	-1077
100-year	15,647	185	10,868	2,402	2,192	-8.2%	-1406

NRCS designated prime and unique farmland is currently within the project footprint. Based on available soils data, 90.7 acres of prime farmland and 185.2 acres of prime farmland if drained are within the project footprint. The Farmland Conversion Impact Rating for this alternative is 104.85 of a possible 200 points (see **Appendix D-8**). This land would be taken out of agricultural production and placed into perennial vegetation. While there would be direct impacts to prime farmland as a result from Alternative 2, reduced downstream flooding will benefit prime farmland and farmland of statewide significance downstream.

5.1.3 Alluvial Soils

5.1.3.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no effect on the alluvial soils. Shale material would continue to be eroded from high-risk shallow bedrock outcrops, and subsequent deposition would occur downstream; particularly within river reaches and legal drains east of Hwy 32. Pembina County would continue to excavate shale deposition with the ditched river channel as well as spray out willows and other vegetation in an attempt to maintain conveyance capacity. Given limited resources, there will remain time periods where sediment deposition causes overtopping of County Road 3 on the north tributary to the NB park River and cropland flooding occurs. Straightened (ditched) reaches of the river will continue to have high rates of bank erosion and related deposition of that material as the channel attempts to restore natural sinuosity.

5.1.3.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would not significantly impact sediment deposition or bank erosion within the river channel either upstream or downstream of the proposed diversion to the dry dam from current conditions. Construction of the diversion dam and placement of riprap will reduce erosion potential in that immediate area only. Current maintenance completed on the ditched river channel will not be affected by the project. Due to reduced erosive forces from peak flow reduction, as documented in Table 5-2, cropland erosion will be reduced downstream of the dam. The current ditch along 85th Street NE will be modified into the dams auxiliary spillway; which has been shown to be stable for NRCS design criteria outlined in TR-60 (USDA, 2019), specifically Stability Design Hydrograph. Details about the dam design can be found in **Appendix D-3** Concept Design Report.

Local sedimentation at the diversion dam, that would need to be addressed with annual operation and maintenance, is not expected to be any different than that of the current bridge. The inlet channel crossing includes a 73"x45"x22' arch culvert through a diversion dam. This culvert allows low flows to pass downstream along Cart Creek. The diversion dam pushes higher flows to the inlet channel for storage in reservoir. The culvert area is ~23 sq. ft., which equates to approximately a 1-year frequency flow; this is smaller than bankfull channel forming area of ~38 sq. ft. The bankfull channel forming area represents the area of the channel based on regional curve that would be expected based on the drainage area size from similar watersheds in the region. Therefore, this bankfull channel in natural conditions would trend over time to the 38 sq. ft. However, since flood flows are diverted to the inlet channel and reservoir, flood flows do not have excessive stream power to widen the channel; plus culvert fringe is armored to protect against erosive currents. The culvert being less than bankfull area also does not make the engineers foresee deposition as hydraulic modeling velocities through culvert are high (~8 ft/sec) for 2-year and higher floods. In summary, the culvert through inlet channel crossing is not expected to have erosion due to fringe rock protection and conversely not expected to have deposition as the culvert funnels flow through it to be self-cleaning due to high velocities for seasonal high-water events.

Hydraulic modeling shows similar velocities (~8 ft/sec for 2-year and higher floods) through the diversion and dewatering culvert, which is similarly sized 73"x45"x36' arch culvert. This culvert also has fringe rock protection for erosive forces during flooding and expected to be self-cleaning due to high velocities for seasonal high-water events. There is potential for deposition during dewatering of inlet channel on receding limb of hydrographs, however high velocities during flood events are expected to self-clean the culvert. The diversion and dewatering culvert is on the outside bend of Cart Creek; this placement is such that helical flow at the cross section puts higher velocities along outside bend and lower velocities along inside bend (NEH Part 653, Chapter 2). Sediment deposition trends are such that outside bends rarely incur deposition, rather the inside bend is depositional.

Inlet channels are not expected to incur significant deposition due to limited bedload entering inlet channel at 73"x45"x36' arch culvert, short duration of filled inlet channel with suspended sediment load, and infrequency of filling inlet channel. For example, the 2-year through 100-year event inlet channel is drained withing ~2.5 days from initial fill up.

Sediment deposition in the reservoir and inlet channels are estimated to be 0.16 ac-ft/year, or 0.005 ac-ft/year/sq. mile. For the service life of the reservoir (50-years), the total sediment volume estimate is 8.2 ac-ft. This volume is ~0.9% of volume at principal spillway riser tower crest and

0.2% of volume at top of dam; which sedimentation is considered a low concern for dam safety and environmentally. This sedimentation rate is lower than typical dams in the region due to no permanent pool (dry dam), and only flood flows are diverted to reservoir (low and medium flows continue in channel). The volume is from the suspended and bedload sediment loads from Cart Creek watershed (North Inlet) and South Inlet watershed. The North Inlet is reverse grade 200 foot bottom width starting from 73”x45” RCPA and sheetpile weir at 90-degree bend, with raised broad crested weir inlet at reservoir for high flows and 24” HDPE pipe to biomass harvest areas. The inlet channel velocities range from 2 ft/sec (2-year) to 4 ft/sec (100-year). Due to Inlet Channel diversion from Cart Creek (arched pipe and weir at 90-degree angle), reverse grade, raised spill-out, and low velocities bedload delivered to the reservoir is less than amount that continuous in main channel.

The annual sediment load is estimated based on NRCS developed flow gauge and TSS plus bedload rating curve based on field measurements. The 2021 hydrograph was used with frequency-based flow rates (2-yr through 100-year) applied to determine synthetic annual load. Trap efficiency of reservoirs can be significantly different for dry dams versus those with permanent pools. With the active reservoir volume and annual average inflow volume of very similar magnitude (~1,500 acre-ft), the conservative trap efficiency of standard reservoir of ~95% (Brune, 1953).) is used in this analysis. The frequency applied annual estimate from North Inlet is 0.11 ac-ft/year, and total for 50-year life span is 5.4 ac-ft of sedimentation.

The south inlet bedload and suspended load was calculated based similar process as north inlet using NRCS developed rating curves and frequency-based flood flows. Therefore, the South Inlet estimated sedimentation rate is 0.06 ac-ft/year; the total 50-year life span sedimentation is 2.8 ac-ft. Sediment deposition is expected to be variable, including within the inlet channels, within 133.6 acres biomass harvest site, as well as remainder of reservoir. The sediment volume delivered within channels and reservoir will experience perennial vegetation growing through deposits, similar to riverine floodplain deposition.

5.1.4 Soil Salinity

5.1.4.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no effect on soil salinity. Crop fields affected by inherent, and ditch effected salinity would remain effected. No additional protection to salinity in crop fields would be provided and no action would be taken to reduce salinity which currently adversely affects crop production throughout the planning area.

5.1.4.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would provide long-term protection against salinity in crop fields adjacent to inlet and outlet ditches, due to the lowered ditch bottom below current elevation. In addition, salinity management practices would be implemented. A ditch effected salinity evaluation was completed for the straightened reach of Cart Creek and several road ditches in and around the project area. The maximum salinity effect of ditches goes 200 feet laterally, based on historical imagery; an example sites is shown in **Figure C-6.** The maximum (200-foot) distances related to crop fields immediately adjacent to the ditch. The adjacent areas with perennial vegetation have very minor salinity indicators, and don’t extend beyond 60 feet. There is some inherent salinity in fields beyond 200 feet, however, is not consistent and likely due to soils and field swales. Salinity management will be completed over 70 acres following Conservation Practice Standard 610: Saline and Sodic Soil Management; which outlines vegetative methods, soil amendments, mulching, and improved drainage where feasible.

5.1.5 Water Quantity

The water resources under review for potential Environmental Consequences include Cart Creek located east of the City of Mountain, ND, and Pembina County Drain 28 (a legal assessment drain maintained by the SLO) at the location of Alternative 2 downstream to the North Branch Park River outlet located northwest of the City of Grafton, ND. Current conditions include reoccurring flooding that results in increased channel instability, channel erosion, and deposition/sedimentation within and downstream of these resources. Based on USGS gage data, total annual runoff has been increasing since 1960, and increased runoff and flooding along Cart Creek, North Branch Park River, and their tributaries has been a growing issue and concern. Alternative 1 and Alternative 2 inundation maps are shown in **Figure C-1** within **Appendix C**.

5.1.5.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no direct disturbance or changes to Cart Creek, Pembina County Drain 28, or North Branch Park River. Flooding would continue and emergency flood risk reduction measures may need to be implemented during flood events. The purpose and need for this project would not be met as flooding continues to damage cropland, and no action would be taken to address flood resiliency of infrastructure or communities within the planning area.

5.1.5.2 Alternative 2 – Cart Creek Site 1

Cart Creek and North Branch Park River would experience a significant reduction of peak flows (see table below) under Alternative 2. Cart Creek would experience an approximate 65% reduction of peak flow during a 100-year event at the intersection of 86th Street NE at Cart Creek. The City of Crystal would receive flood relief of 17% peak flow reduction compared to existing conditions for a 2-year event and up to nearly 16% reduction of peak flow for a 100-year event. Benefits at the outlet of the North Branch Park River range from a 1%-0.5% (2-yr to 100-yr) reduction only at the channel and 2.3%-7.3% (2-yr to 100-yr) peak flow reduction at the outlet when considering the breakout flows.

Table 5-2: Alternative 2 Peak Flow Changes

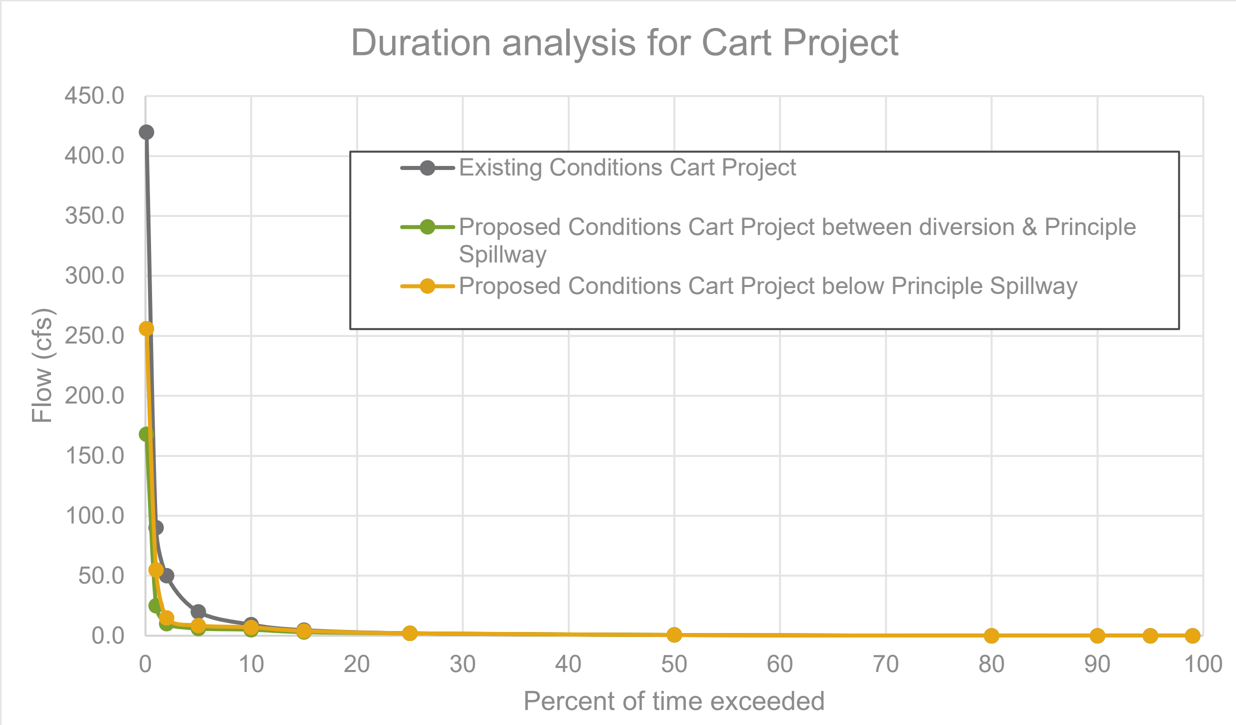
Location	Percent Change in Peak Flow Per Event						
	2-year	5-year	10-year	25-year	50-year	100-year	500-year
86th St. NE – Cart Creek	-39.0%	-57.3%	-64.0%	-68.4%	-65.9%	-65.5%	-54.0%
County Road 12 – Cart Creek	-17.0%	-18.6%	-19.0%	-20.8%	-17.5%	-15.9%	-22.9%
Crystal, ND – Cart Creek	-14.1%	-18.7%	-20.4%	-18.3%	-13.7%	-28.2%	-17.1%

Location	Percent Change in Peak Flow Per Event						
	2-year	5-year	10-year	25-year	50-year	100-year	500-year
Highway 18 – Cart Creek	-13.8%	-18.2%	-22.3%	-20.8%	-13.3%	-9.8%	-7.6%
77th St NE – North Branch Downstream of Cart Creek	-5.4%	-7.0%	-8.6%	-5.0%	-3.2%	-1.5%	-0.2%
North Branch Outlet	-2.3%	-4.4%	-6.6%	-10.5%	-5.7%	-7.3%	-3.2%

For more information, please refer to the Concept Design Report, **Appendix D**.

There is a shift in flow-duration curve downstream of the project due to diverted water to the impoundment, see **Chart 5-1**. The existing condition flows were extrapolated based on drainage area from HEC-SSP Duration Analysis using 31 years of continuous daily flows at USGS 5089500 (Cart Creek at Mountain, ND). The proposed condition flows were estimated from hydraulic modeling, see **Appendix D-3** for details. For low flow conditions, no flow is diverted until Cart Creek flow is greater than 2 cfs. Therefore, baseflow is remains unchanged to maintain hydrology for existing vegetation, fish, and wildlife. The change in flow regime is considered noticeable, but not significant. Cart Creek is an ephemeral stream; over 20% of the time there is no flow, and 50% of the time flow is less than 1 cfs. The reach between diversion and principal spillway is straightened reach with pushup levees, causing degraded instream and floodplain conditions. Therefore, the reduced in-stream flows are not expected have significant impacts on stream functions; further details about biological inventory are described in **Appendix D-6**. Construction is not anticipated to affect water quantity within the Alternative 2 footprint or downstream. Long-term, with Alternative 2 in operation, flood relief would be experienced because of the decreased and regulated flows downstream of the Alternative 2 site.

Chart 5-1: Duration Analysis



A summary of the effects of Alternative 2 on water quantity within the planning area are outlined in Table 5-3.

Table 5-3: Alternative 2, Water Quantity Effects

Purpose and Need Objective	Alternative 2, Cart Creek Site 1 Effects
Reduce flood damages	Reduces flood damages for up to a 10-year flood event on cropland by approximately 13.2% (769 acres)
Increase flood resiliency for public and private infrastructure	Approx. 20.4% reduction at Crystal, ND (10-year event) Approx. 8.6% reduction at the North Branch Confluence (10-year event)
Increase flood resiliency for the community of Crystal, ND	Approx. 28.2% reduction to peak flow at Crystal, ND during 100-year flood event.
No increase in peak flow rate at the outlet of the North Branch Watershed	Reduction ranges from 2.3% for the 2-year flood event to 10.5% for the 25-year flood event.

5.1.6 Water Quality

North Branch of Park River and Cart Creek are both classified as Class III streams, which are defined by NDAC 33-16-02.1-09 as, “suitable for agricultural and industrial uses. Streams in this class generally have low average flows with prolonged periods of no flow. During periods of no flow, they are of limited value for recreation and fish and aquatic biota. The quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses." According to the *North Dakota 2018 Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads* (Final, April 26, 2019), portions of the North Branch of the Park River, and Cart Creek are listed as impaired. See **Table 3-3** in Section 3.2 for the listed designations. TMDL studies are required for these segments of North Branch Park River and Cart Creek; they are currently listed as Low TMDL Priority in the State's integrated water quality report (p. VI-24).

Nutrient loading in the North Branch Watershed was estimated using observed data from a downstream gaging location (USGS Gage 05090000 Park River at Grafton, ND). Observed data was used to develop empirical relationships between flow and loading for sediment, nitrogen, and phosphorus. Loadings were estimated at 86th Street NE, and at the North Branch Watershed outlet. **Table 5-4** summarizes loadings at these locations for the existing conditions, Alternative 1, and Alternative 2.

5.1.6.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no action to improve water quality or address issues that affect water quality, such as flooding, within the planning region. Conditions would be anticipated to be unchanged, and general water quality may increase or decrease over time depending on any land use changes and climatic/weather variations.

5.1.6.2 Alternative 2 – Cart Creek Site 1

Sediment, nitrogen, and phosphorus loading would be reduced in the Cart Creek and North Branch water courses downstream of Alternative 2. As detailed in **Appendix D-7**, removal of dissolved phosphorus is extremely challenging in this landscape, given it does not settle or bind to vegetation as particulate bound phosphorus would. As a result typical best management practices such as filter strips, buffers, and settling basins are not effective for phosphorus removal in the RRB. The use of shallow retention basins to store 1-2 ft of water through the growing season, allowing growing wetland vegetation to uptake dissolved phosphorus (and nitrogen), with harvest timed in late summer/early fall prior to the phosphorus moving back into the soil, has been proven effective via monitoring at shallow retention areas with biomass harvest in Minnesota and Manitoba. Due to loss of critical vegetation cover for wildlife in the fall, going into winter, this is not considered an acceptable practice in natural wetlands (from an NRCS standpoint). Hence the need to construct dedicated retention basins as is proposed with this project. The increased residence time in the temporary flood pool will promote deposition of sediment which will have a small component of particulate bound phosphorus. Based on the data sources outlined in **Appendix D-7**, Phosphorus, Nitrogen, and Sediment would be reduced by 66%, 73%, and 42%, respectively, immediately downstream of the outlet for Alternative 2 at 86th Street NE. Cursory modeling of in-channel biogeochemical reactions indicated that at the North Branch Watershed outlet, the reductions would be 10%, 8%, and 20% for phosphorus, nitrogen, and sediments, respectively. Monitoring associated with the project, post-installation, will increase knowledge as on the use of this relatively novel practice **Table 5-4** below provides the anticipated loadings for each alternative. References and methods to accomplish that modeling are not available within reasonable scope for a watershed planning effort.

Table 5-4: Phosphorus, Nitrogen, and Sediment Loading Summary

Location & Parameter	Existing Conditions	Alternative 1 No-Action	Alternative 2 Cart Creek Site 1	Alternative 2 % Reduction
<u>86th Street NE</u>				
Total Phosphorus	8,499 lbs/yr	8,499 lbs/yr	2,890 lbs/yr	66%
Total Nitrogen	46,106 lbs/yr	46,106 lbs/yr	12,449 lbs/yr	73%
Total Suspended Solids	1,845 tons/yr	1,845 tons/yr	1,070 tons/yr	42%
<u>North Branch Outlet</u>				
Total Phosphorus	36,412 lbs/yr	36,412 lbs/yr	32,599 lbs/yr	10%
Total Nitrogen	197,533 lbs/yr	197,533 lbs/yr	182,089 lbs/yr	3%
Total Suspended Solids	12,752 tons/yr	12,752 tons/yr	10,231 tons/yr	7%

*see notes above regarding underestimate at the North Branch outlet

Short-term construction impacts would be reduced by use of BMPs and would also be addressed through the course of permitting and resulting requirements for the NPDES, Stormwater Construction Permit and USACE Section 404 permit. Construction BMPs would be required for stormwater control and would minimize adverse impacts from construction within the creek. USACE verified both Cart Creek and North Branch Park River are jurisdictional and considered Waters of the United States (WOTUS). Therefore, a USACE Section 404 permit would be required for discharges of dredged or fill material into WOTUS. As a component of this permit, a Section 401 Water Quality Certification would be required, which would ensure that no detrimental water quality discharges would result from the structures. Proper design and construction management would reduce impacts, which are therefore anticipated to be minor. Consultation with USACE throughout the planning project has resulted in no concerns with the current details of the project.

An aquatic resource delineation was completed at the proposed site location. Methods described in the 1987 Army Corps of Engineers Manual for "routine" delineations (U.S. Army Corps of Engineers, 1987) were used along with methodology specific to the Great Plains Regional Supplement (U.S. Army Corps of Engineers, 2010). Refer to **Appendix D-5** for more information on the determination of water bodies and wetlands that has been completed at the project site to date.

5.1.7 Wetlands

The footprint of Alternative 2 is consistent with sloped wetlands that rely on infiltration and groundwater movement. Review of aerial imagery and mapped soil types indicated that 399.6 acres of the footprint of Alternative 2 are historic sloped wetlands with severely degraded current wetland function due to roadway and drainage modifications. The enhanced surface drainage provided by modifications within and adjacent to the footprint intercepted much of the groundwater discharge and drained remaining hydrologic inputs at the sloped wetland location. This hydrologic alteration has resulted in existing vegetation that consists of a mixed upland/wetland plant community and limited hydric properties in the existing soils, as observed during the field visit in August 2019.

The extents of the sloped wetlands within the project area were estimated by using hydric soil ratings greater than 66% as indicated in the web soil survey (U.S. Department of Agriculture). This resulted in two sloped wetlands within the project footprint. 150-acres in the northeast portion of the impoundment currently includes subsurface drains that consist of pattern perforated tile. Of these 150 acres, approximately 71.5 acres are within the estimated sloped wetland footprint and were removed from the existing condition wetland area. Subsurface drainage removes the groundwater before surface discharge can occur, therefore wetland function was assumed to be completely lost. **Table 5-5** provides the acreages associated with each of the three sloped wetlands contained within the project area. See **Figure C-17** in **Appendix C** for the location of delineated wetlands at the Alternative 2 site and **Appendix D-5** for more information on results of field wetland delineation within the Alternative 2 footprint. The existing wetlands delineated at the site will be restored/re-established as the principal spillway will be set back to natural grade; which will also not cause long term (> 15 days) ponding to switch wetland classes.

Existing condition wetland function was assessed using the NRCS Hydrogeomorphic (HGM) Functional Assessment Model for sloped wetlands. The biomass harvest area wetlands are also scored with Slope HGM due to shallow groundwater table interaction that supports adjacent wetland restorations, especially in dry years. There is no HGM for biomass harvest wetlands as they are constructed wetlands. Even though these areas will receive diverted overland flow during flood events, a major hydrologic input is shallow groundwater discharge moving through these areas. A summary of the calculated Functional Capacity Units (FCU) for each wetland is provided in **Table 5-7** and detailed in **Appendix D-7.**

5.1.7.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, no changes in wetland resources within the planning area are anticipated. Intensity and frequency of precipitation events and snowmelt would influence these resources throughout the planning area. The existing WRP easements will expire in 2040 and 2042.

5.1.7.2 Alternative 2 – Cart Creek Site 1

Wetland restoration and enhancement will occur within the flood pool of Alternative 2 through the following actions:

- The east/west drainage ditch that currently drains the site would be filled in to create the biomass harvest areas used for watershed protection.
- The first stage inlet of the principal spillway would be raised approximately 1.4 feet over the current excavated ditch channel.
- The north and south inlets are designed to induce shallow sheet flow across the flood pool.
- The in-place one line of 36” culvert through 131st Avenue NE will be enhanced to provide three lines of culverts at varying locations to avoid concentrated flow entering the site from the upper watershed.
- Decommission the in-place perforated tile system in the northern portion of the flood pool.
- Vegetation re-establishment of tilled portions of the flood pool.

- Embankments used to promote biomass growth for nutrient reduction will result in a constructed wetland by ponding shallow water.

Direct impacts from the Alternative 2 design would include approximately 2.13 acres of wetlands filled for the embankment footprints and 2.96 acres of excavation. Alternative 2 will also result in the following wetland benefits:

- Wetland restoration of historic upslope wetlands via tile decommissioning, natural hydrology, and vegetation re-establishment (71.5 ac).
- Upland habitat creation via tile decommissioning and natural vegetation re-establishment (36.3 ac)
- Upland habitat protection of established vegetation (3.9 ac)
- Wetland restoration of upslope wetlands via natural hydrology and vegetation re-establishment (57.7 ac)
- Wetland restoration of upslope wetlands via natural hydrology re-establishment (208.0 ac)
- Wetland enhancement via natural hydrology re-establishment (18.5 ac)
- Constructed wetland for water quality treatment (133.6 ac)

Alternative 2 will result in restoration of 470.8 acres of wetlands and enhancement of 18.5 acres of wetlands, with a net gain of 468.6 acres of wetland by the project. **Table 5-5** provides a summary of impacted acres under Alternative 2. See **Figure C-18** in **Appendix C** for a map showing the location of direct wetland impacts from embankment construction and excavation. The temporarily impacted wetlands (2.96 acres) are associated with inlet channels, principal spillway, and auxiliary spillway features.

Wetland function under Alternative 2 was assessed using the NRCS Hydrogeomorphic Functional Assessment Model for sloped wetlands. These values were then compared to the existing condition FCU to assess increases in wetland function as a result of Alternative 2. Based on this assessment, wetland function is expected to increase approximately 300% to 350% for each of the analyzed functions. A summary of the calculated FCU increases for each wetland under the proposed condition is provided in **Table 5-6**.

Table 5-5: Summary of Wetland Acreages

Wetland Area	Existing and No-Action Conditions (Acres)	Alternative 2 Condition (Acres)	Gain (+) or Loss (-) (Acres)
Enhanced Existing Wetlands Summary			
1b	0.01	0.00	-0.01
3	0.06	0.00	-0.06
4 - Prairie	0.13	0.13	0.00
5	0.25	0.00	-0.25
7	0.17	0.17	0.00
8	1.21	1.21	0.00
9	1.86	1.86	0.00

Wetland Area	Existing and No-Action Conditions (Acres)	Alternative 2 Condition (Acres)	Gain (+) or Loss (-) (Acres)
10	0.18	0.18	0.00
11	15.76	14.25	-1.51
12	0.06	0.06	0.00
13	0.19	0.00	-0.19
14	0.11	0.00	-0.11
17	0.60	0.60	0.00
Enhanced Existing Wetlands Subtotal	***20.59***	***18.46***	***-2.13***
Restored Wetlands Subtotal			
Biomass Harvest Area	0	133.64	133.64
Restoration of Tilled Land (Tile drained)	0.06	71.53	71.47
Restoration of Tilled Land (Not tile drained)	0	57.70	57.70
Restoration of Prairie Land	0	208.02	208.02
Restored Wetlands Subtotal	***0.06***	***470.89***	***470.83***
Total	**20.65**	**489.35**	**468.70**

**Note: Wetland acreages exclude portions of wetlands outside of the project footprint that are not impacted by the project.*

Table 5-6: Composite Wetland Function Impacts

Function	Description	Existing and No-Action Conditions (FCU)	Alternative 2 Condition (FCU)	Functional Gain (+) or Loss (-) (FCU)
Moderation of Groundwater Flow	the capacity of the wetland to regulate the outflow of groundwater	13.34	371.09	+357.75
Velocity Reduction of Surface Water Flow	the reduction in the velocity of surface water movement through the wetland from storm events and/or snowmelt runoff	10.77	395.08	+384.31
Elemental and Nutrient Cycling	short- and long-term cycling and removal of elements and compounds on site through the abiotic and biotic processes that convert elements from one form to another	8.21	273.23	+265.02

Function	Description	Existing and No-Action Conditions (FCU)	Alternative 2 Condition (FCU)	Functional Gain (+) or Loss (-) (FCU)
Retention of Particulates and Organic Matter	deposition and retention of inorganic and organic particulate (>45 um) from the water column, primarily through physical processes	11.31	343.3	+331.99
Organic Carbon Export	export of dissolved and particulate organic carbon and detritus from the wetland	15.74	423.79	+408.05
Maintenance of Characteristic Plant Community	species composition and physical characteristics of living plant biomass	14.16	392.41	+378.25
Maintenance of habitat interspersion and connectivity among wetlands	the spatial relationship of an individual wetland with respect to adjacent wetlands in the complex	12.42	343.39	+330.97

5.1.8 Riparian Areas

Riparian areas under consideration for environmental effects are Cart Creek from ND Highway 32 and downstream to its confluence with the North Branch Park River, and the North Branch Park River from Cart Creek downstream to its confluence with the Park River mainstem.

5.1.8.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there are no anticipated changes to riparian areas. Theses habitat types would continue to be influenced by adjacent land uses and flooding. Riparian areas would not benefit from reductions in chemical, nutrients, and pesticide loading from runoff and erosion contributing by flood flows.

5.1.8.2 Alternative 2 – Cart Creek Site 1

There are limited riparian areas directly within the Alternative 2 footprint, so only limited direct, short-term effects are anticipated. Over the long-term, negligible impacts downstream of site along Cart Creek are anticipated as a result of Alternative 2 due to limited change to flow-duration curve, channelized stream segments, levees on banks, and row crops covering much of the floodplain. Row crops in floodplains limit floodplain habitat due to tillage, pesticide use, and annual vegetation with idle periods before planting and after harvest.

5.1.9 Floodplain Management

Designated FEMA Flood Zones existing within the planning area were evaluated in the context as discussed in the Affected Environment section (Section 3.2.5).

5.1.9.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no changes anticipated in the short-term to the existing FEMA floodplains. In the long-term it would be anticipated that the floodplain remains unchanged, unless extreme flooding or land use changes are significant enough to make changes to the existing designated floodplain.

5.1.9.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would reduce the existing flooding extents throughout the eastern portion of the planning area east of Mountain, ND and downstream to the outlet of the North Branch Park River watershed. Some reduction in the area flooded downstream during a 1% chance exceedance event would be achieved.

The northeastern corner of the embankment footprint is located within the currently mapped FEMA Special Flood Hazard Area (Zone A). Therefore, a floodplain development permit would be required. A detailed model may be required to ensure that there is no net rise in the base flood elevation resulting from construction.

5.1.10 International Water Management Concerns

Alternatives are evaluated based on their consistency with internationally accepted water management objectives for flood damage reduction and water quality improvements. International objectives related to flood damage reduction and water quality improvements are further discussed in the Affected Environment section (Section 3.2.6).

5.1.10.1 Alternative 1 – No-Action

The Alternative 1 - No-Action would provide no contribution to the Red River Basin Commission's Long-Term Flood Solutions, Basin-Wide Flow Reduction Strategy and does not assist in attaining flood protection recommendations within this regional water plan. The No-Action Alternative would also provide no contributions to water quality compliance with the Red River at the International Border in accordance with the Boundary Waters Treaty.

5.1.10.2 Alternative 2 – Cart Creek Site 1

2,593 acre-feet of flood storage would be provided towards the Red River Basin Commission's Long-Term Flood Solutions, Basin-Wide Flow Reduction Strategy. Phosphorus, nitrogen, and sediment loading would also be reduced downstream of Alternative 2 as a result of increased residence time provided by temporary flood storage (discussed in Section 5.2.2). Implementation of Alternative 2 provides an opportunity to demonstrate commitment to internationally developed Red River Basin objectives for water quantity and water quality.

5.2 Air

Air effects are evaluated in the context as described in the Affected Environment section.

5.2.10.1 Alternative 1 – No Action

Under Alternative 1 - No-Action, there would be no changes to the quantity of criteria pollutants emitted from existing land use management practices which include typical cropping practices which may emit small quantities of diesel emissions from implements such as tractors and trucks. Small amounts of fugitive dust are common from rural gravel roads and wind erosion during winter and spring months. There would be no effect to visibility and no changes to any emissions that may contribute to deposition such as ammonium ions from fertilizer applications.

5.2.10.2 Alternative 2 – Cart Creek Site 1

Long term effects to air will not change under Alternative 2. Some cropland would be converted to grassland, thus reducing annual tractor/truck emissions and fertilizer application. However, the grassland and biomass harvest management will still require the use of diesel implements (tractors and trucks) which will result in emissions similar to typical agricultural operations. The most significant air effects under Alternative 2 will occur during construction where temporary increases in tailpipe emissions and fugitive dust are possible. An equipment roster is shown in **Table 5-7**. Construction specifications will require equipment meet EPA Tier Exhaust Emission Standards. Equipment must be manufactured no earlier than 2014 and within the equipment's Useful Life hours/year, NTE 8,000 hrs/10 years. The criteria pollutants for tailpipe emissions include carbon monoxide, nitrogen oxides and particulate matter. EPA standards are compared with expected construction engine types in **Table 5-8**

Table 5-7: Equipment Roster and EPA Tier Rating

Heavy Equipment	Model	Power	EPA Tier Rating
Tracked Hydraulic Excavators	Cat 320	109 kW/146 hp	Tier 4
Tracked Bulldozer	CatD6	97 kW/130 hp	Tier 4
Self-propelled Scrapers	Cat 623L	304 kW/407 hp	Tier 4
Self-propelled Vibratory Pad Food Compactor	Cat 815K	185 kW/248 hp	Tier 4
Off Road Trucks	Cat 770G	360 kW/483 hp	Tier 3

Table 5-8 Equipment Emission Standards

Heavy Equipment	CO (g/kW-hr)	NO(x) (g/kW-hr)	PM (g/kW-hr)
Tracked Hydraulic Excavators	5.0	0.40	0.02
Tracked Bulldozer	5.0	0.40	0.02
Self-propelled Scrapers	3.5	0.40	0.02
Self-propelled Vibratory Pad Food Compactor	3.5	0.40	0.02
Off Road Trucks	3.5	-	0.20

The criteria pollutant of interest associated with fugitive dust is PM10 (EPA AP-42 2023). Dust is generated by the pulverization and abrasion of surface materials by application of mechanical force through implements. Emission factors for fugitive dust emissions were derived from table values in EPA AP-42 Compilation of Air Pollutant and Emission Factors, Vol 1, 5th Edition: Section 11.9, Section 13.2.2, and Section 13.3.3 as shown in **Table 5-9:** Estimated Construction PM10 Emissions, Alternative 2. Note that these assume a 50% effective control rate via dust abatement activities such as watering roads and the construction site.

Table 5-9: Estimated Construction PM10 Emissions, Alternative 2

Activity	Emission Factor	Amount Traveled or Moved	Estimate Construction PM10 Emissions
Scrapers Excavating	0.06 lb / ton	572 tons	17 tons
Scrapers Traveling	0.60 lb / VMT	10,659 miles	3,198 tons
Scrapers Dumping	0.04 lb / ton	572 tons	11 tons
Excavator- Ditch Exc, Riprap, Misc	2.66 lb / VMT	180 miles	239 tons
Loading Trucks	0.75 lb / ton	64 tons	24 tons
Off Road Trucks Transporting	2.48 lb / VMT	1,681 miles	2,083 tons
Dozer Spreading, Finish Grading	0.75 lb / ton	572 tons	215 tons
Self-propelled Vibratory Compactor	2.99 lb / VMT	108 miles	162 tons
Vehicle Travel, Unpaved Public Roads	0.86 lb / VMT	750 miles	324 tons
Wind Erosion, Exposed Surfaces	0.38 ton / ac	512 acres	97 tons
Total Construction Project Estimate			**6,370 tons**

EPA AP-42 provides a general emission factor for construction sites of 1.2 tons/ac/month for total suspended particles (includes both PM10 and PM 2.5 size particles), when measured concentrations are unknown. Based on this factor total emissions would be computed as 1.2 tons/acre/month x 512 acres x 12 months (start of construction to final revegetation) = 7,373 tons.

Alternative 2 construction and operation activities would not be expected to exceed air quality monitoring thresholds or ambient air quality standards. Any impacts would be minor and temporary in nature. The impacts would be minimized by using best practices during construction activities including, but not limited to, the use of water sprays for fugitive dust suppression and the use of construction equipment with appropriate emission controls.

Post-construction air quality improvement is estimated to be 278 tons of CO_2 annually. This includes both the reduction of equipment emissions as well as the increased carbon stored in the additional perennial vegetation and soils. The reduced equipment emissions from 129.2 acres of cropland converted to perennial vegetation results in 9 tons per year. The growing season net ecosystem CO_2 exchange improvement (467 g C m^{-2} yr^{-1}, Kim et al., 2022) for 129.2 acres converted cropland to perennial vegetation results in 269 ton per year.

5.3 Habitat

Habitat effects are evaluated in the context as described in the Affected Environment section (Section 3.4) and focused within the footprint of evaluated alternatives.

5.3.10.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, conservation and wetland reserve programs would remain an important means for conservation in the planning area. It’s anticipated that new contracts would continue to be signed, adding additional set-aside lands, while some existing contracts may not re-enroll. In those cases where the acres are not re-enrolled, the vegetative habitat may be converted back to crop production, and the undisturbed/natural habitat lost. Because of this voluntary enrollment process, it is anticipated that there would be no significant changes in designated natural areas under this alternative.

5.3.10.2 Alternative 2 – Cart Creek Site 1

Alternative 2 offers a targeted approach to managing flood waters with on-land storage, while also integrating habitat conservation. Habitat benefits would be achieved through preservation of 226.5-acres of existing perennial vegetation and establishment of 303.0-acres of perennial vegetation on tilled areas within the flood pool. In total, through a combination of preservation and establishment provides a large contiguous 529.5-acre block of mixed upland/wetland prairie habitat. This native prairie vegetation will provide habitat for upland nesting waterfowl species as well as prairie habitat for local wildlife populations.

Impacts associated with the frequency and duration of flooding are considered minimal. The relatively short duration of flooding and acres inundated as compared to frequency of use is not anticipated to result in significant changes to wetland and upland plant communities within the flood pool. Artificial flooding during spring periods could result in impacts to breeding bird populations. Similar to effects to riparian areas (section 5.2.8), minimal effects are expected to habitat within and adjacent to Cart Creek due to changes in flow-duration curve.

5.4 Plants and Animals – Wildlife and Listed Species

The planning area is located in the Lake Agassiz Plain Ecological Province, Glacial Lake Agassiz Basin (USEPA 2019). Typical vegetation (grasses and forbs) and wildlife (birds, mammals, reptiles/amphibians, and fish) found in the Tallgrass Prairie habitat types characteristic of the Red River Valley, are tabulated in Section 3.5.14. A majority of the native/natural cover that supports the plant and animal species have been altered by development of lands managed for agricultural production and rural community development.

5.4.11 Fish and Wildlife (including Species of Conservation Priority)

Existing fish and wildlife species that can be found in this area are referenced above in Section 3.5.14. State designated, Species of Conservation Priority are included in the North Dakota, *SWAP*, 2015 (https://gf.nd.gov/publications/599). A *Biological Inventory Report* was conducted for the project and is attached in **Appendix D-6**. Animal (fauna), and plant species lists for creek habitat, wetland habitat, prairie habitat, and wooded habitat in the general vicinity of the Alternative 2 footprint was field verified August 2019 by HEI. These vegetative species lists are included here by reference.

5.4.11.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no effect on special status species. Flooding, increased frequency of variable climactic and weather patterns, and land use management practices would continue to be active across the planning area, which would continue to pose concern for habitat fragmentation and decreased presence of fish and wildlife.

5.4.11.2 Alternative 2 – Cart Creek Site 1

Based on the *Biological Inventory Report*, there were no Species of Conservation Priority located within the Alternative 2 footprint. This does not mean that they may not be present. No stream surveys were conducted to assess fish species present in Cart Creek near the Alternative 2 footprint. Fish and other aquatic species are not anticipated to be adversely affected by implementation of the project because Cart Creek regularly goes dry and much of the stream has been channelized with immediately adjacent levees for over 60 years, the duration flow relationship is documented in Section 5.2.5. However, fish and aquatic species may benefit from the flood risk management, decreased flashiness and erosion of Cart Creek and North Branch Park River and resulting water quality improvements to these drainages. Design measures including a channel sloped back to Cart Creek will minimize the likelihood of any fish being diverted into the impoundment.

Effects on terrestrial wildlife communities resulting from the implementation of Alternative 2 would be direct and indirect, short-term and long-term, as well as localized and far reaching. Short-term direct and indirect impacts to wildlife would occur during and following project construction. Locally, movements and forage patterns of mammals would be temporarily disrupted due to human presence and machinery noise. However, most mammal species are widespread, wide-ranging, relatively abundant, and readily disperse across the landscape to other suitable habitat in response to disturbance. Completing construction and vegetation reestablishment activities in the shortest practical timeframe would minimize direct disturbance impacts to local wildlife populations.

Direct impacts to small animals, especially burrowing mammals, amphibians, and reptiles could include mortality or displacement during construction activities, and stress from human presence and construction noise. Small animal species may experience localized reduced populations in direct proportion to the amount of habitat disturbed. Restricting ground disturbance to the smallest practical footprint for project components would reduce direct loss of small burrowing animals and temporal loss of their habitat. Alternative 2 would require 152-acres of structural right of way, 19-acres of flowage easement for the diversion channels, and the 529.5-acres of perennial vegetation. Reseeding disturbed areas would occur in a timely manner (within one growing season) and seed mixes would be approved prior to use. Weed management would be implemented according to county standards, at a minimum.

In the long-term, Alternative 2 is anticipated to benefit plants and animals due to the preservation and establishment of 529.5-acres of perennial vegetation. Alternative 2 is anticipated to support a greater range of plants and wildlife species that are native to this area than are currently supported under existing and No-Action conditions. Long-term and indirectly, Alternative 2 would result in water quality benefits that would improve the health of aquatic, wetland, and riparian habitats downstream of the Alternative 2 site, through Cart Creek and to the outlet of North Branch Park River.

5.4.12 Threatened and Endangered Species

A field review as conducted in August of 2019 to identify present species and critical habitats for species identified in Section 3.5.15. This field review concluded the following:

Northern-Long-Eared Bat: Although no sightings of northern-long-eared bats occurred during the field review and no historic sites in the region exist, habitat is present in the project area.

<u>Whooping Crane</u>: While whooping cranes are known to occur in all counties of ND, they are typically observed further south and west of the planning extents.

5.4.12.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no effect to T&E species. Flooding, climactic and weather variability, and land use management practices would continue across the planning area, which would continue to pose concern for habitat fragmentation and potentially decrease the occurrence of T&E species that have the potential to occur within the planning area.

5.4.12.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would make available a 529.5-acre area of wetland and native prairie habitat that would potentially be conducive, in the long-term, to supporting a broader range of species.

No trees suitable for bat habitat are present in the construction zone. With the lack of northern-long-eared bats present during field review, and no historic sites in the region, no impacts to the bats are anticipated. However, given the resent uplisting of the northern-long-eared bat to "endangered", running the USFWS IPAC consultation software will be required in the design phase to assure no new information has occurred that would impact the NLEB. Regardless, NRCS would conduct a survey of culverts and bridges within the project area prior to construction to ensure no roosting presence and to prevent any adverse impacts to the potential bat populations. NRSC would consult with USFWS as needed based on the field survey. Additionally, no impacts to the whooping crane are anticipated with the construction and implementation of the proposed project. The construction specifications will require temporary ceasing of construction if whooping cranes or NLEB were to be sighted.

5.4.13 Migratory Birds

Review of potential impacts to migratory birds was reviewed in the context of impacts to habitat for species discussed in Section 3.5.16 and for the areas impacted by evaluated alternatives.

5.4.13.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, impacts to migratory birds are expected to be unchanged from the existing condition.

5.4.13.2 Alternative 2 – Cart Creek Site 1

Considering the potential presence of migratory birds within the area of Alternative 2, short-term direct impacts to migratory birds would include disturbances and displacement during construction activities. Wintering or migrating birds are not expected to be measurably affected by construction disturbance or displacement because they have the flexibility to move away from disturbances to other suitable areas. There would be no direct effect on breeding migratory songbirds or water birds when construction activities would occur outside the nesting season (April through July 1). For project activities involving vegetation disturbance that would occur during the nesting season, surveys for nesting birds would be conducted, as deemed necessary after consultation, before vegetation-disturbing activities could begin, to prevent "take" of birds protected by the Migratory Birds Treaty Act of 1918, to the extent practicable. Nesting raptors were not identified on the site and are not anticipated. No mature trees are present in the construction area, therefore no take of Bald or Golden Eagles is possible.

Under Alternative 2, the 529.5-acres of mixed upland and wetland habitat would offer contiguous open space, nesting habitat for upland nesting waterfowl species and increase year-round habitat available to other local wildlife populations. Given the current land use dominated by agriculture and the high crop production potential in this region of the PPR, opportunities to establish contiguous blocks of habitat at this scale are limited. Alternative 2 would significantly benefit potential migratory bird populations and would offer an opportunity for bridging people and environment by conducting flood damage reduction projects in a way that can operate in harmony with nature and provide significant human benefit simultaneously.

5.4.14 Invasive Species

Invasive species are those species (plant, animal, aquatic, or land-ridden) that are not native to an ecosystem and whose presence in some way causes harm or disruption to the natural state of flux within that environment, economy, or to human health. Invasive species that have been identified on site, in the location of Alternative 2 include Canada Thistle (*Cirsium arvense*) and Kochia (*Kochia scoparia*). These plants were field verified during the *Aquatic Resource Delineation* and *Biological Inventory Report* conducted for the project in August 2019 (reports located in **Appendix D**). Canada Thistle is a North Dakota State-listed noxious weed, and kochia is a noxious weed listed in Pembina County. Refer to Section 3.5.17 for additional details on invasive species listed within the planning area.

5.4.14.1 Alternative 1 – No-Action

Alternative 1 - No-Action would result in no effect on the status and management of invasive species in the planning area.

5.4.14.2 Alternative 2 – Cart Creek Site 1

Canada Thistle was identified in the wetland habitat, prairie habitat, and wooded habitat within the Alternative 2 footprint. Kochia was identified within the wetland habitat area in the Alternative 2 footprint. Construction of Alternative 2 would require precautions of transporting invasive species on-site and also transport off-site via the heavy construction machinery. Cleaning the machinery would be necessary in order to reduce the threat of spread of these invasive species. Also, the 497-acres of established perennial vegetation within the proposed pool area would be seeded to native prairie species. During on-site vegetation establishment, it will be noted that these species were on-site, and this Alternative will attempt to remove these species from the site by weed control prior to, during and post-construction. With the use of precautionary measures, no affect is anticipated with these invasive species.

In accordance with North Dakota Century Code 4.1-47-030, it is illegal to willfully transport any material, or equipment in a manner that allows for the dissemination of noxious weeds. Furthermore, materials containing noxious weed seeds or propagating parts may not be disposed of. To reduce the spread of aquatic nuisance species, North Dakota Administrative Code 30-03-06-01 states that upon entering or leaving any water body, construction equipment must be free of prohibited or regulated aquatic nuisance species, as defined in the state's aquatic nuisance species list. All construction related equipment traveling into the state or for which the vessel's last exit was from a class 1 infested water body must be certified free of aquatic nuisance species by the North Dakota Game & Fish Department before entering into any water of the state. Inspection criteria include but are not limited to: Last known location, and water body equipment was at, the last known time the equipment was in the water, date of last cleaning, cleaning procedures

5.5 Human

5.5.15 Land Use

The area of review is directly within the Alternative 2 footprint (at Cart Creek, east of Mountain, ND) and downstream, adjacent lands along Cart Creek to the outlet of the North Branch Park River watershed. According to the USGS NLCD (2019) dataset, land use within this area is predominately agricultural (cultivated crops and pasture/hay) with lesser forested, wetlands, developed, and open space (see **Figure C-12**).

5.5.15.1 Alternative 1 – No-Action

No land use changes are anticipated under Alternative 1 - No-Action. There would be continued flood damage to lands adjacent to Cart Creek and North Branch Park River due to no action to address the Purpose and Need. Continued flood damages would reduce agricultural yields and profits while increasing the cost of emergency and non-emergency infrastructure repair.

5.5.15.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would result in direct, permanent long-term impacts on land use within the project's footprint. Minor changes may occur downstream to benefitted lands and communities due to reduced flooding. Decreased flooding supports existing land uses and makes these agricultural land uses and communities (including Crystal, ND) within the eastern portion of the planning area more resilient. Alternative 2 reduces the total inundated acres for the 2-year through the 100-year events by 5% to 9% and cropland inundated acres are reduced by 5% to 10%. Typical crops within the area include wheat, soybeans, corn, dry beans, potatoes, and sugar beets. See **Table 5-10**, showing the total inundated acres and cropland inundated acres for the analyzed events based on duration.

Land use directly within the Alternative 2 footprint was field verified during the project wetland delineation and is agricultural (wheat, beans) and temporary NRCS easements (see **Figure C-12** and **Figure C-13** for NLCD and NASS data maps). Permanent vegetation exists within the north-central portion of the proposed pond area. Alternative 2 would change the land use within its footprint to perennial vegetation. These land use changes would be permanent. Adverse land use impacts from Alternative 2 would be minor while significant beneficial land use changes would result. Basinwide, this site is well suited for the purpose of the project because optimal production is limited by salinity, sodium and wetness. The project area itself will still provide some agricultural value through grazing and biomass harvest for uses such as livestock feed or bedding.

Table 5-10: Alternative 2, Percent Reduction in Inundated Cropland

Duration	2-year		5-year		10-year	
(hours)	Cropland	Total	Cropland	Total	Cropland	Total
0-24	-13.50%	-17.60%	-14.00%	-17.20%	-14.70%	-16.00%

24-48	-11.40%	-10.00%	-11.70%	-10.00%	-7.70%	-5.80%
48-72	-12.10%	-11.60%	-14.40%	-13.80%	-17.70%	-15.80%
72-96	-8.90%	-7.70%	-10.70%	-9.60%	-14.00%	-13.40%
96-120	-9.70%	-12.30%	-14.50%	-14.90%	-10.40%	-11.40%
>120	12.00%	14.00%	16.90%	18.10%	9.10%	10.80%
TOTAL	-4.90%	-4.70%	-6.10%	-5.70%	-8.30%	-7.20%

Duration (hours)	25-year		50-year		100-year	
	Cropland	Total	Cropland	Total	Cropland	Total
0-24	-27.10%	-26.60%	-17.90%	-18.80%	-17.50%	-18.60%
24-48	-10.80%	-10.60%	-16.80%	-16.40%	-7.90%	-8.50%
48-72	-6.10%	-5.60%	-13.70%	-11.60%	-12.00%	-10.40%
72-96	-10.20%	-9.00%	-3.60%	-3.30%	-9.60%	-7.60%
96-120	-15.00%	-13.80%	-6.30%	-5.20%	-4.50%	-3.00%
>120	14.20%	14.70%	4.40%	6.70%	2.70%	5.20%
TOTAL	-10.00%	-8.60%	-10.10%	-8.80%	-8.60%	-7.70%

5.5.16 Environmental Justice and Civil Rights

Potential effects on environmental justice and civil rights were reviewed in the context as discussed in Section 3.6.19.

5.5.16.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action there would be no reduction in flood impacts to rural and agricultural communities, and the project purpose and need would not be met. Flooding events would continue to result in issues within the planning area, and communities would need to continue to find ways to manage life in those situations.

5.5.16.2 Alternative 2 – Cart Creek Site 1

Alternative 2 would provide flood relief to the communities east of Mountain, ND, and downstream past the outlet of the North Branch Park River watershed. Executive Order (EO) 12898, *Federal Actions to Address Environmental* Justice in Minority Populations and Low-Income Populations, requires all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs and policies on minority and low-income populations and communities. The planning area includes two census block groups where the population of People of Color is greater than the reference community (Pembina County). One of the block groups includes the City of Hoople. Alternative 2 provides some flood benefits to the City of Crystal where children from this block group (Hoople and surrounding areas) attend school. Alternative 2 will therefore have a positive effect on environmental justice for the population in this area when compared with Alternative 1.

5.5.17 Cultural Resources and Historic Properties

Tribal consultation details are discussed in section 6.3. Tribal governments were formally consulted during scoping and on the Class III Survey. Tribes did not communicate any concerns or provide any specific cultural resource data to include in the Class III Survey. McFarlane Consulting conducted a Class I study of cultural resources throughout the study area. Two previously recorded sites are located within one mile (1.6 km) of the Alternative 2-Cart Creek Site 1 area of potential effect (APE). Nether site is eligible for listing on the National Register of Historic Places (NRHP). A Class III intensive cultural resource inventory was conducted by the National Resource Conservation Service, North Dakota State Office for this project. Additional investigation and survey were requested by ND SHPO in 2023. ND SHPO concurred with finding of "No Adverse Effect" of the final Class III Survey; no comments were received from the Tribal Governments on the (see **Appendix A**).

5.5.17.1 Alternative 1 – No-Action

There would be no protection or reduction in flood impacts to the existing historic and cultural resources under Alternative 1.

5.5.17.2 Alternative 2 – Cart Creek Site 1

A Class III cultural resource investigation was completed by the NRCS and is provided as **Appendix D-10**. The survey resulted in no discovery of cultural resources or properties eligible for the National Register of Historic Places within the APE of Alternative 2. The construction of Alternative 2 does not have the potential to directly, indirectly or visually impact the two sites identified in the Class I Literature search. An old farmstead site within the APE lacked integrity due to profound ground disturbance which precluded any meaningful interpretation of the site or artifacts. It was determined further investigation would be non-productive. However, as with any ground disturbing activity, there is potential for unknown cultural resources to be present.

Ground-disturbing activities associated with the proposed project include excavation, grading, or other disturbance that could damage or destroy undiscovered subsurface features comprising archaeological resources. The project agreement and the construction contract will specify that if there are any inadvertent or unanticipated discoveries of cultural resources during construction or operation, work shall immediately be stopped, the affected site secured, and the state archaeologist notified. In addition, the construction contract will prohibit project workers from collecting artifacts or intentionally disturbing cultural resources in any area under any circumstances. All borrow material is anticipated to come from onsite, however should the project require additional borrow material from an offsite or unevaluated location, the location will be evaluated by the NRCS Archeologist and Tribes, and the State Historic Preservation Office consulted to its utilization outlined in 36 CFR800.13B.

5.5.18 Social Issues and Public Health and Safety

The planning area is rural with low density development with employment predominantly services-related (e.g., transportation & public utilities; wholesale trade; finance, insurance, and real estate). Residents in the planning region also hold non-services related employment including farming; agricultural services, forestry, fishing, manufacturing; and construction. Refer to Section 3.6.21

for socioeconomic statistics within the planning area. There is one "critical action" facility in planning region 500-year flood plain to be considered, which is Valley-Edinburg Public Elementary School, in Crystal, ND. The 500-year flood hydraulic model indicated potential effects including maximum depth of 1.45 feet, and maximum velocity of 0.74 feet/second.

The reoccurring flooding within the project area results in various social issues that impose pressures on the communities and rural residents within this area. Risk for flood damages exist for residents living within flood prone areas along Cart Creek, North Branch Park River, and its tributaries. This flood risk has potential to result in loss or damage to personal property, and, in extreme events, potentially loss of life. Residents in flood prone areas also experience many indirect impacts from disruptions to transportation and infrastructure. Flooding results in potential for inundation of buildings along with public and private infrastructure, transportation disruptions, and commerce disruptions. Flooding also puts a strain on the emotional and psychological health of individual communities as they deal with loss and recovery. Extreme flood events and reduction for those events was considered for the elementary school in Crystal, ND. Currently, approximately $1,726,700 in average annual floodwater damages occur within the North Branch Watershed (2019 Price Base). Refer to Section 7.9 and **Appendix D-4** for additional information on the economic review of the study area.

5.5.18.1 Alternative 1 – No-Action

Under Alternative 1 - No-Action, there would be no changes to the existing social, public health and safety issues related to flooding within the planning region. The purpose and need of this project, to reduce flood inundated cropland and increase flood resiliency within the planning area, would not be met.

5.5.18.2 Alternative 2 – Cart Creek Site 1

Alternative 2 is located in an area with low population density and includes lands currently (temporarily) set aside for conservation purposes. Developing this land as temporary flood storage with permanent, perennial vegetation offers communities downstream benefit by relieving flood flows and building flood resiliency to lands adjacent to Cart Creek and North Branch Park River. Consequentially, by addressing flooding, Alternative 2 would also provide reduced stress on the drainages (Cart Creek and North Branch Park River) and the vitality of those adjacent lands. Water quality benefits would result from reduced overland flows and erosion caused by flooding in this area. Alternative 2 would have no significant detrimental short-term social and human safety impacts. Alterative 2 would offer long-term social and human safety benefits to communities by providing increased flood resilience and protecting public and privately-owned land and infrastructure throughout the Cart Creek / North Branch drainage areas. Road overtopping would be reduced, which will decrease potential for people driving automobiles from crossing roads with running water, or erosion from overtopping. During the 500-year flood event, peak flow and inundation near the elementary school in Crystal, ND are reduced with Alternative 2 in-place. The modeled depth is reduced to 1.28 feet, and velocity 0.67 feet/second.

Under Alternative 2, average annual floodwater damages are $1,528,200 within the North Branch Watershed. Alternative 2 would also provide reduced insurance requirements for structures with a reduced flood risk. This represents an annual savings of approximately $6,300 annually.

Regarding floodwater damages, Alternative 2 provides $197,800 of average annual benefit based on the reduction of average annual floodwater damages and insurance savings. Benefits associated with water quality and habitat enhancements are substantial, however were not monetized. Alternative 2 also provides an opportunity to address international objectives established for flood damage reduction and water quality on the Red River (Section 1.1). The average annual cost for the implementation of Alternative 2 is estimated at $330,200, with an additional annual investment of $5,000 for operation and maintenance. Refer to Section 8.7 and **Appendix D-4** for additional information on the economic review of the study area.

Alternative 2 would result in a high hazard dam. The hazard classification was determined as part of the engineering design process for Alternative 2. Title 210 of the *National Engineering Manual, Part 520, Subpart C,* "Dams" (NRCS, 2017) describes the hazard potential resulting from failure of dams. Under this guidance, a High Hazard Potential is "Dams where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroad." Downstream impacts from a dam breach include inundation of 52 homes, industrial, or commercial buildings; inundation of 48 other structures including garages, barns, grain bins, etc.; overtopping of two county roads, one state highway, and numerous township roadways. Within the City of Crystal, ND there would be a total of 37 structures inundated, including one school. **Figure C-21** in **Appendix C** shows the dam breach inundation area for Alternative 2.

It should be noted that there is minimal risk of a 'sunny day' failure of this facility due to the temporary nature of the water stored within. Also, an Emergency Action Plan will be developed and implemented by the Sponsor, defining a mechanism for responding to any dam failure threat.

5.6 Cumulative Impacts

The assessment of cumulative environmental impacts in the National Environmental Policy Act (NEPA) documents is required by the Council of Environmental Quality (CEQ) regulation (1987). This section assesses whether either alternative has potential to result in cumulative impacts to relevant environmental resources when considered in combination with past, present, and reasonably foreseeable projects in the vicinity of the study area. Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects and any resulting environmental degradation that is the focus of this cumulative impact analysis.

The statewide trends include increases in planted acres as well as subsurface drainage, and decreased wetland basins. Between 2002 and 2021 the planted acres increased by 14.5% for selected major crops, including barley, canola, corn, soybeans, sunflowers, and wheat (Parman, 2021). "Tile drain systems have increased dramatically since 2001, now accounting for the majority of permits issued" (North Dakota Water Commission, 2015). The increase in planted acres reduces natural areas that provide habitat for native perennial vegetation, fish, and all wildlife in uplands, riparian areas, and wetlands. The dramatic increase in subsurface drain tile systems lowers water tables in uplands and riparian areas that can limit soils from retaining hydric conditions and wetland status. The loss of wetland basins is validated with estimate of "50,000 basins were lost" between 1997 and 2009 (North Dakota Parks and Recreation Department). Therefore, Alternative 1 (No Action) does nothing to address the cumulative impacts of habitat loss, including wetland losses, due to increases in planted acres and subsurface drainage.

No past, present, or reasonably foreseeable project within the Park River watershed that would result in cumulative impacts were identified for this project. While the project is consistent with regional objectives related to flood damage reduction and water quality improvements, these objectives are assigned to assist a local sponsor in ensuring consideration to reasonable measures to attain such objectives are considered. Alternative 2 provides an opportunity for implementation of reasonable measures consistent with regional objectives are taken in a multipurpose project to achieve locally desired conditions.

5.7 Compliance with Federal, State, and Local Laws

The local, state and federal permits possibly required to implement the preferred alternative are summarized in **Table 5-11**. Additional cultural and historic properties reviews and endangered species consultation will be required before project installation.

Table 5-11: Compliance and Permitting Requirements

Agency	Program	Permit to be applied for
Federal		
U.S. Army Corps of Engineers	Clean Water Act, Section 404	404 Permit
State		
North Dakota Department of Environmental Quality	National Pollutant Discharge Elimination System (NPDES)	North Dakota Pollutant Discharge Elimination System (NDPDES), Stormwater Construction General Permit and Stormwater Pollution Prevention Plan (SWPPP)
North Dakota State Water Commission	Construction Permit	Application / Notification to Construct or Modify a Dam, Dike, Ring Dike or Other Water Resource Facility
	Appropriation - Water Permit	Conditional Water Use Permit (to be applied for as needed)
Local		
Pembina County	Floodplain Permit	Floodplain Development Permit

6 Consultation, Coordination, and Public Participation

6.1 Agency Consultation

Both the USACE and USFWS agreed to be Federal Cooperating Agencies for the planning process. They have been active participants with both the project team and interagency team including providing preliminary review of the Watershed Plan/EA document at various stages.

A roster of local, state, and other federal agencies consulting during the planning process is provided in **Appendix A**.

6.2 Project Team Coordination

A Project Team was established to solicit input from agencies, area residents, and local/state/federal entities. The Project Team met several times to assist in scoping the Watershed Plan-EIS. A roster of the Project Team is available in **Appendix A**.

6.3 Tribal Consultation

Thirty tribal nations and the North Dakota State Historic Preservation Office (SHPO) were initially invited by the sponsor to participate in the planning process in January of 2016. The tribes were officially consulted in accordance with 36 CFR 800.3(b)(3) Section 106 on November 5, 2018. There were no tribal concerns voiced during the original scoping period for the Environmental Assessment. (**Appendix A**)

On February 3, 2023, the 30 tribes were emailed an invitation to a public scoping meeting for the newly required Environmental Impact Statement. A formal letter of request for continued consultation was sent to the tribes and SHPO on February 9, 2023 which included hard copies of the updated Literature Review and the draft Class III Cultural Resources survey. There were no tribal comments regarding the survey, however several tribes expressed an interest in being kept current with planning efforts.(see **Appendix A**).

The ND SHPO requested several additions and corrections to the Class III survey. Some additional field work was completed, and a revised survey was sent to SHPO on June 9, 2023. ND SHPO responded on 7/25/2023 and requested some additional edits to the survey. A second revision of the Class III survey was provided to ND SHPO on 8/7/2023. SHPO responded on 9/8/2023 and concurred with our findings of “No Adverse Effect”.

Thirty Tribes were sent copies of the 2nd Revised Class III Cultural Resource Survey on 8/25/2023. No responses were received, therefore NRCS responsibilities regarding Section 106 were considered completed on 9/25/2023. Consultation will resume if there are new discoveries or new information is provided. All 30 Tribes were notified in November 2023, by email, on the availability of the Draft Plan-EIS and opening of the comment period under NEPA. No comments were received from Tribes or ND SHPO.

6.4 Public Participation

Two public meetings were held by the Sponsoring Local Organization (SLO) to solicit input on concerns within the watershed to advance development of the Purpose and Need for the project. The first of these meetings was held on July 1, 2014 in Mountain, ND. The meeting was hosted through a state and local financed planning effort prior to federal participation through NRCS and was attended by approximately 90 individuals. The meeting focused on soliciting input from attendees to identify problems and opportunities to reduce flood risk. Comment forms were provided to allow input on observed locations of flood concerns in the watershed. In total, approximately 40 comment forms were returned to the SLO. Comments received as a result of this meeting generally indicated a high level of concern with damages related to flood flows within the North Branch Park River Watershed. These damages included field erosion, transportation and infrastructure disruptions, community impacts, and impacts to rural residents.

An initial Public Scoping meeting was held by the SLO occurred on February 17, 2016 in Mountain, ND. The meeting was advertised in the Cavalier Chronicle newspaper and invitations were also mailed to some potentially affected landowners, as well as local, state and federal agencies. The meeting focused on solicitation of public input on concerns within the North Branch Park River Watershed. The meeting was attended by approximately 90 residents and resulted in 13 returned comment forms. The highest indicated concerns included; culvert and bridge washouts, field erosion/deposition, channel erosion/deposition, road damages, floodplain management, land use, soil resources, prevented planting, riparian areas, and delayed planting. (**Appendix A**)

The Project Team has met on five occasions on April 27, 2016; May 25, 2016, June 29, 2016, July 27, 2016; and August 31, 2016. The focus of early coordination with the Project Team was to define resources of concern within the watershed, and to preliminarily narrow the range of alternatives to evaluate within planning effort.

The SLO also met publicly on March 26, 2019, August 13, 2019, and November 19, 2019 during monthly public Pembina County Water Resource District meetings to discuss the development of alternatives. These meetings focused on benefits vs costs, technical feasibility, and local acceptance of proposed actions.

A private meeting was held with the Sponsor, NRCS, and potentially affected landowners on February 9, 2023.

In 2022, NRCS deemed it necessary to upgrade the environmental evaluation from an Environmental Assessment to an Environmental Impact Statement due to planned beneficial water quality impacts to the Red River, an international water course, and the fact that the watershed plan will required congressional authorization. A Notice of Intent (NOI) to prepare an EIS was published to the U.S. Federal Register on December 14, 2022 and advertisements for a Public Scoping Meeting were placed in the Cavalier Chronicle February 8th, 15th and 22nd, 2023 for the new scoping meeting. In addition, local landowners, cooperating federal agencies, 30 Tribes, and the planning team were emailed invitations to the new Public Scoping Meeting on February 3, 2023. The in-person/virtual public scoping meeting was held on February 23, 2023 in Cavalier. Several comments were received from landowners and other stakeholders which were utilized in preparation of the Draft-EIS. A follow up landowner meeting was held on June 23, 2023 to listen to and address several of those concerns in more detail. See **Appendix A** Public Participation Timeline for scoping comments and comment disposition.

The Draft Plan – EIS was posted to the NRCS website on November 17, 2023:
https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/north-dakota/north-branch-park-river-watershed

Also on November 17, 2023 the Notice of Availability of Draft Plan-EIS was submitted to the EPA (USDI) for publishing in the Federal Register. The EPA published the notice on December 1, 2023. All stakeholders including the Governor of ND, tribes, cooperating federal agencies, affected landowners and other local, state and federal agencies were sent a Notice of Availability of the Draft Plan – EIS via mail or email and invited to an in-person Public Meeting on December 12, 2023 in Cavalier, ND. Newspaper advertisements were published 3 times at least 15 days prior to the public meeting. The public comment period began on November 20, 2023 and ended on January 26, 2024.

Eight substantive comments were received and related responses were addressed in this Final Plan-EIS. These comments are summarized in Appendix A. Two agencies provided formal comments – the EPA and ND Game and Fish Department. NRCS has uploaded the Final Plan-EIS to our website and submitted the Notice of Availability of the Final Plan-EIS to EPA to post to the Federal Register in July 2024. The notice of the Final Plan-EIS is also being advertised in the Cavalier Chronicle and Walsh County Record newspapers and emailed/mailed to all stakeholders including tribes, cooperating federal agencies, affected landowners and other local, state and federal agencies.

In the future, at least 30 days after publishing the Federal Register Notice of Availability of the Final Plan-EIS, NRCS will prepare a Record of Decision. After that is complete, it will be submitted for posting to the federal register, placed on the NRCS website, and advertised in the Cavalier Chronicle and Walsh County Record newspapers and emailed/mailed to all stakeholders including tribes, cooperating federal agencies, affected landowners and other local, state and federal agencies.

7 The Preferred Alternative

7.1 Rationale for Selection of the Preferred Alternative

According to P&G (Chapter 1, Section 2), Federal investments in water resources should strive to maximize public benefits, with appropriate consideration of costs. Public benefits encompass environmental, economic, and social goals, include monetary and non-monetary effects and allow for the consideration of both quantified and unquantified measures.

The Preferred Alternative will be the alternative that meets the purpose and need for the project in an environmentally acceptable manner while maximizing net monetized watershed protection benefits, unless there are compelling reasons (trade-offs) based on other non-monetized benefits to other P&G accounts. For projects primarily providing non-monetary benefits, such as ecosystem restoration, the Preferred Alternative shall be the alternative that achieves the purpose and need at the least cost (NWPM, Section 501.42).

The Alternative 1 - No-Action would be identified as the NED Alternative, on the basis of monetized benefits alone however, it was not selected as the Preferred Alternative because it does not adequately address the purpose and need associated with nutrient reduction and related treaty obligations of the U.S. government, regional water resource plans, and wildlife habitat needs. In July of 2020, the North Dakota NRCS State Conservationist requested an NED exception waiver from the NRCS Chief on the basis of documented benefits to the Environmental Quality Account (nutrient reduction and wildlife habitat) and the Other Social Effects Account (treaty obligations of the U.S. and contributions to a regional water resource plan). An exception was granted for Alternative 2 – Cart Creek Site 1 by the NRCS Chief on November 20th, 2020 (see **Appendix A**).

The Preferred Alternative, Cart Creek Site 1, was selected based on its ability to provide flood damage reduction as well as substantial non-monetized watershed protection benefits to the study area. While the costs exceed monetized benefits achieved as a result of flood damage reduction, benefits to the Environmental Quality and Other Social Effects Accounts are substantial.

7.1.1 Flood Damage Reduction

The Preferred Alternative reduces peak flows downstream of the alternative location by temporarily storing surface runoff within the impoundment location. The project site is ideally located to reduce flood damages both to the community of Crystal, ND, which has a substantial flood risk under the existing condition and the anticipated *No-Action* condition, and area crop land.

7.1.2 Habitat and Water Quality Enhancements

The Preferred Alternative would create a 529.5-acre contiguous block of wildlife habitat. An important objective of the Red River Basin RCPP projects is to *conserve, manage, and restore diversity and viability of native fish and wildlife populations and their habitats.* The Red River Valley is one of the largest artificially drained landscapes in the world with miles of principal drain ditches, small laterals, and subsurface tile. As a result, the Prairie Pothole Region (PPR) in the northcentral Great Plains is one of the most threatened waterfowl habitats in the U.S. due to habitat fragmentation and degradation. The remaining wetlands and grasslands of the PPR are some of the most productive areas in the world for breeding waterfowl and are important habitat for migratory grassland and shore birds as well. Between 50% and 80% of North American ducks breed in the PPR, and waterfowl production is closely associated with the number and quality of wetlands and surrounding grasslands.

Water quality downstream of the Preferred Alternative is expected to improve due to the installation of the flood pool and restoration of habitat. Floodwater that is temporally retarded on perennial vegetation is expected to reduce downstream nutrient loading of total phosphorus, total nitrogen, and total suspended solids by 66%, 72%, and 42%, respectively, immediately downstream of the Preferred Alternative in the Cart Creek (See **Appendix D-7).**

Opportunities to incorporate habitat and water quality enhancements into flood damage reduction projects within the Red River Basin are rare. High crop production potential, and associated high land values, often limits the ability for local practitioners to implement such project directly. The Preferred Alternative provides a unique opportunity to accomplish local flood damage reduction goals, establish a large contiguous block of habitat, and improve water quality conditions downstream.

7.1.3 Consistency with International Treaties and Regional Water Management Plans

The Preferred Alternative provides an opportunity to further water quality and water quantity objectives defined for the Red River Basin. The Red River Basin is an international, multijurisdictional watershed with complex issues related to water management. This has resulted in international and regional water management planning efforts to better synchronize solutions within the Red River Basin. While the Preferred Alternative may not fully solve those international and regional water management plan objectives as an individual project, it will work in concert with other similar projects being planned throughout the Red River Basin to address flood damage reduction and nutrient reduction objectives.

7.1.3.1 International Treaty Obligations – Red River Nutrient Loads

The Red River and its tributaries provide domestic water supply for communities throughout the region, as well as supporting a variety of aquatic life. The Red River outlets into Canada's Lake Winnipeg, the world's 10th largest freshwater lake. Lake Winnipeg supports commercial fishing industries, recreation, over 30 communities, and numerous native populations that rely on the lake for economic, cultural, and spiritual activities. The Red River of the North discharges into Lake Winnipeg in Manitoba, CA where excess nutrient loading is a contributor to ongoing eutrophication of Lake Winnipeg. Increases in runoff, nutrient loads, and warming temperatures since the 1990s have resulted in degraded water quality and extensive algal blooms, with subsequent negative consequences to fisheries, recreation, and lake ecology. While the Red River contributes only 10-15% of runoff to the lake by volume, monitoring records indicate that is contributes an estimated 60% of the total phosphorus to Lake Winnipeg (McCullough, 2012).

The Boundary Waters Treaty (BWT) was signed in 1909 to adjudicate conflicting interests on rivers and lakes along the international border between the U.S. and Canada. Article IV of the BWT states that "boundary waters or waters flowing across the boundary shall not be polluted to the injury of health and property of the other". The International Joint Commission was established as an independent and objective advisor to the two governments to prevent and resolve disputes therefore their sub-entities in the Red River, the International Red River Board and Red River Joint Commission have been engaged in scientific studies, stakeholder group meetings, and negotiations for over a decade on Red River nutrient impacts on Lake Winnipeg. The result was adoption of total phosphorus and total nitrogen load and concentration objectives at the U.S. Canadian border in 2020.

Based on the data sources outlined in **Appendix D-7**, Phosphorus, Nitrogen, and Sediment would be reduced by 66%, 72%, and 42%, respectively, immediately downstream of the outlet for Alternative 2 at 86th Street NE. Cursory modeling of in-channel biogeochemical reactions indicated that at the North Branch Watershed outlet, the reductions would be 10%, 8%, and 20% for phosphorus, nitrogen, and sediments, respectively from the biomass harvest site alone. Actual nutrient load reductions from the project will in reality be much higher due to reduced extent and frequency of cropland flooding below the dam, as outlined in **Table 5-1**.

7.1.3.2 Regional Plans - Water Quantity

The Red River Basin RCPP effort was also initiated to provide contributions to the Red River Basin Commission's (RRBC) Long Term Flood Solutions (LTFS). One component of the LTFS is the Basin-Wide Flow Reduction Strategy (BFRS) which provides for peak flow and volume reduction goals within each tributary sub-watershed in the Red River Basin. Reduction goals are based on coincident peak flood timing between the tributary and the Red River. The overall goal of the BRFS is to provide for enough tributary volume reduction to reduce Red River mainstem peak flow rates by 20% on an event of similar magnitude as the 1997 flood event. The LTFS Report estimates that approximately 1.5 million acre-feet of volume reduction is still required to attain the BRFS (Red River Basin Commission, 2011). The Park River Watershed has a goal of 51,800 acre-feet of additional flood storage to attain the BRFS, as specified in the LTFS document. The Preferred Alternative provides flood storage towards the Park River Watershed tributary goal to attain the BRFS.

7.2 Measures to be Installed

The Preferred Alternative includes installation of a multipurpose water storage project. Runoff would be temporarily stored within the normal pool to attenuate peak flow rates and reduce downstream flood damages. Runoff would be diverted into the flood pool from Cart Creek and Pembina County Drain 28. The flood pool does not hold any permanent storage and would fully drain to a dry condition after flooding would recede. Within the flood pool 135 acres of shallow retention cells will be constructed and operated for nutrient removal from the upstream watershed. In addition, the project will restore 284 acres (net) of wetlands, enhance 16 acres of existing wetlands, and enhance 52 acres of upland wildlife habitat. Grazing infrastructure may be installed for wildlife habitat management. The contents of Section 7.2 provide an overview of measured required to implement the Preferred Alternative. Also refer to **Figure B-1** in **Appendix B** for a site map showing each component of the Preferred Alternative. More detailed design information is also available in **Appendix D-3**.

7.2.4 Site Location

The screening of strategies and alternatives described in detail in preceding sections of this report led to the identification of an off-stream, multipurpose storage facility, known as Cart Creek Site 1, as the preferred alternative. This storage facility would be created by the construction of earthen levees to contain flow within Section 24 of Thingvalla Township. The site is located approximately 2.5 miles east and 1 mile south of Mountain, ND and approximately 8 miles northwest of Crystal, ND.

The proposed site is located just upstream of the confluence of Cart Creek and Pembina County Drain 28 and would be designed to capture and detain flow from both sources, thus providing some control of the runoff from 33.8 square miles or 13% of the 257 square mile Cart Creek watershed (see **Figure C-22**).

There are three locations where floodwaters enter the site; direct drainage to the site from the west, the north inlet, and the south inlet. The site consists of an embankment on the north, east, and south sides. This allows the direct drainage from the west to flow freely into the site.

7.2.5 Dam Safety Requirements

7.2.5.1 Breach Analysis

A breach of the dam proposed as part of the Preferred Alternative was evaluated to estimate the hazard classification of the multipurpose flood pool. The breach analysis was completed using peak discharge criteria discussed in *Technical Release 210-60: Earth Dams and Reservoirs* (USDA 2019) . The flood pool of the Preferred Alternative was assumed to be at the top of dam elevation of 983.2 feet. The breach analysis indicated that approximately 4,400 acre-feet was discharged with a peak flow rate of approximately 14,000 cubic feet per second under the breach scenario. The breach hydrograph was routed downstream to assess risk and assign hazard classification.

Downstream impacts from the dam breach include inundation of rural farmsteads; inundation of rural structures; overtopping of township roads, county roads, and state highways; inundation of homes in the City of Crystal, ND; and inundation of industrial and commercial buildings including a school in the City of Crystal, ND. In total, 105 structures would be impacted by a dam breach and over half of those structures are homes, industrial buildings, or commercial buildings. A map of the breach inundation zone is provided in **Figure C-21** within **Appendix C**.

Title 210, National Engineering Manual, Part 520 Subpart C "Dams" (USDA 2017) describes the hazard potential resulting from failure of dams. According to this guidance, a High Hazard Potential is "Dams where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroad." Based on the breach results, the embankment at Cart Creek Site 1 would be classified as a High Hazard Dam.

7.2.5.2 Spillway Capacity Requirements

Technical Release 210-60: Earth Dams and Reservoirs (USDA 2019), provides guidance on the minimum spillway precipitation criteria for a high hazard dam classification. **Table 7-1** presents the minimum precipitation data and precipitation depth for the design of principal and auxiliary spillways for a high hazard dam.

Table 7-1: Minimum Precipitation Capacity for High Hazard D Dams

Design Event Hydrograph	Precipitation Data[1]	Depth (inches)
Principal Spillway Hydrograph	P_{100}	4.75 [2] 7.56 [3]
Auxiliary Spillway Hydrograph	$P_{100} + 0.26 * (PMP - P_{100})$	8.6 [4]
Freeboard Hydrograph	PMP	26.4

[1] P_{100} = Precipitation for the 100-year return period; PMP = Probable Maximum Precipitation
[2] Runoff depth based on *NEH Part 630 Chapter 21*. See **Appendix D-3** for additional information
[3] Rainfall depth based on *NOAA Atlas 14*. See **Appendix D-3** for additional information
[4] Rainfall depth based on a 6-hour duration event. See **Appendix D-3** for additional information

7.2.6 Project Components

7.2.6.1 Inlets

The north inlet would be located along the south bank of Cart Creek downstream of the crossing with 131st Avenue NE. A crossing with a 73” x 45” arch pipe (60” equivalent circular pipe) will be constructed on Cart Creek to attenuate flows along Cart Creek and allow flows to be diverted into the site. The inlet consists of a low flow 73” x 45” arch pipe (60” equivalent circular pipe) and a 450-foot sheet pile weir. The weir will be constructed to an elevation that will divert flows above the 1.5-year event. Once flows exceed the 1.5-year event, floodwater will enter the site via the 450-foot inlet weir or continue downstream in Cart Creek via the 73” x 45” arch pipe channel crossing. An overflow structure will be constructed along the south side of the Cart Creek channel crossing. The overflow structure will allow flows above the 100-year event to bypass the inlet and continue downstream along Cart Creek.

Floodwaters overtopping the inlet weir will be conveyed to the site through a constructed channel. The inlet channel consists of a 200-foot bottom width, 4:1 side slopes, and a -0.03% channel gradient. The channel will be constructed to a depth so that the 100-year water surface elevation within the channel is below the adjacent field elevation. A levee will be constructed on the east side of the inlet channel to the water surface elevation resulting from the stability design hydrograph. The channel will contain flows for all events through the stability design hydrograph event. The north inlet channel will enter the site in the northwest corner of Section 24 where it crosses 87th Street NE through 6-lines of 12’ x 4’ reinforced concrete box culverts. The channel will continue south from these box culverts for approximately 890 feet. Flows will enter the impoundment location via a 600’ spillway. The spillway is intended to induce sheet flow across the impoundment location to the principal spillway. The negative slope on the inlet channel would allow receding flows to drain back to Cart Creek as the flood hydrograph recedes. The hydraulic design capacity of the north inlet channel includes flows diverted from Cart Creek as well as overland flows intercepted by the channel.

The south inlet would be located along Pembina County Drain 28 upstream of the crossing with 131st Avenue NE. The existing structure at 131st Avenue NE will be replaced and reduced to two lines of 44” x 27” arch pipes (36” equivalent circular pipe). This will meter flows along the drain and allow flows to be diverted into the site. Flows will be diverted into the impoundment location via a constructed channel. The inlet channel consists of a 50-foot bottom width, 4:1 side slopes, and a -0.03% channel gradient. The inlet will cross 131st Avenue NE through 3-lines of 10’ x 4’ reinforced concrete box culverts. The channel will then flow north for approximately 220’ on the east side of 131st Avenue NE.

Localized drainage west of 131st Avenue NE would enter the site via four lines of 36” diameter corrugated metal pipe. These pipes would be placed at four locations, spaced approximately 800’ to 1,500’ separated from one another. The frequency and spacing of inlet pipes through 131st Avenue NE will minimize the occurrence of shallow concentrated flow into the site to maintain sheet flow across the restored wetlands in the flood pool.

7.2.6.2 Dam Embankment

The embankment would be configured with a 10-foot top width at an elevation of 983.2 feet with 4:1 side slopes on both the wet and dry side of the embankment. The embankment consists of a maximum height of 17.3 feet and an average height of 9.7 feet. Based on the geotechnical evaluation, a clay core with 1.5:1 side slopes on both the wet and dry sides of the dam will be constructed in the center of the embankment, and random fill will be placed between the core and the 4:1 side slopes. More information on the geotechnical evaluation is available in **Appendix D-9**. The embankment will tie-in to natural ground on the west side of the project site. The embankment is routed to avoid impacts to the WRP easement within the impoundment area. The embankment will be constructed from in-site excavated materials from other project components.

An inspection trench would be excavated below the embankment and filled with impervious clay material consistent with the embankment clay core. The inspection trench would have a 5-foot bottom width, 1:1 side slopes, and a maximum depth of 6 feet.

7.2.6.3 Principal Spillway

The principal spillway would consist of a riser tower with a primary low flow inlet pipe, a secondary inlet weir, and an outlet conduit. The low flow inlet would be a 36-inch reinforced concrete pipe set at the upstream channel elevation of 967.4 feet. This configuration would allow the site to be drawn down to the historic channel elevation. The secondary inlet would be the weir crest of the riser tower. The riser tower would be a 10’ x 24’ concrete riser. At the crest elevation, the riser would be open on two sides allowing for 48 feet of weir flow length. The crest of the riser tower would be at an elevation of 975.7 feet. The weir crest would begin to operate between a 10-year and 25-year event. During the 10-year event, only the primary low flow pipe is operating. The outlet conduit is a 10’ x 9’ reinforced concrete box culvert and outlets into Cart Creek. The principal spillway is sized to provide adequate hydraulic capacity to pass the required Principal Spillway Hydrograph design event listed in **Table 7-1**.

7.2.6.4 Auxiliary Spillway

The auxiliary spillway consists of an earthen ramp spillway in the southwest corner of Section 24 with a crest elevation of 979.8 feet and will be excavated into natural ground. The spillway provides a total of 800 feet weir flow. The auxiliary spillway is divided into four bays to prevent velocity variations within the spillway cross section. The spillway outlets into Pembina County Drain 28 along the south embankment of the site. Drain 28 will be modified to consist of a 50-foot bottom width, 4:1 side slope and a 0.1% channel gradient. During the passage of the freeboard hydrograph the water surface in the outlet channel will not encroach upon the toe of the embankment. The auxiliary spillway is sized to provide adequate hydraulic capacity to pass the required Auxiliary Spillway Hydrograph design event listed in **Table 7-1**.

7.2.6.5 Shallow Retention Basins Managed with Biomass Harvest

Within the temporary flood pool, 133.6 acres of shallow retention cells will be constructed via 12,900 feet of five feet (maximum) high embankments. Wetland vegetation will naturally dominate in the bottoms of the cells, given the 1-2 of water that will remain present in them from spring runoff until late August/early September. Vegetation will be harvested prior to the first hard freeze to prevent nutrients from migrating out of the plant biomass and back into the soil. Opening the water control structures will drain surface water via the 0.2 to 0.3% slope on the retention cell bottom. Perforated pattern tile will be installed across the 133.6-acre retention areas to allow for subsurface drainage as well, which will be managed via a pump with surface outlet to dry out the site to allow for timely harvest operations regardless of precipitation events. Vegetation will be cut, baled, and trucked to an offsite non-contributing area of the watershed; likely a feedlot operation. Water quality and soil nutrient monitoring will help to determine the frequency of harvest operations needed to ensure the underlying soil does not become oversaturated with phosphorus, but it is predicted that harvest 2 out of 3 years will be necessary to achieve that. Drought years, where there is limited water in the retention basin, will likely be the non-harvest years. The Sponsor may want to attempt trials with alternative vegetation or crops, rather than naturally establishing wetland vegetation (cattails) that will dominate the basins, which will be acceptable within the framework of the Operation and Maintenance agreement to determine how to most effectively operate the structure for phosphorus removal.

7.2.6.6 Wetland Restoration and Wetland/Upland Habitat Enhancement

Restoration of natural wetland hydrology within the remainder of the flood pool will be accomplished through the design of the inlet structures, installation of culverts, and earthwork required for excavation areas made for borrow material for the dam and retention basin embankments. Detail on planned construction elements is provided in Section 5.2.5. Each inlet structure is designed to act as a spreader to restore shallow sheet flow across the areas outside of the retention cells, where wetland enhancement and wildlife habitat is the primary management goal. The east/west ditch flowing across the flood pool will also be plugged to eliminate lateral effect and minimize the occurrence of shallow channelized flow. The project will also involve plugging an existing perforated subsurface tile system in the northeast corner of the flood pool. All disturbed areas and existing cropland in the flood pool will be seeded to a mixed upland/wetland perennial vegetation mix. The short duration of inundation resulting from this project will not detrimentally impact the perennial vegetation in wetlands or uplands. During a 2-year event, 56% of the inundation occurs for less than 5 days. During a 10-year event 28% of the area is inundated for less than 5 days, and for a 100-year event 38% of the inundation occurs for less than 5 days.

7.3 Avoidance, Minimization, and Mitigation Features

Impacts to existing wetlands were considered during the development of the Preferred Alternative. Structural components of the Preferred Alternative were placed to avoid or minimize potential impacts associated with placement of fill within delineated wetland areas. A total of 5.09 acres of wetlands are impacted by the implementation of structural components of the Preferred Alternative. These impacted acres can further be broken down into 2.13 acres of wetlands are permanently impacted as a result of placing fill within a wetland, and 2.96 acres are permanently impacted as a result of excavation occurring within a wetland extent. The Preferred Alternative would also result in a gain of 71.5 acres of sloped wetlands by plugging the tile line in the northeast corner of the flood pool.

Wetlands within the flood pool will be periodically inundated by the operation of the Preferred Alternative, however this inundation will not result in a loss of wetland function. This is due to the limited frequency of inundation and the relatively short duration of inundation. Overall wetland function of the existing wetlands will increase due to the restoration of native perennial vegetation of wetland and upland areas within the flood pool and restoration of 470.8 acres (net) of sloped wetlands. The Preferred Alternative is considered self-mitigating and will result in an overall gain in wetland function for the area.

7.4 Permits and Compliance Requirements

7.4.7 State Permits

The North Dakota State Engineer regulates the construction of dams, dikes and other devices. The proposed Cart Creek Detention Site 1 will require a construction permit from the State Engineer. The permit review will include compliance with state dam design standards as well as ensuring the required property interests have been obtained for both the construction area as well as the proposed impoundment.

The North Dakota State Engineer also regulates the use of water in North Dakota. While no water will be put to beneficial use in this instance, the requirement for a water use permit for flood control dams with no permanent pool has varied through the years. Prior to construction, the need for a water use permit will be considered.

7.4.8 Federal Permits

The USACE regulates the deposition of fill into Waters of the US under Section 404 of the Clean Water Act. USACE is a cooperating agency on the watershed planning effort and has indicated that they are both in support of the project and that immediately prior to construction an individual permit under Section 404 should be requested.

7.4.9 Other Considerations

The proposed project will potentially involve the placement of fill within a FEMA mapped floodplain. The floodplain is mapped as an approximate A zone, which does not include a regulatory floodway. However, a permit will likely be required from the local floodplain administrator and additional coordination with FEMA may also be required.

7.5 Costs and Cost Sharing

Costs include construction, contingencies, project development, engineering and survey, permitting, utility relocations, right-of-way acquisition, and legal/administrative fees. The overall cost to implement the Preferred Alternative is $12,228,700 to be shared among NRCS and the SLO. The SLO will develop a funding scenario of various non-federal sources. The availability of these sources is dependent on each of their respective budgets. This includes funding from the North Dakota State Water Commission, the Red River Joint Water Resource District, and local assessment.

Water quality improvement and habitat creation components of the Preferred Alternative may also allow the SLO to secure other “non-traditional” funding sources, such as the North Dakota

Outdoor Heritage Fund, wildlife organizations, and other groups with similar objectives to watershed protection outcomes from the Preferred Alternative.

7.6 Financing

Local assessment will likely require a formal process defined in the North Dakota Century Code in order to establish taxing authority by the SLO specific to the Preferred Alternative. The taxing authority would allow for continued generation of funds for operation and maintenance responsibilities after installation is completed.

7.7 Installation Sequence and Responsibilities

The Preferred Alternative will be implemented in Phases, with the initial phase consisting of final design and cost estimate. The second phase will be largely legal/administrative and will develop a non-federal financing package that will consist wholly, or in-part of the sources discussed in Section 7.5. It is anticipated that the embankment would be constructed first to provide a means of detaining water before it is diverted. The third phase will consist of land acquisition for structural measures to be installed and the flood pool. The fourth phase will consist of construction of structural measures and seeding of habitat creation areas.

7.8 Operation, Maintenance, and Replacement Responsibilities

Operation and Maintenance requirements for the Cart Creek Site 1 project will be written into a formal O&M agreement that the Park River Joint Water Resource District would sign with NRCS prior to construction, as the Sponsoring Local Organization. The O&M Agreement will cover, in detail, the following Sponsor responsibilities over the 50-year lifespan of the project:

- Operation and maintenance of the dam embankment, diversion structure, channels, and spillways. Typically includes items such as regular mowing, trash rack cleaning, repair of concrete cracking, earthwork repairs after major floods, ensuring channels are kept clean and at original grade, replacement/maintenance of gates and valves, and ensuring vigorous vegetation growth where planned and woody vegetation removal where not planned. Salinity in cropland adjacent to new channels will follow criteria and considerations in CPS 610.
- Operation and maintenance of the water control structures and drains in the retention basins to be operated for phosphorus removal; gates for both the gravity surface water release will typically be shut from November through August/early September to collect and hold water in the retention cells from spring snowmelt runoff as well as summer precipitation events, allowing growing vegetation to uptake dissolved phosphorus from both the water column and underlying soils. In September the control structure gates would be opened to drain standing water and the subsurface drainage system pump turned on to dewater the ground surface. The O&M Plan will require that in mid to late September vegetation in the cells will need to be cut, baled, and hauled off site to a non-contributing area of the watershed. It is anticipated it may be utilized as bedding or feed in a confined animal feeding operation, with permitted stormwater facilities. Harvest is

expected to be needed 2 out of every 3 years, but monitoring of phosphorus in soils may determine a lower frequency of harvest during drought periods.

Additional details, including establishment of thresholds for success for water/soil quality and wetlands/wildlife habitat, will be determined during the final design phase of the project and incorporated into in an Operation and Maintenance Plan for Cart Creek Site 1. It is anticipated that development of the O&M Plan will would involve researchers and experts from local, state, and federal agencies working on dissolved phosphorus removal in the Red River Basin. Monitoring and adaptive management would take place, as more is learned about efficient operation and management of constructed biomass harvest cells over time at this site and other similar ones. Prior to receiving federal construction funds, the local Sponsor would concur with the conditions and sign the O&M Agreement.

NRCS and the Local Sponsor will be required to complete annual inspections of the project over the 50-year O&M Agreement time period to assess the status of the dam, retention cells, and wildlife habitat. NRCS is required to issue a letter after each inspection, documenting satisfactory O&M or any outstanding items that must be addressed. If the Sponsor were to be negligent in performing their O&M responsibilities the agreement provides a mechanism where the federal government would require repayment of all federal funds received for the project. Both the Pembina County WRD and Walsh County WRD (the entities who make up the Park River WRD) have a long history of successfully implementing O&M Agreements for NRCS PL-566 projects.

7.9 Economic and Structural Tables

Overall costs are presented in **Table 7-2 (Economic Table 1)**. The Preferred Alternative is a multiple purpose structure that provides one flood retarding structure and 540 acres of watershed protection. Watershed protection provides water quality and habitat enhancements.

Table 7-2: Economic Table 1 - Estimated Installation Costs[1]

Works of Improvement	Unit	Number	Public Law 83-566	Other Funds	Total
Flood Retarding Structure	No.	1	$ 8,412,600	$ 704,100	$ 9,116,700
Watershed Protection			$ 1,248,400	$ 1,863,600	$ 3,112,000
Total Project			**$ 9,661,000**	**$ 2,567,700**	**$ 12,228,700**

[1] Price Base 2019; 2018 normalized prices for cropland.

Table 7-3 (Economic Table 2) provides costs broken down by category. Construction costs were estimated through conceptual engineering design of the Preferred Alternative. Engineering services include both design and construction administration and were estimated based on an assumed 25 percent of the construction costs. Real property rights were estimated by reviewing recent land sales local to the area and applying the appropriate per acre rate for land acquisition. Project administration costs are primarily associated with formation of local financing sources and legal fees associated with acquiring land rights. All costs presented are for planning purposes and may vary in future phases.

Table 7-3: Economic Table 2 – Estimated Cost Distribution, Water Resource Project Measures (Dollars)[1]

Works of Improvement		Installation Cost Distribution		
		Federal Funds[2,3,4]	Other Funds	Total
Flood Retarding Structure	Construction	$ 6,725,000	$ -	$ 6,725,000
	Engineering Services	$ 1,682,000	$ -	$ 1,682,000
	Real Property Rights	$ -	$ 429,500	$ 429,500
	Project Administration	$ -	$ 269,000	$ 269,000
	Subtotals	$ 8,412,600	$ 704,100	$ 9,116,700
Watershed Protection	Construction	$ 1,098,000	$ 366,000	$ 1,464,000
	Engineering Services	$ 148,000	$ -	$ 148,000
	Conservation Easement[5]	$ 2,400	$ 2,400	$ 4,800
	Real Property Rights	$ -	$ 1,495,200	$ 1,495,200
	Project Administration	$ -	$ -	$ -
	Subtotals	$ 1,248,400	$ 1,863,600	$ 3,112,000
Total	Construction	$ 7,823,000	$ 366,000	$ 8,189,000
	Engineering Services	$ 1,830,000	$ -	$ 1,830,000
	Conservation Easement[5]	$ 8,000	$ 8,000	$ 16,000
	Real Property Rights	$ -	$ 1,924,700	$ 1,924,700
	Project Administration	$ -	$ 269,000	$ 269,000
	Total	$ 9,661,000	$ 2,567,700	$12,228,700

[1] Price Base 2019.

[2] Federal cost share for FRS-related construction costs is 100%. Federal engineering services costs, as well as real property acquisition and permit costs, are not included when calculating eligible federal cost share. Therefore, federal cost share for FRS-related construction is based on total eligible project cost of $6,207,000.

[3] Federal cost share for watershed protection-related construction costs is 75%. Federal engineering services costs, as well as sponsor project administration, real property acquisition and permit costs, are not included when calculating eligible federal cost share. Therefore, federal cost share for watershed protection-related construction is based on total eligible project cost of $378,000.

[4] Federal cost share for watershed protection-related real property acquisition is 50%.

[5] Land rights required for wetland mitigation for embankment, diversion channels, and spillways under the flood prevention purpose and for the biomass harvest area under the watershed protection purpose.

Structural information for Cart Creek Site 1 is provided in **Table 7-4 (Structural Table 3)**. **Table 7-5** and **Table 7-6 (Structural Table 3b)** show structural information on the two inlet channels that carry flows to Cart Creek Site 1.

Table 7-4: Structural Table 3 – Structural Data for Cart Creek Site 1 (North Branch Park River Watershed, ND) (a more detailed analysis can be found in Appendix D-3)

Item	Unit	Cart Creek Site 1
General Statistics		
Type of Structure	--	Off-Channel, Dry Dam
Seismic Zone	--	Zone 1
Class of Structure	--	High

Item	Unit	Cart Creek Site 1
Unregulated Drainage Area	Sq. Mi.	33.7
Regulated Drainage Area	Sq. Mi.	0
Total Drainage Area	Sq. Mi.	33.7
Runoff Curve Number (24-Hour, AMC II)	--	74
Time of Concentration (Tc)	hours	14.2
Top of Dam Elevation	NAVD 1988	983.2
Auxiliary Spillway Crest Elevation	NAVD 1988	979.8
High Stage Inlet Elevation (Crest of Riser Tower)	NAVD 1988	975.7
Low Stage Inlet Elevation (Pipe Inlet)	NAVD 1988	967.4
Auxiliary Spillway Type	--	Earthen
Auxiliary Spillway Bottom Width	Feet	800
Auxiliary Spillway Exit Slope	Foot/Foot	0.04
Maximum Height of Dam	Feet	17.3
Fill Volume	Cubic Yards	403,660
Total Capacity[1]	Acre-Feet	2,593
Sediment Submerged	Acre-Feet	0.5
Sediment Aerated	Acre-Feet	270
Beneficial Use (Watershed Protection)	Acre-Feet	195
Floodwater Retarding	Acre-Feet	2,593
Between High and Low Stage	Acre-Feet	1,054
Surface Area		
Sediment Pool	Acres	1
Beneficial Use Pool (Watershed Protection)	Acres	1
Floodwater Retarding Pool	Acres	466
Principal Spillway Design		
Rainfall Volume (1-day)	Inches	5.17
Rainfall Volume (10-day)	Inches	7.24
Runoff Volume (10-day)	Inches	4.75
Capacity of Low Stage (Max.)	CFS	125
Capacity of High Stage (Max.)	CFS	1,106
Dimensions of Conduit	Feet	10 x 9
Type of Conduit	--	Reinforced Conc. Box
Frequency Operation-Auxiliary Spillway	% Chance	1
Auxiliary Spillway Hydrograph		
Rainfall Volume	Inches	8.6
Runoff Volume	Inches	5.5
Storm Duration	Hours	6
Velocity of Flow	FPS	3.5
Maximum Water Surface Elevation	NAVD 1988	980.9
Freeboard Hydrograph		
Rainfall Volume	Inches	26.4
Runoff Volume	Inches	22.6
Storm Duration	Hours	24
Maximum Water Surface Elevation	NAVD 1988	983.1
Capacity Equivalents		
Sediment Volume	Inches	0.15
Floodwater Retarding Volume	Inches	1.44
Beneficial Volume (Watershed Protection)	Inches	0.11

1/ Crest of Auxiliary Spillway

Table 7-5: Structural Table 3b (1) – Channel Work for North Inlet Channel Entering Cart Creek Site 1

Item	Unit	Cart Creek Site 1
General Statistics		

Item	Unit	Cart Creek Site 1
Source Watercourse	--	Cart Creek
Channel Name	--	North Inlet Channel
Station	--	NA
Drainage Area	Sq. Mi.	25.2
100-Year Frequency Design Discharge	CFS	1,700
Water Surface Elevation	NAVD 1988	985.0
Hydraulic Gradient[1]	Foot/Foot	0.0007
Channel Dimensions		
Gradient	Foot/Foot	-0.0003
Bottom Width	Feet	200
Elevation	NAVD 1988	979.0
Side Slope	Horizontal:Vertical	4:1
Manning *n Value*		
Aged Manning *n* Value	--	0.045
As-Built Manning *n* Value	--	0.035
Velocities		
Aged Velocity	FPS	0.7
As-Built Velocity	FPS	0.8
Channel Work		
Excavation Volume	Cubic Yards	286,306
Type of Work[2]	--	I
Existing Channel Type	--	NA
Present Flow Condition	--	Ephemeral

1/ From channel inlet to spill-out entrance into Cart Creek Site 1
2/ I Establishment of new channel including necessary stabilization measures
II Enlargement or realignment of existing channel or stream
III Cleaning out natural or manmade channel (including bar removal and major clearing and snagging operations)
IV Clearing and removal of loose debris within channel section
V Stabilization as primary purpose (by continuous treatment or localized problem areas – present capacity adequate)

Table 7-6: Structural Table 3b (2) – Channel Work for South Inlet Channel Entering Cart Creek Site 1

Item	Unit	Cart Creek Site 1
General Statistics		
Source Watercourse	--	County Drain 28
Channel Name	--	South Inlet Channel
Station	--	NA
Drainage Area	Sq. Mi.	5.7
100-Year Frequency Design Discharge	CFS	788
Water Surface Elevation	NAVD 1988	984.7
Hydraulic Gradient[1]	Foot/Foot	0.0010
Channel Dimensions		
Gradient	Foot/Foot	-0.0003
Bottom Width	Feet	50
Elevation	NAVD 1988	979.4
Side Slope	Horizontal:Vertical	4:1
Manning *n Value*		
Aged Manning *n* Value	--	0.045
As-Built Manning *n* Value	--	0.035
Velocities		
Aged Velocity	FPS	1.4
As-Built Velocity	FPS	1.4
Channel Work		
Excavation Volume	Cubic Yards	7,233
Type of Work[2]	--	I
Existing Channel Type	--	NA

Item	Unit	Cart Creek Site 1
Present Flow Condition	--	Ephemeral

1/ From channel inlet to spill-out entrance into Cart Creek Site 1
2/ I Establishment of new channel including necessary stabilization measures
II Enlargement or realignment of existing channel or stream
III Cleaning out natural or manmade channel (including bar removal and major clearing and snagging operations)
IV Clearing and removal of loose debris within channel section
V Stabilization as primary purpose (by continuous treatment or localized problem areas – present capacity adequate)

Total projects costs were annualized assuming 52-year period of analysis, which includes a 2-year design and installation period and 50-years of useful life.

The annual operation and maintenance cost for the flood retarding structure is estimated at $5,000 per year, which is based on similar projects of similar size in the region. The cost breakdown includes embankment mowing and spraying, inlet channels cleaning, inspections, documentation, and upkeep of structural elements. Environmental quality improvement annual costs are expected to be approximately $12,400 per year. The breakdown of biomass harvesting costs are summarized in **Table 7-7** below, which includes assumptions and references for cost estimate. The cattails could be used by farmers and ranchers for bedding or compost. Compost is high in nutrients, notably phosphorus, which is beneficial as fertilizer. However, application locations would be limited to uplands with very low connectivity to main stem rivers that could reintroduce the nutrients to the Red River of the North. The estimated one-time rate of harvesting biomass is approximately $138/acre, which is slightly higher than $105/acre estimate from North Ottawa project in Minnesota; which is reasonable due to longer haul distance. Future refinement and adaptive management of the biomass harvesting system will attempt to find closer disposal sites, which can considerably reduce costs. Also, similar sites in Canada have attempted to turn biomass into fuel pellets, which with enough demand could offset and further reduce operation and maintenance costs.

Table 7-7: Average Annual Biomass Harvesting O&M Cost Estimate

Item	Amount	Unit	Rate	Cost	Cost Rate
Mowing and Raking[1]	135	acres	$20/acre	$ 2,700	
Bailing[1]	135	acres	$12/acre	$ 1,620	
Loading and Moving Bales[1, 2, 3]	954	Bales	$5/bale	$ 4,770	
Hauling Large Round Bales[1, 4]	50	miles	$4/load/mile	$ 9,000	
Compost[5]				$ -	
Coordination				$ 500	
Total				$ 18,590	$ 137.70/acre
Average Annual Cost[6]				**$ 12,393**	**$ 91.80/acre**

[1] University of Nebraska Extension (https://extensionpublications.unl.edu/assets/pdf/ec823.pdf)

[2] Grosshans, 2011. Dry weight of cattails 1.2kg/m2 = 5.3 ton/ac in second year of project; therefore 715 tons.
[3] Average Large round bale is 1,500 lbs (0.75 ton); therefore 954 bales.
[4] Truck load is 16 ton from #1, therefore 45 truckloads.
[5] Assume no unloading cost as recipient will bear that cost, as the product and delivery will be paid for by sponsor.
[6] Assume harvest completed in 2 out of 3 years, which will rejuvenate energy in cattail root systems during off years.

Total annual costs for installation and operation and maintenance are provided in **Table 7-8 (Economic Table 4)**.

Table 7-8: Economic Table 4 – Estimated Average Annual National Economic Development (NED) Costs (Dollars)[1]

Works of Improvement		Amortization of Installation Costs[2]	Operation, Maintenance, and Replacement Cost	Total
Cart Creek Site 1	Flood Retarding Structure	$ 326,900	$ 5,000	$ 331,900
	Water Quality / Wildlife Habitat Improvements	$ 111,600	$ 12,400	$ 124,000
Total Costs		**$ 438,500**	**$ 17,400**	**$ 455,900**

[1] Price Base 2019; 2018 normalized prices for cropland.
[2] Amortized for 52 years at 2.875 percent

A summary of flood damages under each alternative is shown in **Table 7-9 (Economic Table 5)**. Benefits have been converted to their average annual equivalents using FY 2019 project discount rate. Implementation of the Preferred Alternative would reduce flood damages by an average of $204,823 annually, or $193,545 in annual average equivalents over the 50-year life of the project.

Table 7-9: Economic Table 5 – Estimated Average Annual Flood Damage Reduction Benefits (Dollars)[1]

Item	Estimated Average Annual Damage		Damage Reduction Benefit	Damage Reduction Benefit, Average Annual Equivalent Value[3]
	Without Project (Agriculture Related)	With Project (Agriculture Related)		
Flood Damages[2]				
Structures and Vehicles	$ 770,811	$ 616,352	$ 154,459	$ 145,954
Roads	$ 79,647	$ 67,229	$ 12,418	$ 11,734
Cropland	$ 876,320	$ 844,674	$ 31,646	$ 29,903
Insurance Administratin Costs	$ 6,300	$ 0	$ 6,300	$ 5,953
Total	**$ 1,733,078**	**$ 1,066,362**	**$ 204,823**	**$ 193,545**

[1] Price Base 2019; 2018 normalized prices for cropland. **Prepared: July 2024**
[2] Because all floodwater damages occur within rural communities; all are considered agriculture-related.
[3] Amortized for 50 years at 2.875 percent.

Table 7-10 (Economic Table 6) provides a comparison of annual costs and benefits for the Preferred Alternative. Benefits and costs of the No-Action Alternative are not presented. The No-Action Alternative could be identified as the National Economic Development (NED) Alternative, however was not selected as the Preferred Alternative because it does not meet the objectives of the SLO, and does not provide ecosystem services benefits. The Preferred Alternative, Cart Creek Site 1, was selected based on its ability to provide flood damage reduction objectives as well as substantial non-monetized ecosystem services benefits to the study area. While the costs exceed the benefits regarding flood damage reduction, ecosystem services benefits are substantial. Non-monetized ecosystem services benefits include wildlife habitat creation, improvements to water quality, and an incremental contribution to regional water resource plans.

In comparing the Preferred Alternative and the No-Action Alternative, the Preferred Alternative has an increase in net benefits associated with the non-NED accounts greater than the reduction in net benefits associated with the NED account.

Table 7-10: Economic Table 6 – Comparison of NED Benefits and Costs[1]

Works of Improvement		Total Average Annual Agricultural Related Benefits [2,3]	Average Annual Costs	Benefit to Cost Ratio 3
Cart Creek Site 1	Flood Retarding Structure	$ 193,545	$ 331,900	0.6 to 1.0
	Watershed Protection	n/a	$ 124,000	n/a
Total		**$ 193,545**	**$ 455,900**	**0.4 to 1.0**

[1] Price Base 2019; 2018 normalized prices for cropland. **Prepared: July 2024**

[2] Because all floodwater damage occurs within rural communities, all are considered agricultural related.

[3] Benefits related to watershed protection are presented in a quantified, but not monetized, manner within the Watershed Plan-EIS and consist of contributions to the Environmental Quality (wildlife habitat and water quality benefits) and Other Social Effects Accounts (contributions to international treaty obligations of the U.S. government and regional water resource plans).

8 References

Arndt, M. (1975). Geology of Cavalier and Pembina Counties, Bulletin 62-Part 1, County Groundwater Studies 20-Part 1.

Brune, G. M. (1953). Trap Efficiency of Reservoirs. Transactions. American Geophysical Union 34(3):407-418

Bryce, Sandra A., et al. (n.d.). *Ecoregions of North Dakota and South Dakota.* Retrieved from ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/sd/ndsd_eco.pdf

Cavalier County Board. (adopted April 16, 2002). *Cavalier County Comprehensive Plan and Zoning Regulations.* Retrieved from http://cavaliercounty.us/wp-content/uploads/2018/01/CAVALIER-COUNTY-ZONING-REGS-2017.pdf

Franzen, David (2019) Managing Saline Soils in North Dakota https://www.ag.ndsu.edu/publications/crops/managing-saline-soils-in-north-dakota

Goldstein, R. U. (1995). *Water-Resources Investigations Report 95-4047: Aquatic Communities and Contaminants in Fish from Streams of the Red River of the North Basin, Minnesota and North Dakota.*

International Joint Commission Canada and United States (2020) Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary

Jared M. LeBoldus, et al., North Dakota State University. (2013, January). *Dutch Elm Disease in North Dakota: A New Look (PP1635)*. Retrieved from https://www.ag.ndsu.edu/publications/lawns-gardens-trees/dutch-elm-disease-in-north-dakota-a-new-look

Kim, K., et al. (2022). Carbon and water dynamics of a perennial versus an annual grain crop in temperate agroecosystems. Agricultural and Forest Meteorology Volume 314, March 2022, 108805

Mayer, B. a. (2012). Isotopic characterization of nitrate sources and transformation in Lake Winnipeg and its contributing rivers, Manitoba, Canada. *Journal of Great Lakes Research 38:135-146*.

McCullough, G. e. (2012). Hydrologic forcing of a recent trophic surge in Lake Winnipeg. . *Journal of Great Lakes Research 38*, 95-105.

National Atmospheric Deposition Program (2023) National Trends Network https://nadp.slh.wisc.edu/networks/national-trends-network/

North Dakota Department of Health. (Final, April 26, 2019). *North Dakota Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads*. Retrieved from https://deq.nd.gov/publications/WQ/3_WM/TMDL/1_IntegratedReports/2018_Final_ND_Integrated_Report_20190426.pdf

North Dakota Environmental Quality, Division of Air Quality. (2019, Aug.). *North Dakota Ambient Monitoring Program, Network Plan With Data Summary 2019*. Retrieved from Public comment period began: Aug. 16, 2019 and ends Sept. 15, 2019: https://deq.nd.gov/AQ/PublicCom.aspx

North Dakota Game and Fish Department (1). (n.d.). *North Dakota Grassland Birds*. Retrieved from Whooping Crane: https://gf.nd.gov/wildlife/id/grassland-birds/whooping-crane

North Dakota Game and Fish Department (2). (n.d.). *Tallgrass Prairie (Red River Valley)*. Retrieved from https://gf.nd.gov/wildlife/habitats/tallgrass

North Dakota Game and Fish Department (4). (n.d.). *Aquatic Nuisance Species (ANS) Infested Waters in North Dakota*. Retrieved from Aquatic Nuisance Species Infestations: https://gf.nd.gov/ans/infested-waters

North Dakota Game and Fish Department (6). (n.d.). *Wildlife Conservation.* Retrieved from Geographic Regions: https://gf.nd.gov/wildlife/habitats/regions

North Dakota Game and Fish Department (SWAP). (2015). *State Wildlife Action Plan.* https://gf.nd.gov/sites/default/files/publications/swap-2015_0.pdf.

North Dakota Game and Fish Department, Threatened and Endangered Species. (last updated May 2015, accessed Sept 30 2019). https://gf.nd.gov/wildlife/endangered.

North Dakota State University. (last updated May 18, 2017). *Invasives*. Retrieved from http://www.ndinvasives.org/

North Dakota State University. (n.d.). *North Dakota Invasives*. Retrieved from http://www.ndinvasives.org/

Red River Basin Commission. (2011). *Long Term Flood Solutions For the Red River Basin.*

Red River Basin Commission. (2017). *Red River of the North - Comprehensive Watershed Management Plan. Appendix C - Water Quality.*

Rodney G. Lym and Andrea J. Travnicek, North Dakota State University. (2015, May). *Identification and Control of Invasive and Troublesome Weeds in North Dakota*. Retrieved from https://www.ag.ndsu.edu/pubs/plantsci/weeds/w1411.pdf

Soil Survey Staff, USDA-NRCS. (2019, Jan 27). Web Soil Survey. Available online at the following link: https://websoilsurvey.sc.egov.usda.gov/.

U.S. Army Corps of Engineers. (1987). *Wetlands Delineation Manual.* Department of the Army, Waterways Experiment Station. Vicksburg: US Army Corps of Engineers.

U.S. Army Corps of Engineers. (2010). Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0). (J. Wakeley, R. Lichvar, & C. Noble, Eds.) Vicksburg, Mississippi, USA: U.S. Army Engineer Research and Development Center.

U.S. Department of Agriculture. (2012). *National Agricultural Statistics Service*. Retrieved from Cavalier, Walsh, and Pembina Counties.

U.S. Department of Agriculture. (2017) Title 210, National Engineering Manual, Part 520 Subpart C-Dams

U.S. Department of Agriculture. (2019) Technical Release 210-60 Earth Dams and Reservoirs.

U.S. Department of Agriculture. (n.d.). *Pembina, Cavalier, and Walsh County Soil Surveys*.

U. S. Department of the Interior, National Park Service (NPS) Air Quality Monitoring (2023). https://www.nps.gov/subjects/air/air-monitoring.htm

U.S. Department of Agriculture. (2024). COMET-Farm Tool, Retrieved from https://comet-farm.com

U.S. Department of Homeland Security. (accessed April 11, 2016). *FEMA website*. Retrieved from htpp://www.fema.gov/flood-zones

U.S. Environmental Protection Agency. (accessed Oct 10 2017). *Cleanups in My Community.* Retrieved from https://www.epa.gov/cleanups/cleanups-my-community

U.S. Environmental Protection Agency. (data current as of July 31, 2019). *Criteria Pollutant Nonattainment Summary Report.* https://www3.epa.gov/airquality/greenbook/ancl3.html.

U. S. Environmental Protection Agency. (accessed October 2023). 2022 Design Value Interactive map. https://www.epa.gov/air-trends/air-quality-design-values

U.S. Environmental Protection Agency (accessed September 2023) AP-42 Compilation of Air Emissions Factors https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors

U.S. Fish and Wildlife Service (1). (accessed Oct 3 2017). *Information Planning and Conservation System (IPaC).* https://ecos.fws.gov/ipac/.

U.S. Fish and Wildlife Service (2). (n.d.). *Environmental Conservation Online System (ECOS)*. Retrieved from Whooping crane (Grus americana): https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=758

U.S. Fish and Wildlife Service. (accessed Oct 4 2017). *Flyways.us: Central Flyway.* Retrieved from http://central.flyways.us/

U.S. Fish and Wildlife Services. (2017, 10 4). *US Counties within North Dakota in which the Northern Long-eared Bat*. Retrieved from https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=9045#currentRange

Walsh County (ND). (1994, July). *Walsh County Comprehensive Plan.* Retrieved from http://walshnd.govoffice3.com/vertical/sites/%7BCA2F63BF-8E2B-4414-9099-2788D7A97F23%7D/uploads/Zoning_Manual_1of2.pdf

U.S. Environmental Protection Agency (accessed September 2023) AP-42 Compilation of Air Emissions Factors https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors

9 List of Preparers

Table 9-1: List of Preparers

Name	Present Title	Education	Years Experience	Registration/ Certifications
Zachary Herrmann	Project Manager, Houston Engineering, Inc.	B.S. Civil Engineering	15	PE-8405
Craig Odenbach	Project Manager, Houston Engineering, Inc.	M.S. Civil Engineering	38	PE-3399 CFM–US-02-00476
Bret Zimmerman	Project Engineer, Houston Engineering, Inc.	B.S. Civil Engineering	11	PE-10646
Paul LeClaire	Project Engineer, Houston Engineering, Inc.	B.S., M.S. Civil Engineering	7	PE-28012
Mark Aanenson	Senior Environmental Scientist, Houston Engineering, Inc.	B.S. Biology	31	Certified Wetland Delineator (MN)
Donna Jacob	Environmental Scientist, Houston Engineering, Inc	PhD Botany; M.S. Botany; B.S. Environmental Biology	27	Professional Wetland Scientist (2672) Certified MN Wetland Professional (1267)
Noah Irby	GIS Analyst	B.S. Environmental Geography; B.A. Philosophy	3	
Mike Ulmer	Soil Scientist, Prairie Soils Consulting, LLC	B.S., M.S. Soil Science		
Katherine Sharpe	Senior Environmental Economist, Gannett Fleming, Inc.	MPS Environmental Management	22	AICP, ENV-SP
Kathy Malarich	Environmental Economist, Gannett Fleming, Inc.	M.A. Economics, M.S. Natural Resource Economics	33	
Kayla Briggs	GIS Analyst, Gannett Fleming, Inc.	B.S. Geoenvironmental Studies	13	

Name	Present Title	Education	Years Experience	Registration/ Certifications
James Cummings	Principal Investigator, McFarlane Consulting LLC	M.A. Archaeology & Cultural Resource Management	40	
Christi Fisher	State Conservation Engineer NRCS (ND)	B.S. Forest Engineering M.S. Environmental Science	29	PE-6053
Jonathan Petersen	State Hydrologist, NRCS (ND)	B.S., M.S. Civil Engineering	16	PE-27066
Todd Schwagler	State Resource Conservationist, NRCS (ND)	B.S. Range Management	31	
Curtis Bradbury	State Biologist, NRCS (ND)	B.S. Fisheries & Wildlife Management	26	
Christopher Plount	Cultural Resources Specialist, NRCS (ND)	M.A. Cultural Resource Management; B.A. Anthropology	6	
Rita Sveen	Watershed Planner, NRCS (ND)	B.S. Natural Resources & Environmental Studies	32	
Janelle Harrison	Cultural Resources Specialist, NRCS (ND)	M.A. Maritime Archaeology & History	15	Registered Professional Archeologist (RPA)
Richard Webb	State Resource Conservationist NRCS (ND)	B.S. Ag Systems Management	21	
Dana Whippo	Economist	PhD Political Science M.S. Economics B.A. Univ. Scholars Pgm	10	

10 Distribution List

Biliske, Dennis	ND Outdoor Heritage Fund
Hannesson, Russell and Sherry	ND Parks and Recreation
Bernhoft, Neil and Melanie	North Dakota Department of Transportation
Bernhoft, Ryan and Neil	Northern Cheyenne Tribe
Bernhoft, Wayne & Loretta	NRCS - Cavalier County
Blackfeet Indian Reservation of MT	NRCS - Pembina County
Bois Forte Band of the MN Chippewa Tribe	Oglala Sioux Tribe
Cavalier County Soil Conservation District	Olason, Darren & Nicole
Cavalier County Water Resource District	Olason, Douglas & Danielle
Cheyenne River Sioux Tribe	Olason, Roger
Chippewa Cree Tribe of the Rocky Boy’s Reservation	Olason, Susan Chambers
City of Cavalier	Pembina County Commission
Confederated Salish and Kootenai Tribes	Pembina County Emergency Services
Crow Creek Sioux Tribe	Pembina County Highway Department
Federal Emergency Management Agency - Region 8	Pembina County Soil Conservation District
Fingarson, Lindsey & Lori	Pembina County Water Resource District
Flandreau Santee Sioux Tribe	Prairie Island Indian Community in MN
Fond du Lac Band of MN Chippewa Tribe	Red Lake Band of Chippewa Indians
Fort Belknap Indian Community	Red River Retention Authority
Fort Peck Assiniboine and Sioux Tribes	Rosebud Sioux Tribe of Indians
Grand Portage Band of MN Chippewa Tribe	Shepherd, Ruth
Hannesson, Rick and Elma	Shoshone Tribe of the Wind River Reservation
Heuchert, Donald & Candace	Sisseton-Wahpeton Oyate
Kennedy, Helen Eva & Francis	Spirit Lake Tribe of Fort Totten
Knutson, Darlene	Standing Rock Sioux Tribe
Leech Lake Band of Ojibwe	State Historical Society of North Dakota
Lower Sioux Indian Community	State Historical Society of North Dakota
Mille Lacs Band of Ojibwe	The Crow Tribe of Montana
ND Department of Emergency Services	The Three Affiliated Tribes
ND Department of Environmental Quality	Turtle Mountain Band of Chippewa
ND Department of Water Resources	Upper Sioux Community
ND Forest Service	US Army Corp of Engineers
ND Game and Fish Department	US Environmental Protection Agency
ND Geological Survey Paleontology	US Fish and Wildlife Service
Northern Arapaho Tribe	Yankton Sioux Tribe
Governor of North Dakota	

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