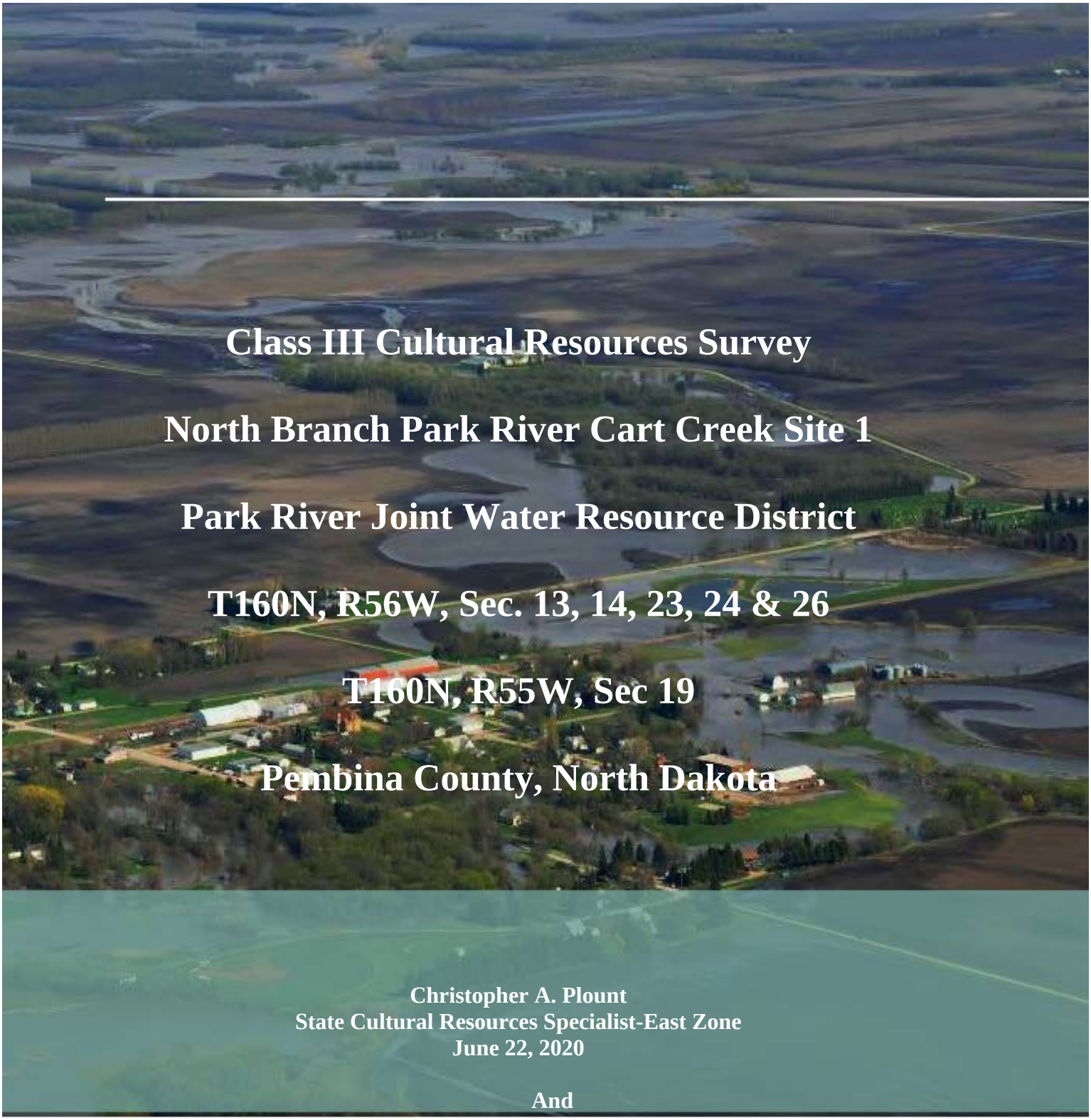

Class III Cultural Resources Survey

North Branch Park River Cart Creek Site 1

Park River Joint Water Resource District

T160N, R56W, Sec. 13, 14, 23, 24 & 26

T160N, R55W, Sec 19

Pembina County, North Dakota

Christopher A. Plount
State Cultural Resources Specialist-East Zone

June 22, 2020

And

Janelle L. Harrison
NRCS- State Cultural Resources Specialist

Updated: August 1, 2023
North Dakota State Office

USDA United States Department of Agriculture
Natural Resources Conservation Service

Abstract:

The North Branch Park River Cart Creek Site 1, as proposed, has benefited from a Class I literature review and Class III survey encompassing the entirety of the Cart Creek site APE. North Dakota State Historic Preservation Office and Natural Resources Conservation Service Archive searches were coupled with interviews with the landowner Rick Hannesson, USDA Soil data, and other State and Federal information sources. These efforts have resulted in the discovery of no culturally sensitive material nor properties eligible for the National Register of Historic Places within the area of potential effect (APE) or one mile surrounding. The areas of excavation and earthen levee construction have been impacted by decades of agricultural use and flooding. The proposed undertaking rests within the ancient glacial lake Agassiz plain formed by glaciation and does not exhibit signs of glacial beach lines which could have the potential for cultural deposits. Based on the soil profile, land use, and the nature of the undertaking, which is primarily building up or rehabilitation of extant water control features and excavation/levee construction in previously disturbed areas, makes the inadvertent discovery of cultural resources unlikely.

The purpose of this investigation was to assess what, if any, cultural resources are located within the 208-acre survey area, the area of direct impact (ADI) from ground disturbance. The investigation excludes survey of the proposed flood control/ inundation areas that will not have direct earth moving activities.

On September 18, 2018, James Cummings (Principal Investigator for McFarlane Consulting LLC) conducted a Class I file search for a 260-square mile area surrounding the proposed project area (Appendix A). Two previously recorded sites (32BPX201 and 32BPX202) and one previous survey (015649) were identified within 1-mile of the proposed project area.

In February of 2023, Janelle Harrison, North Dakota NRCS State Cultural Resources Specialist conducted a supplemental Class I literature review for a 1-mile radius around the proposed project area. No new cultural resources were identified in the file search.

In 2020 one new site was documented within the projects APE: 32PB263. In May of 2023, Janelle Harrison resurveyed 10-acres, including the location of 32PB263 and recorded additional details to submit to the ND SHPO for a Smithsonian Institute Trinomial System Number (SITS#).

Site 32PB263 is a small historic very disbursed artifact scatter consisting of glass shards, pieces of red and yellow brick, historic brown ceramic sherds, and various metal agricultural objects. It is the author's professional opinion that subsurface testing would not provide additional information of the site that would contribute to Criterion D of the National Register of Historic Places (NRHP). Based on the additional historical records research conducted at the Pembina County Recorder's Office, it is also the author's professional opinion that 32PB263 is not recommended eligible for the NRHP under Criteria A-C, and no further investigation is required.

Therefore, NRCS recommends that the project proceed under a *No Historic Properties Adversely Affected* as surveyed, mapped, and described herein.

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1.0 PROJECT TITLE: NORTH BRANCH PARK RIVER CART CREEK SITE 1

Legal Location: T160N; R56W; Sec.(s): 13, 23, 24, & 26 and T160N; R55W; Sec. 19
County: Thingvalla Township, Pembina County
USGS 7.5' Quadrangle: Mountain, North Dakota 2017
Personnel: Christopher A. Plount (Principal Investigator-NRCS State Office) Zach Herman (Lead Engineer-Houston Engineering) and Rita Harmsen Sveen (District Conservationist-NRCS Cavalier Field Office) and Janelle Harrison (Principal Investigator- North Dakota NRCS State Office).
Total Acres Surveyed in 2020: Approx. 208 acres.
Total Acres Re-Surveyed in 2023: Approx. 10 acres.

Description of Proposed Project: Cart Creek Impoundment Site 1 would consist of two proposed flood pools located adjacent to each other. The primary flood pool (Flood Pool 1) is an off-channel impoundment constructed of earthen embankments in Section 24 of Thingvalla Township. In order to get flows from the Cart Creek into Flood Pool 1, an inlet channel would be constructed to divert high flows to the south from Cart Creek on the west side of 131st Avenue NE into Flood Pool 1. The secondary flood pool (Flood Pool 2) is primarily located in the SW ¼ of Section 19 in Park Township. Flood Pool 2 is an on-channel site and consists of a system of earthen embankments with a reduced hydraulic capacity outlet. The reduced capacity outlet would convey the 2-year event within the channel. Larger events would result in attenuated flows to provide increased access to floodplain storage contained within the setback levees. In total, Cart Creek Impoundment Site 1 would have a drainage area of 36.3 square miles and would provide 4,600 acre-feet (2.4 inches) of flood storage. The drainage area is primarily located west of ND Highway 32. Flood Pools 1 and 2 would require a total estimated area of 785 acres. The amount of inundated area would vary depending on the flood event. Both flood pools are proposed as dry dams, meaning no normal or conservation pool would be permanently held.

Site Evaluation Criteria:

To be eligible for inclusion on the NRHP, a site must usually be more than 50 years old and retain sufficient historic integrity to communicate significance based on one or more of the following seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. Furthermore, the site must meet at least one of the following criteria:
(a) Associated with events that have made a significant contribution to the broad patterns of our history; or
(b) Associated with the lives of persons significant in our past; or
(c) Embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinctions; or
(d) Have yielded, or may be likely to yield, information important in prehistory or history.

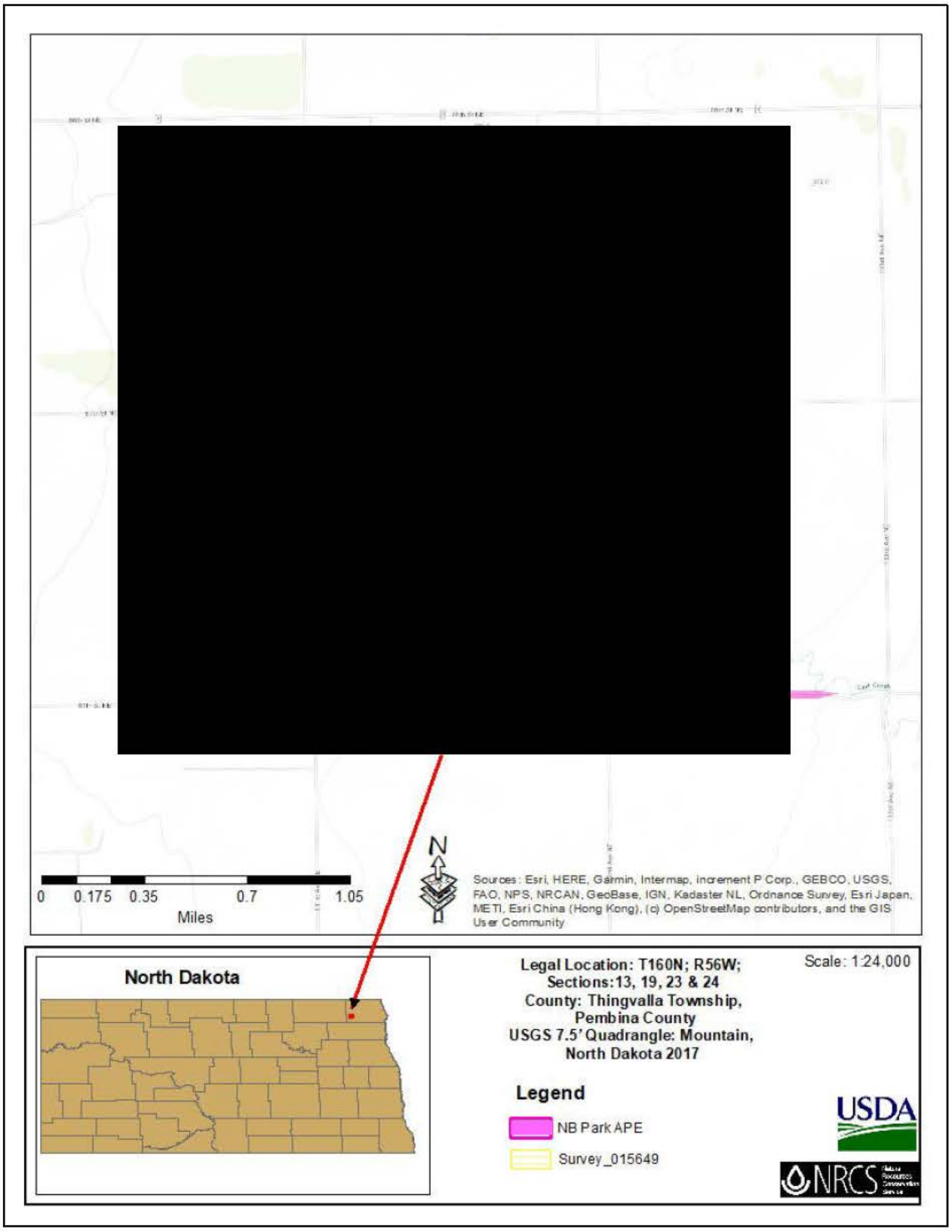


Figure 1. 1:24,000 Scale of APE and Proposed Project Location in Pembina County

2.0 INTRODUCTION:

The North Dakota Natural Resources Conservation Service (NRCS) proposes to construct an embankment and channel system to control seasonal flooding. Part of the larger North Branch Park River Watershed Plan, the Cart Creek Site 1 will implement NRCS Practice 587 (Water Control), 356 (Dike), and 362 (Diversion) is intended. A detailed description of the practices is listed in Appendix B.

The undertaking will repurpose and improve extant water control ditching and culverting in T160N, R56W, Sections 13, 19, 23, 24 and 26. Construction of a levee system, inclusive of a primary and auxiliary spillway, will follow the northern, eastern and southern exterior boundaries of Section 24. A new water control diversion is planned through the center of Section 24. The undertaking is designed to use a significant portion of Section 24 as an inundation zone for major flooding events (Figure 2). **A retrenching of an extant water control ditch and culvert replacement will occur on the southern boundary of T160N, R55W, S ½ Section 19.**

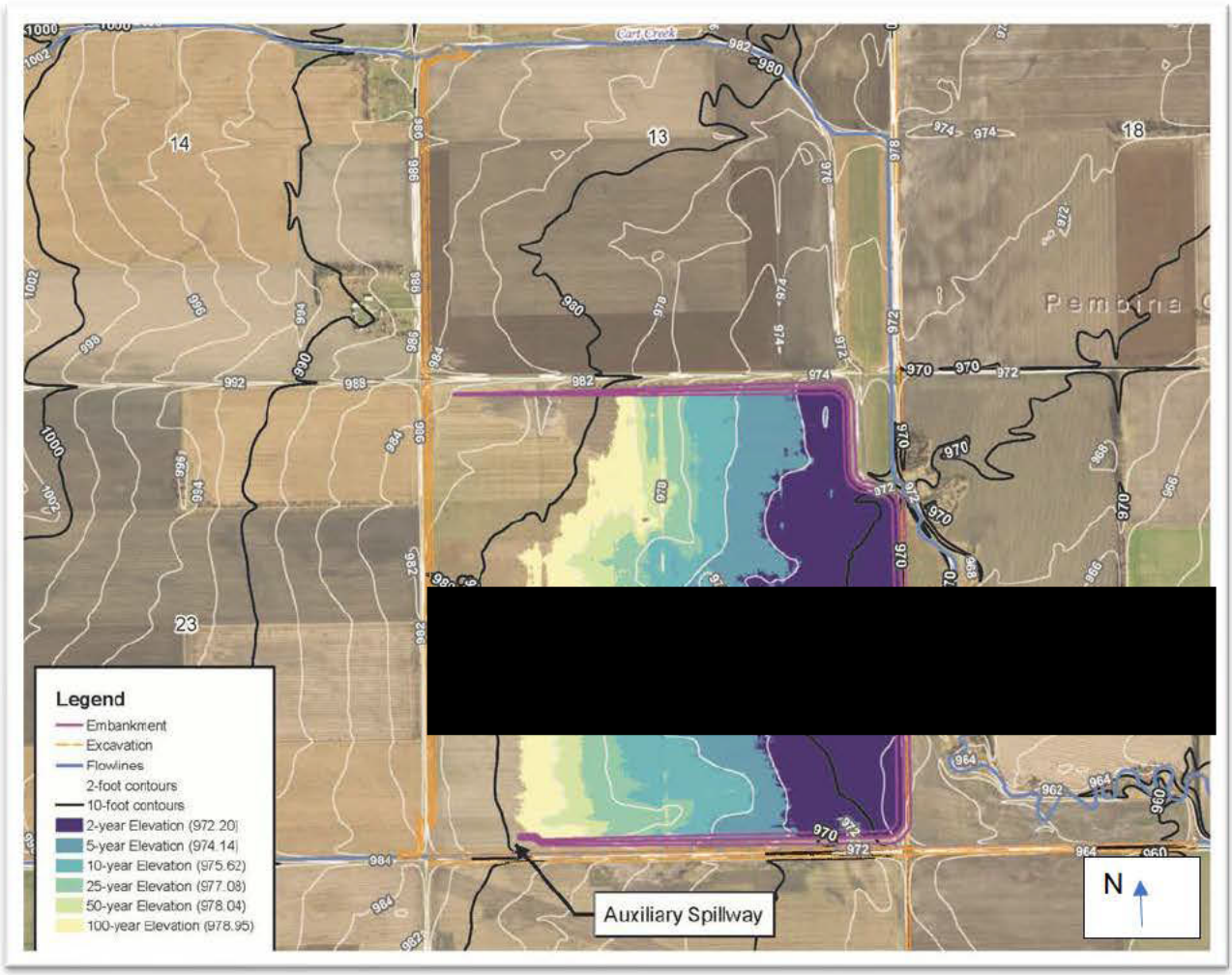


Figure 2. Section 24 Inundation zone.
Source: Houston Engineering.

2.2 Northern Red River Study Unit

The NRRSU includes in part or in whole 10 counties in North Dakota. One of these counties is Pembina. The proposed undertaking is located in Pembina County, ND. The Northern Red River flows in a northward direction until it drains into the Hudson Bay. The primary tributaries of the Red in the NRRSU from north to south are the Pembina (and Tongue), Park, Forest, Turtle, and Goose rivers. Many of these longer tributary streams exhibit relatively steep slopes as they drain eastward from the uplands across the Pembina Escarpment to the Red River Valley (Picha et al. 2021).

The NRRSU has six major physiographic features and the current proposed undertaking rests in the glacial Lake Agassiz plain with glacial beach lines and delta deposits. These land formations are the remnants of glacial sediments derived from glacio-lacustrine processes ((Picha et al. 2021). The glacial lake plain of ancient Agassiz is flat and occurs throughout eastern portions of the NRRSU (Picha et al. 2021). This area has very little elevation change and consists primarily of Glyndon, Bearden, and Fargo series soils are routinely mapped here.

The Paleo cultural chronology identifies Clovis, Folsom, and Plano complexes as occurring or anticipated in the NRRSU. According to Picha et al., one Clovis point was retrieved from an upland setting at site 32PB25 along the Pembina River. Investigations have yet to produce any Folsom components while more recent investigations have identified artifacts from the Plano complex (Picha et al. 2021).

Additional periods of chronological occupation include the Plains Archaic, Plains Woodland, Plains Village, and Plains Equestrian/Fur Trade period. These periods are usually defined by projectile point typology, other artifact typology, and/ or radiocarbon dating. For further details consult the NRRSU.
(https://www.history.nd.gov/hp/PDFinfo/9_NorthernRedRiverStudyUnit.pdf)

2.3 Research Goals and Methods:

Historic maps, topographic maps, literature review, and in person interviews were combined with LiDAR, satellite imagery and engineering plans to pinpoint areas of interest. On April 23, 2020, Chris Plount M.A., State Cultural Resources Specialist-East Zone completed Class III Survey of the area of potential effect (APE). The entire APE was surveyed at 15-meter parallel pedestrian transects. Representatives of the NRCS Cavalier Field Office and Houston Engineering were present. On May 26, 2023, Janelle Harrison M.A. RPA, State Cultural Resources Specialist conducted an intensive survey of the locations identified as trailheads on the 1881 GLO maps and the agricultural field where a small historic artifact scatter was identified.

The field reconnaissance was designed to achieve four goals:

- Positive location and identification of known cultural resources within the APE.
- Discovery and recordation of unknown cultural resources within the APE.
- Field assessment of NRHP eligibility of any cultural resources.
- Determine effects of the undertaking on any NRHP eligible properties.

The ground visibility ranged from 5% in the southeast with grass coverage and 100% to the west and northwest in the agricultural field where a small historic artifact scatter was located. Visibility at the location of site leads 32BPX201 and 32BPX202 ranged from as low as 5% on either side of the road/bridge crossing where is site lead is located and 100% on road 131st where two bridges were constructed to cross the creeks. On May 26, 2023, the weather was sunny with a slight breeze and high humidity.

3.0 ENVIRONMENT:

The project is in western Pembina County, North Dakota. No traditional medicine or culturally significant plants needing protection are known to be in the area (NRCS-Plants 2020). Silty loam and silty clay soils dominate the area (USDA-Soil Survey 2023). The elevation of the project area is roughly 1000 feet to 925 feet above sea level. The proposed APE encompasses part of the Cart Creek channel which has been heavily modified by both natural and anthropogenic forces since the original 1881 mapping (Figure 4).

3.2 Soil Description and Profile of APE:

- 30.4% Niche Silt Clay: Neche soils are on nearly level fans, natural levees, splays, and stream terraces. Slopes range from 0 to 3 percent. The soils formed in recent alluvium deposited on older lake sediments of glacial Lake Agassiz.

Typical profile
Ap - 0 to 10 inches: silty clay
C1 - 10 to 23 inches: silty clay loam
Ab - 23 to 33 inches: silty clay loam
2C2 - 33 to 60 inches: loam

- 32.8% Fargo Silt Clay: The Fargo series consists of very deep, poorly drained and very poorly drained, slowly permeable soils that formed in calcareous, clayey lacustrine sediments. These soils are on glacial lake plains, floodplains, and gently sloping side slopes of streams within glacial lake plains. Slopes range from 0 to 2 percent.

Typical profile
Ap - 0 to 8 inches: silty clay
A - 8 to 13 inches: silty clay
Bss - 13 to 21 inches: silty clay
Bkg - 21 to 32 inches: silty clay
Cg - 32 to 79 inches: silty clay

- 24.1% Ryan-Fargo Silt Clays: The Ryan series consists of very deep, poorly drained, very slowly permeable soils that formed in alkaline clayey sediments. These soils are on stream terraces and glacial lake plains and have slopes of 0 to 1 percent.

Typical profile
Ap - 0 to 10 inches: silty clay
Btnz - 10 to 20 inches: silty clay
Bkzg - 20 to 33 inches: silty clay
Czg - 33 to 79 inches: silty clay

Table 1. Soil types within the APE. Data Source: https://websoilsurvey.sc.egov.usda.gov

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
I130A	Hegne-Fargo silty clays, 0 to 1 percent slopes	12.8	10.2%
I201A	Glyndon silt loam, 0 to 2 percent slopes	10.3	8.2%
I229A	Fargo silty clay, 0 to 1 percent slopes	32.8	26.2%
I231A	Dovray silty clay, 0 to 1 percent slopes	13.1	10.4%
I242A	Ryan-Fargo silty clays, 0 to 1 percent slopes	24.1	19.2%
I256B	La Prairie-Fluvaquents, channeled complex, 0 to 6 percent slopes, frequently flooded	0.1	0.1%
I383A	Overly silty clay loam, 0 to 2 percent slopes	1.7	1.3%
I562A	Neche silty clay, 0 to 1 percent slopes, occasionally flooded	30.4	24.3%
I644A	Grano silty clay, plane, 0 to 1 percent slopes	0.0	0.0%
Totals for Area of Interest		**125.3**	**100.0%**

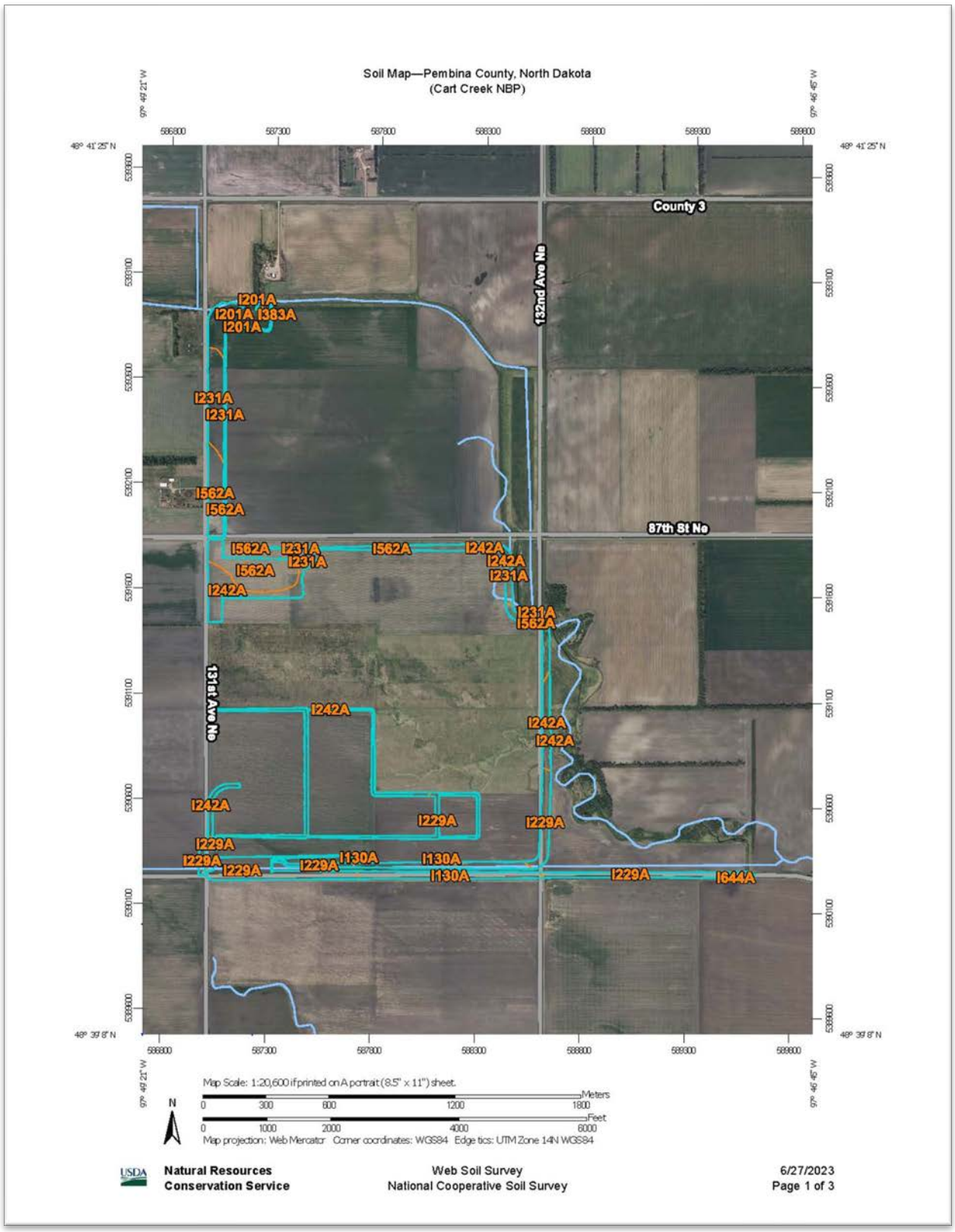


Figure 3. Soil Map with APE for reference only.
Image source: https://websoilsurveysc.egov.usda.gov

4.0 LITERATURE REVIEW:

Historic maps, both topographic and General Land Office survey, were combined with LiDAR imagery and engineering plans to pinpoint areas of interest. North Dakota State Historic Preservation Office (SHPO) records were researched for sites and reports. NRCS archives were accessed for information about agricultural practices that involved ground disturbance and prior CRM reports.

McFarlane Consulting conducted a Class I literature review of the entire watershed in September 2018. Two years had passed between the Class I and Class III, therefore, McFarlane's results were reverified in April 2020 and again in February 2023. A discrepancy was noted concerning the characterization of sites 32PBX201 and 32PBX202. Both sites were listed by McFarlane as "RR tracks, spur & siding" (McFarlane, section 5.3).

Coded sometime near 1986, 32PBX202 is described with "Site Type 48: Railroad Grade and Tracks" and "Context 29: Roads, Trails and Hwy". 32PBX201 lists only "Site Type 48: Railroad Grade and Tracks" and no context code. Closer inspection of the site forms reveals that 32PBX202 is the location and description of a portion of the Ridge Tail whereas 32PBX201 describes the intersection of the Tongue River Trail and Ridge Trail. Both are marked on the GLO 1881 map (Figure 4).

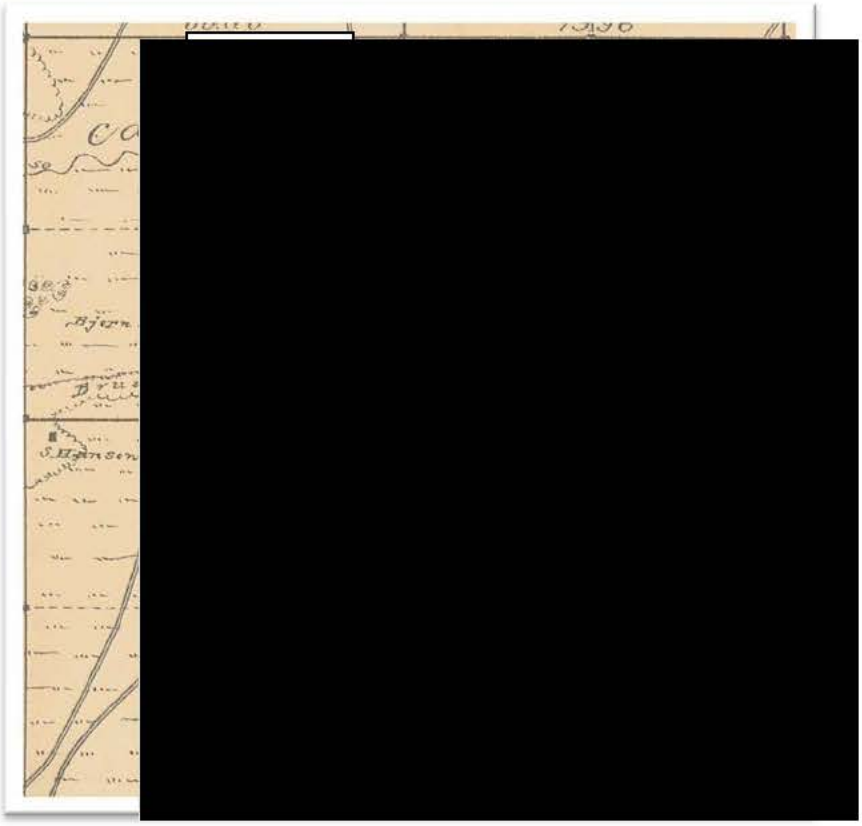


Figure 4. 1881 GLO map with 32PBX201/32PBX202 highlighted.

Data Source: North Dakota State Historical Society Archives

LiDAR imagery and historic topographic maps revealed two areas in need of special scrutiny within the planned inundation zone.

- Unknown rectangular structure near the center of Section 24 (Figure 5).
- Unknown structure in the NE ¼ of Section 24 (Figure 6).

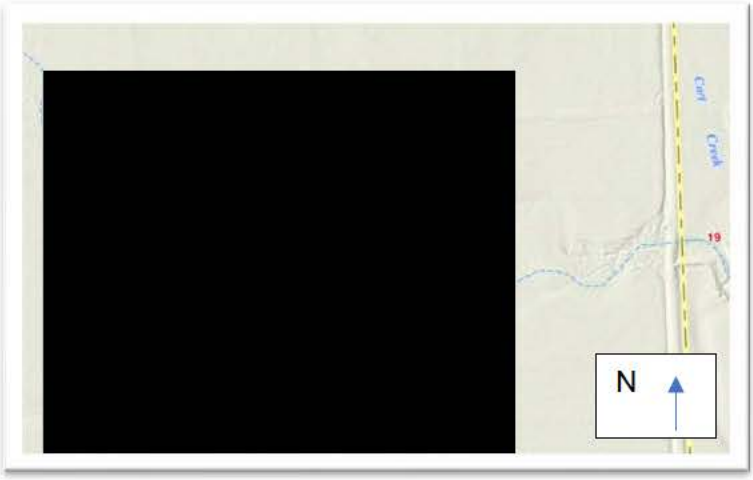


Figure 5. LiDAR indicated structure. Source: North Dakota State Water Commission.

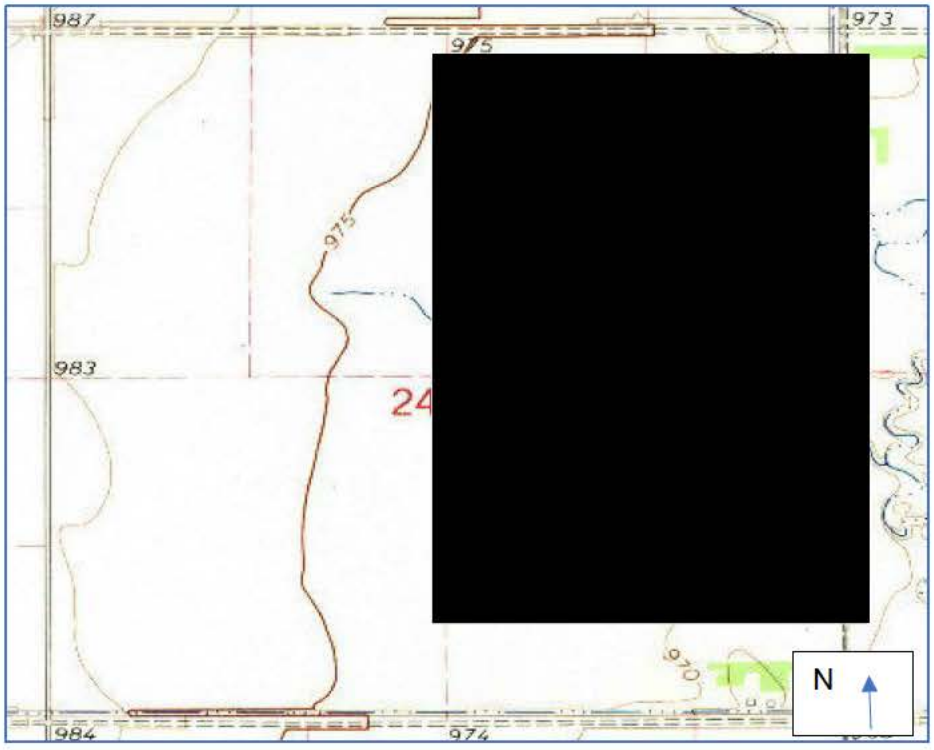


Figure 6. Unknown Structure no longer extant. Assigned site number 32PB263. USGA Quad: Mountain 7.5 topographic (1964). Source: https://ngmdb.usgs.gov/topoview.

Figure 7 on the following page depicts the proposed locations for the:

- North Inlet Channel/Overflow Spillway
- Principal Spillway Structure
- Auxiliary Spillway Structure

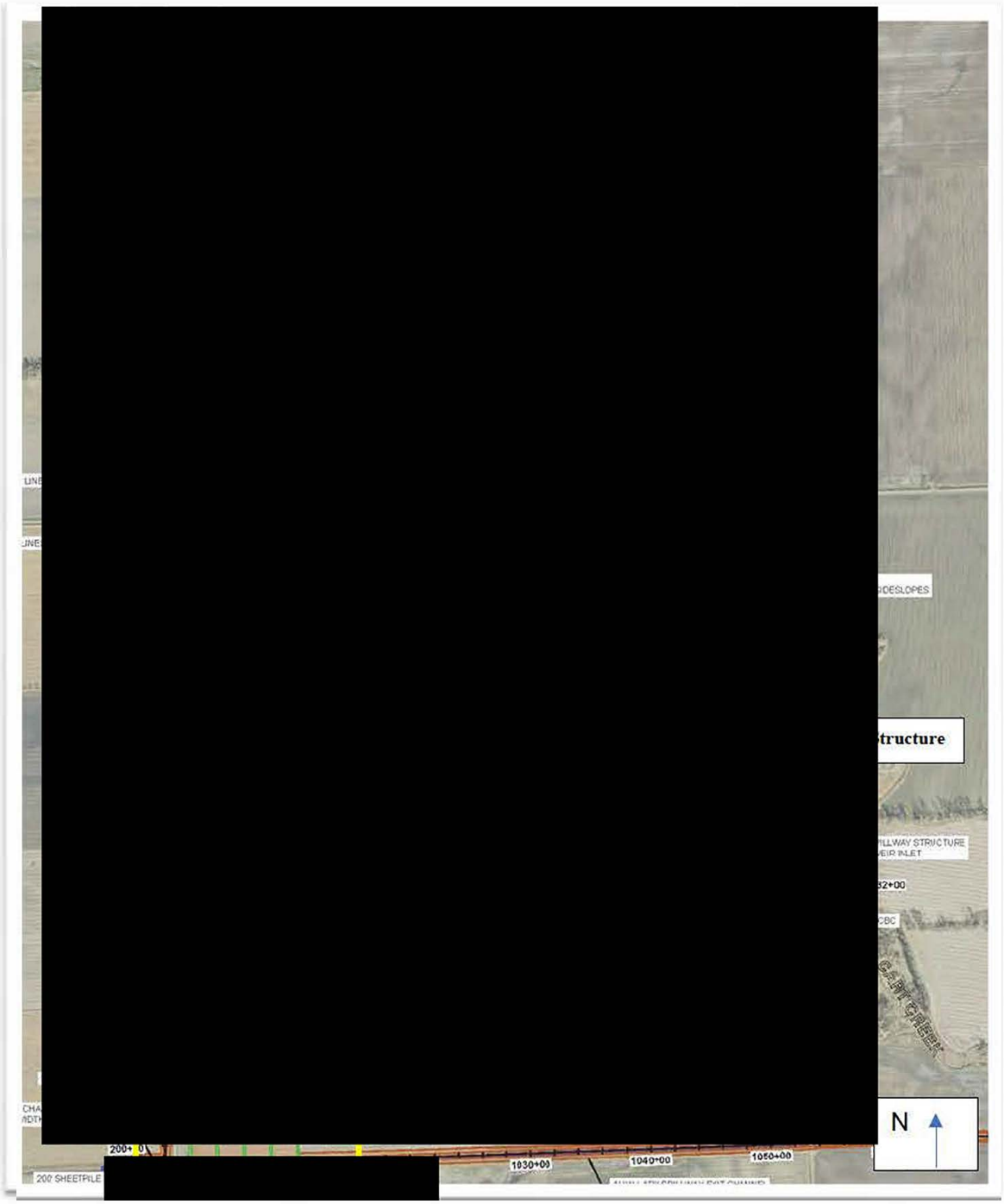


Figure 7. Design plans showing areas of focused investigation. Source: Houston Engineering. See Appendix C

Table 2. Literature Review; sites within 1-mile of the APE

County	Site Name	Number	Location	Quad
Pembina	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

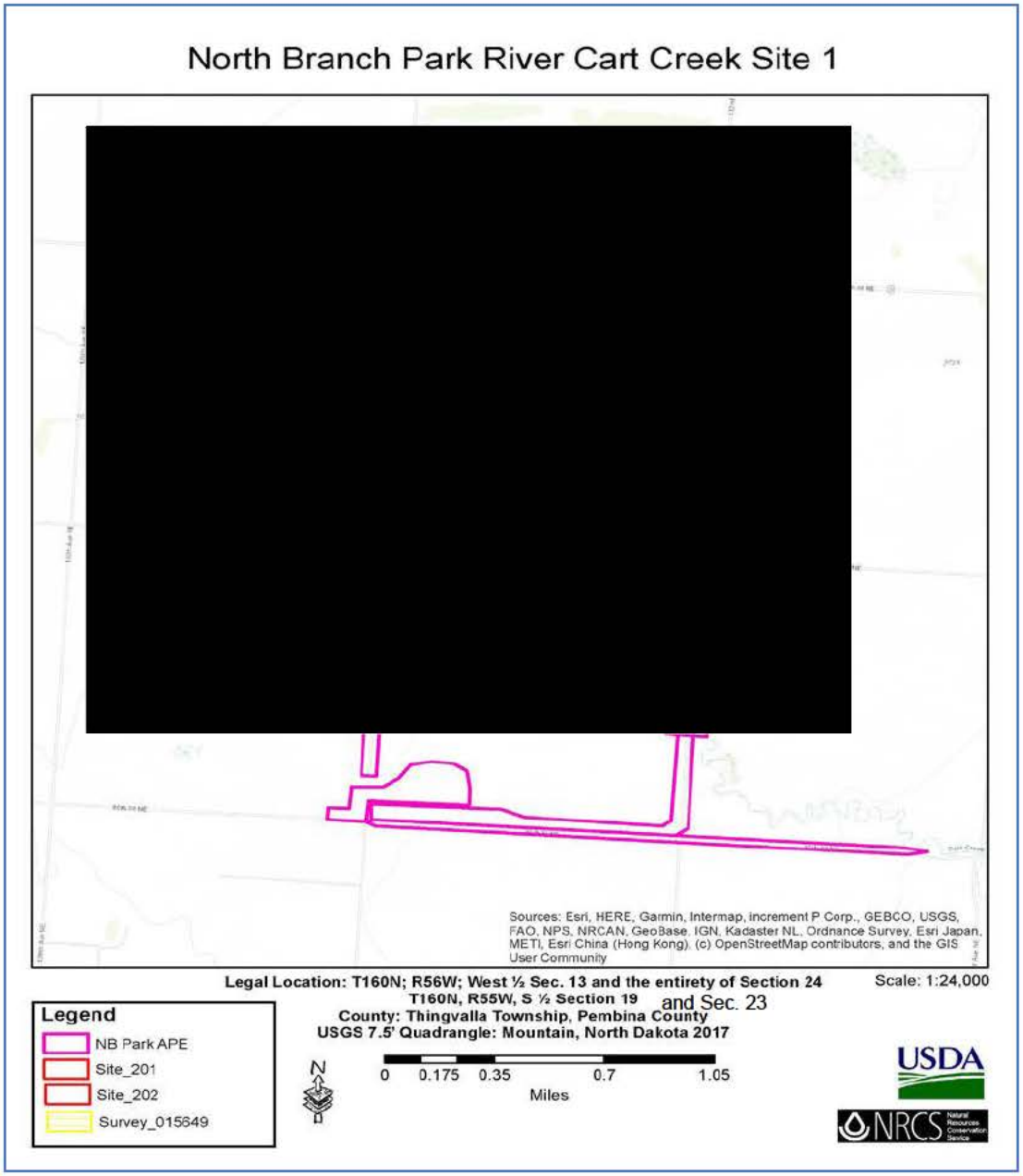


Figure 8. Updated design plans depicting the APE with previous surveys and sites.

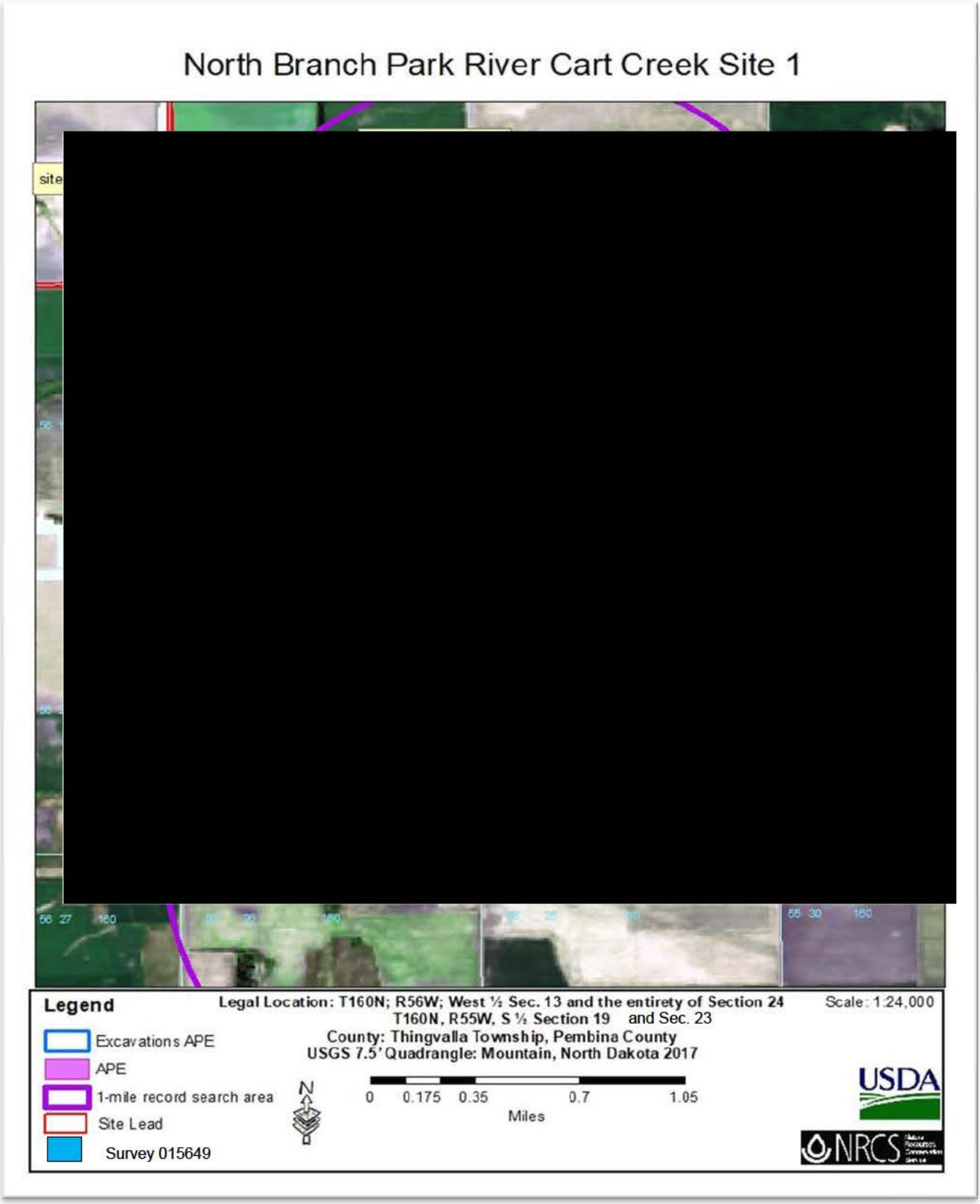


Figure 9. Updated design plans showing areas of proposed excavation and berm/levee construction.

5.0 Results of Field Reconnaissance:

On April 23, 2020, Christopher Plount, M.A., State Cultural Resources Specialist-East Zone completed a Class III survey of the entire APE. Representatives of the NRCS Cavalier Field Office and Houston Engineering were present. The team was escorted by Mr. Rick Hannesson, landowner, who provided historic information of the APE. A second pedestrian survey was conducted by Janelle Harrison, M.A., RPA, NRCS-State Cultural Resources Specialist on May 26, 2023, to document the small historic artifact scatter, and the location of the sites leads for the trails 32BPX201 and 32BPX202.

5.1 *Historic Ridge Trail:*

W ¼

, 11)

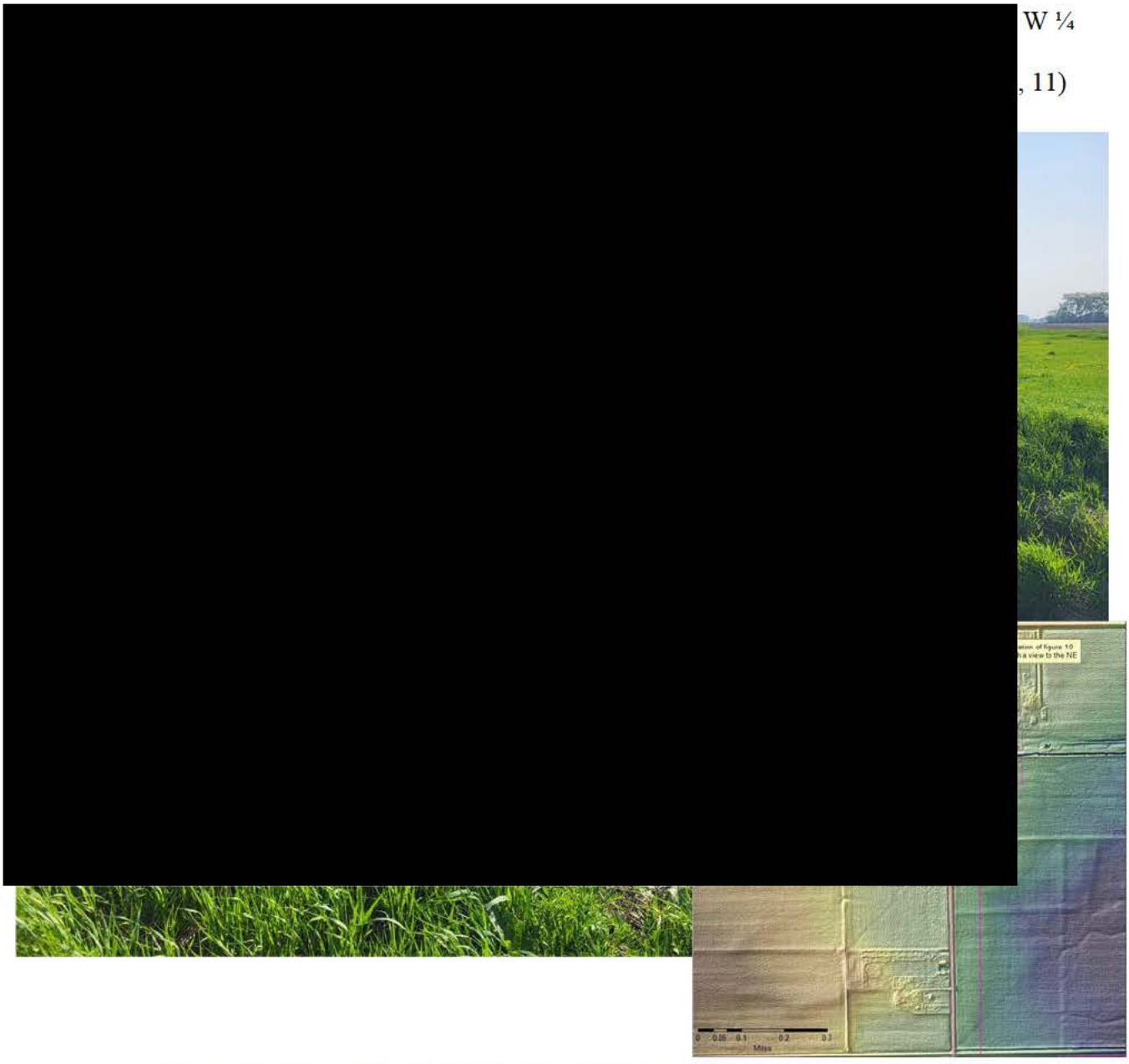


Figure 10. View of 32BPX202 looking to the northeast. Bridge is road 131st.

Figure 11. View of 32BPX202 looking to the southeast from west side of road/bridge.

The State Historical Society of North Dakota has provided details of the Red River Ox Cart Trails in a blog written by Jeff Blanchard. "The river trails were still used during dry times, and the primary trails were moved out of the Red River Valley onto the ancient beach ridges formed by glacial Lake Agassiz. Aptly called the Ridge Trail or West Plains Trail, the soil was much sandier and well-drained, making mud less of a factor" (Blanchard, 2020).

[redacted]

5.2 ***Site Lead 32PBX201:***

[redacted]
the APE.

5.3 ***Site Lead 32PBX202:***

[redacted] deemed not to be the best use of time and therefore no shove probes were conducted.

5.4 ***Rectangular Structure:***

The rectangular structure visible on LiDAR (Figure 5) was explored. Interview with the landowner (Hanneson) and on-site inspection revealed the rectangular structure shown on LiDAR (Figure 5) is a seasonal dam used to control intermittent flooding. The landowner informed the field team that a skid steer or similar equipment is occasionally used to construct an earthen diversion dam during periods of high rainfall. The structure is frequently rebuilt using the surrounding soil as borrow (Figure 12). Records discovered after the field work supported Mr. Hanneson's claim (Figure 13).

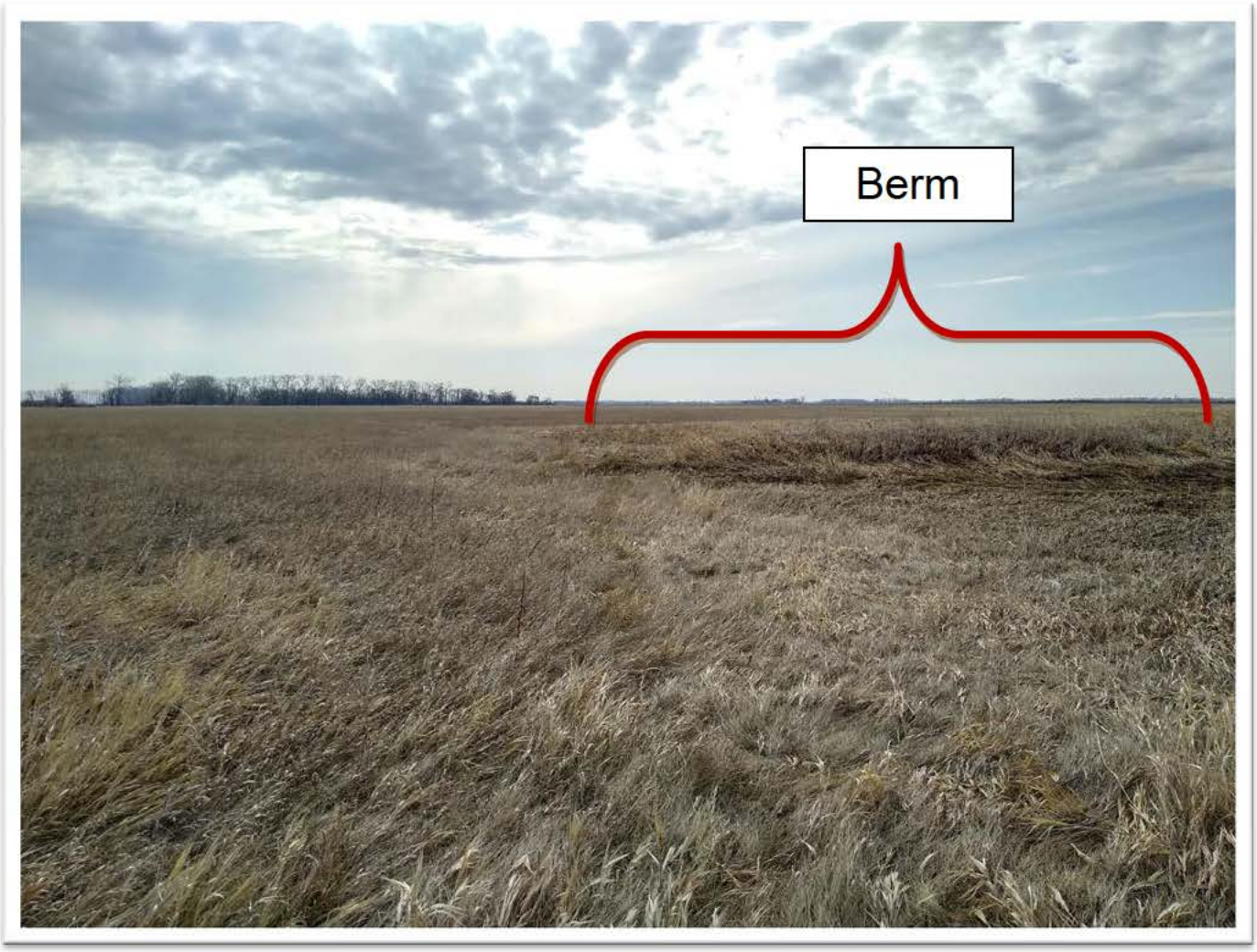


Figure 12. Berm structure; flattened and in need of seasonal repair.

Figure 13. Area of berm structure (WL5) showing areas of sediment removal. Image Source: NRCS Archives.

5.5 Site 32PB263:

Site 32PB263 is the surface remains of an unknown structure shown on the Mountain 7.5 minute (1964) topographic map (Figure 6) was determined to be the remains of a farmhouse. Several artifacts were scattered across a wide area. Red and cream bricks and a cartwheel hub (Figure 14); pieces of laminate floor tile, and metal fragments were strewn about the surface. Various shards of thick brown bottles and glass containers, none with markings, were readily evident. Mr. Hanneson proffered that the farmhouse had been razed and the remains burned in the 1980's.

According to the landowner, the privy and cellar were filled in, then plowed under, in order to maximize the crop acreage. Additionally, Mr. Hanneson installed a subsurface drain system known as "Tiling", far below the plow zone, that controls drainage/standing water further disturbing the potential site.

The site has endured heavy ground disturbance. The heaviest concentration of surface artifacts was plotted (Figure 18) but are unlikely to provide meaningful context to the former farmhouse. In addition to a subsurface drain system and 40 years of agricultural production, figure 10 shows that sediment removal intersects the southernmost artifact area further disturbing the site. Temporal/stratigraphic integrity is unlikely due to heavy ground disturbance and the former home site is unlikely to provide further historic or scientific data under Criterion D of the NRHP, therefore no shovel probes were conducted at 32PB263.

Figure 14. Red and cream-colored brick at razed farm site.

Figure 15. Wheel hub and metal object at razed farm site.

Figure 16. Solarized (amethyst color) bottle neck.

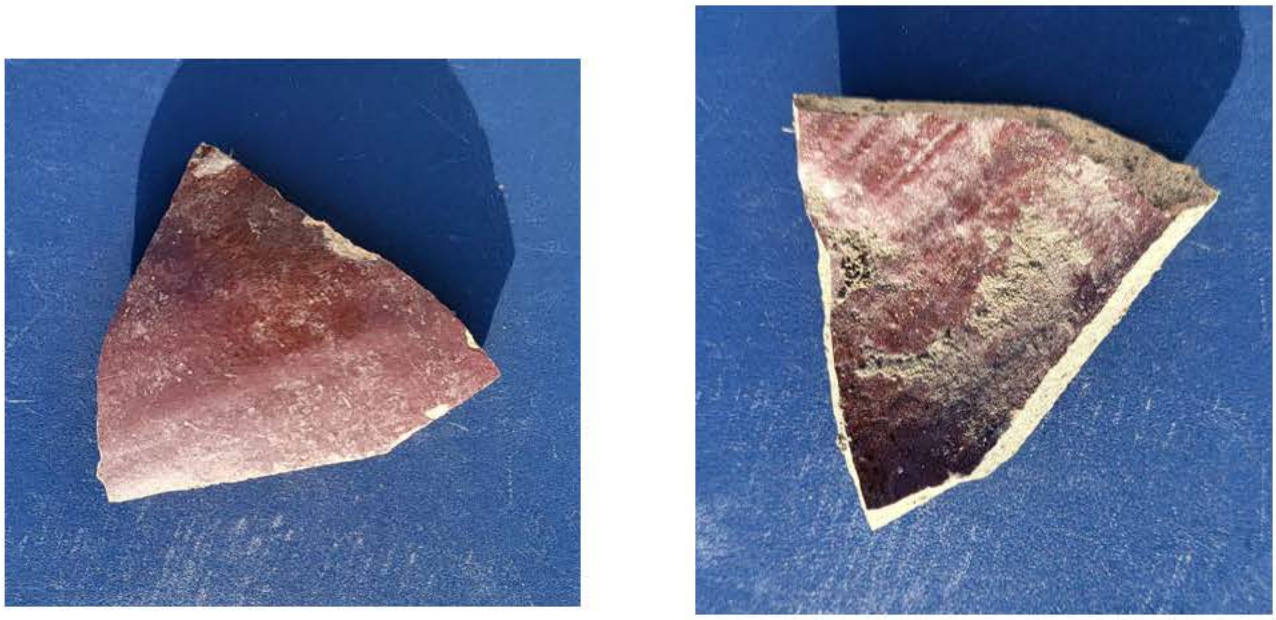


Figure 17. Red ceramic sherd.

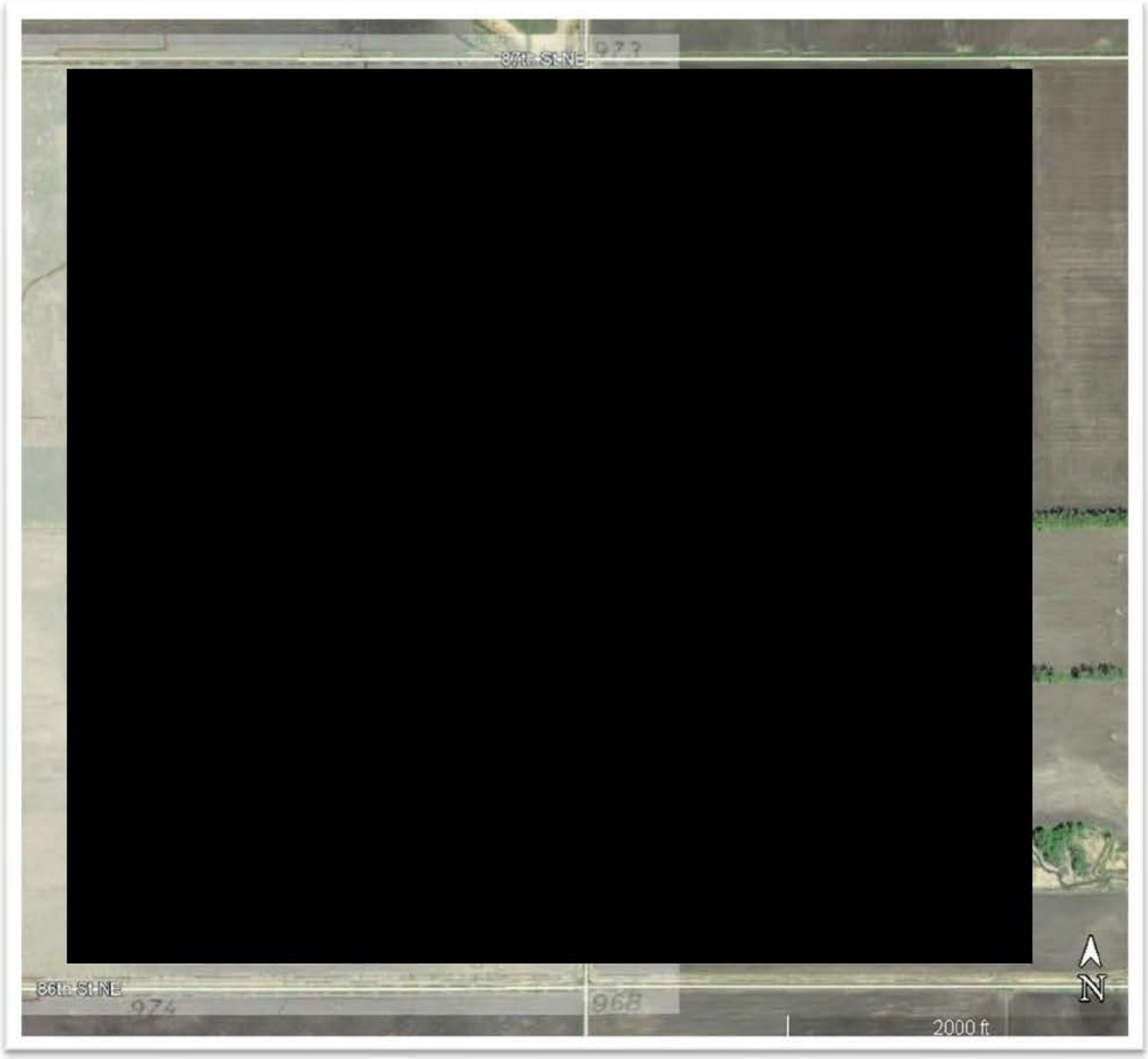
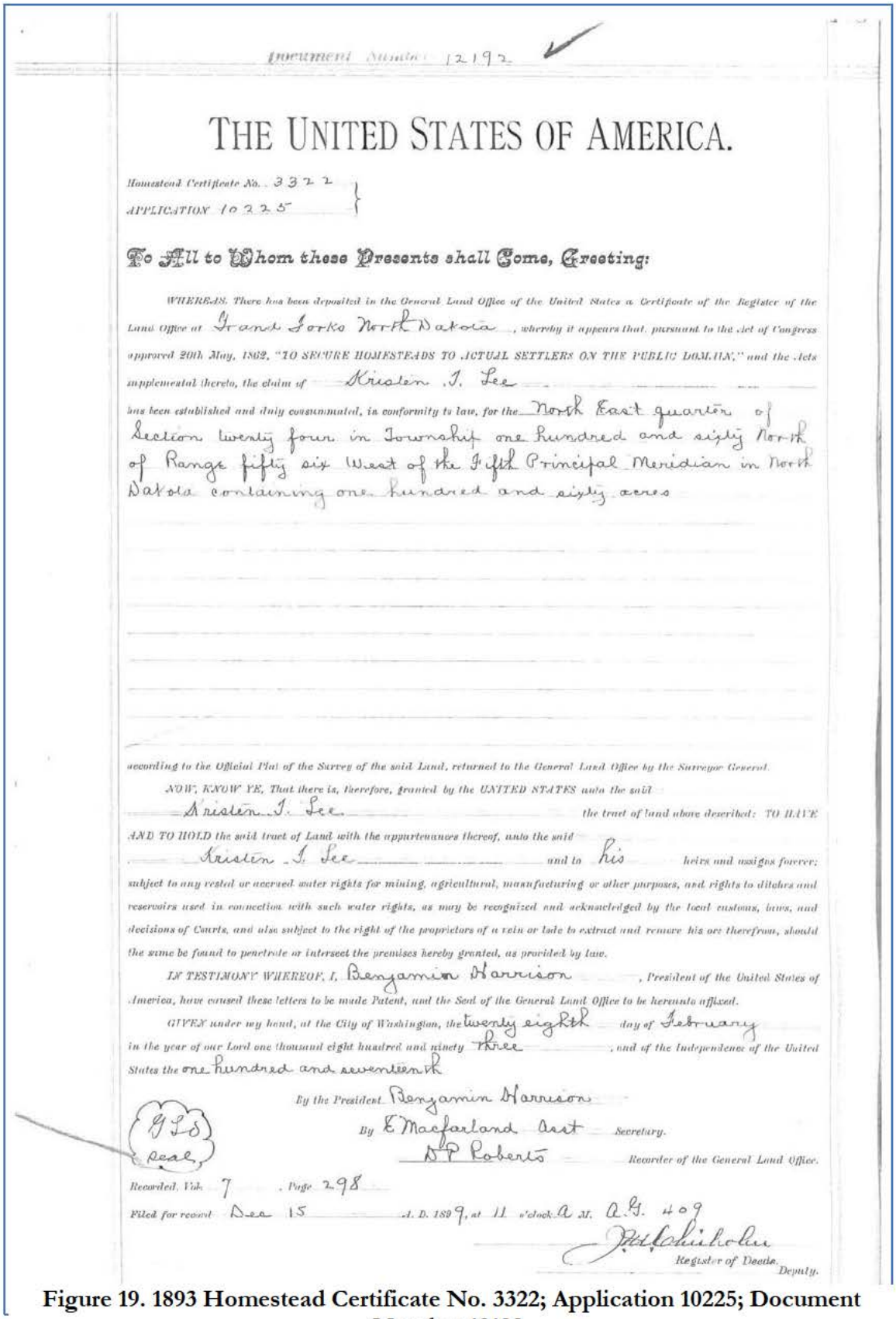


Figure 18. 1964 topo overlaid with 2018 satellite imagery. Artifact scatter depicted in pink outline.



Document Number 12192.

THE UNITED STATES OF AMERICA.

Homestead Certificate No. 3322
APPLICATION 10225

To All to Whom these Presents shall Come, Greeting:

WHEREAS, There has been deposited in the General Land Office of the United States a Certificate of the Register of the Land Office at Grand Forks North Dakota, whereby it appears that, pursuant to the Act of Congress approved 20th May, 1862, "TO SECURE HOMESTEADS TO ACTUAL SETTLERS ON THE PUBLIC DOMAIN," and the Acts supplemental thereto, the claim of Kristen I. Lee has been established and duly consummated, in conformity to law, for the North East quarter of Section twenty four in Township one hundred and sixty North of Range fifty six West of the Fifth Principal Meridian in North Dakota containing one hundred and sixty acres

according to the Official Plat of the Survey of the said Land, returned to the General Land Office by the Surveyor General.

NOW, KNOW YE, That there is, therefore, granted by the UNITED STATES unto the said Kristen I. Lee the tract of land above described: TO HAVE AND TO HOLD the said tract of Land with the appurtenances thereof, unto the said Kristen I. Lee and to his heirs and assigns forever; subject to any vested or accrued water rights for mining, agricultural, manufacturing or other purposes, and rights to ditches and reservoirs used in connection with such water rights, as may be recognized and acknowledged by the local customs, laws, and decisions of Courts, and also subject to the right of the proprietors of a vein or lode to extract and remove his ore therefrom, should the same be found to penetrate or intersect the premises hereby granted, as provided by law.

IN TESTIMONY WHEREOF, I, Benjamin Harrison, President of the United States of America, have caused these letters to be made Patent, and the Seal of the General Land Office to be hereunto affixed.

GIVEN under my hand, at the City of Washington, the twenty eighth day of February in the year of our Lord one thousand eight hundred and ninety three, and of the Independence of the United States the one hundred and seventeenth

By the President Benjamin Harrison
By E. Macfarland Asst Secretary.
D. P. Roberts Recorder of the General Land Office.

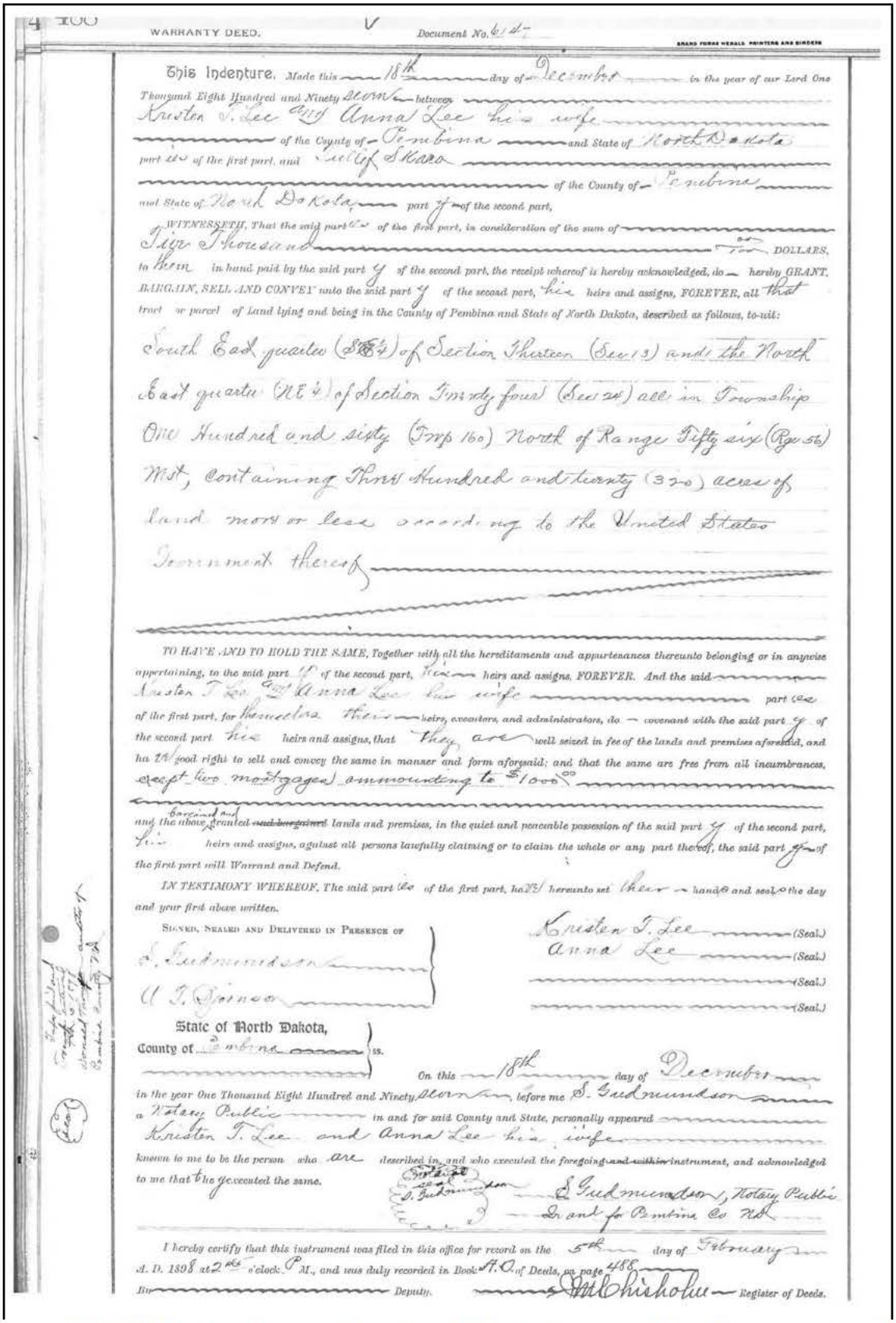
(G L O Seal)

Recorded, Vol. 7, Page 298

Filed for record Dec 15 A. D. 1899, at 11 o'clock A M. A.G. 409

Register of Deeds. Deputy.

Figure 19. 1893 Homestead Certificate No. 3322; Application 10225; Document Number 12192.



WARRANTY DEED. Document No. 6147

This Indenture, Made this 18th day of December in the year of our Lord One Thousand Eight Hundred and Ninety Seven between Kristen T. Lee and Anna Lee his wife of the County of Pembina and State of North Dakota part ies of the first part, and Nellie S Kaza of the County of Pembina and State of North Dakota, part y of the second part,

WITNESSETH, That the said part ies of the first part, in consideration of the sum of Five Thousand Dollars, to them in hand paid by the said part y of the second part, the receipt whereof is hereby acknowledged, do hereby GRANT, BARGAIN, SELL AND CONVEY unto the said part y of the second part, his heirs and assigns, FOREVER, all that tract or parcel of Land lying and being in the County of Pembina and State of North Dakota, described as follows, to-wit:

South East quarter (SE¼) of Section Thirteen (Sec 13) and the North East quarter (NE¼) of Section Twenty four (Sec 24) all in Township One Hundred and sixty (Twp 160) North of Range Fifty six (Rge 56) West, containing Three Hundred and twenty (320) acres of land more or less according to the United States Government thereof.

TO HAVE AND TO HOLD THE SAME, Together with all the hereditaments and appurtenances thereunto belonging or in anywise appertaining, to the said part y of the second part, his heirs and assigns, FOREVER. And the said Kristen T. Lee and Anna Lee his wife part ies of the first part, for themselves their heirs, executors, and administrators, do covenant with the said part y of the second part his heirs and assigns, that they are well seized in fee of the lands and premises aforesaid, and ha ve good right to sell and convey the same in manner and form aforesaid; and that the same are free from all incumbrances, except two mortgages amounting to $1000.00

and the above granted ~~and bargained~~ lands and premises, in the quiet and peaceable possession of the said part y of the second part, his heirs and assigns, against all persons lawfully claiming or to claim the whole or any part thereof, the said part y of the first part will Warrant and Defend.

IN TESTIMONY WHEREOF, The said part ies of the first part, ha ve hereunto set their hands and seals the day and year first above written.

SIGNED, SEALED AND DELIVERED IN PRESENCE OF

S. Sudmundson
U. T. Grinde

Kristen T. Lee (Seal.)
Anna Lee (Seal.)
(Seal.)
(Seal.)

State of North Dakota,
County of Pembina ss.

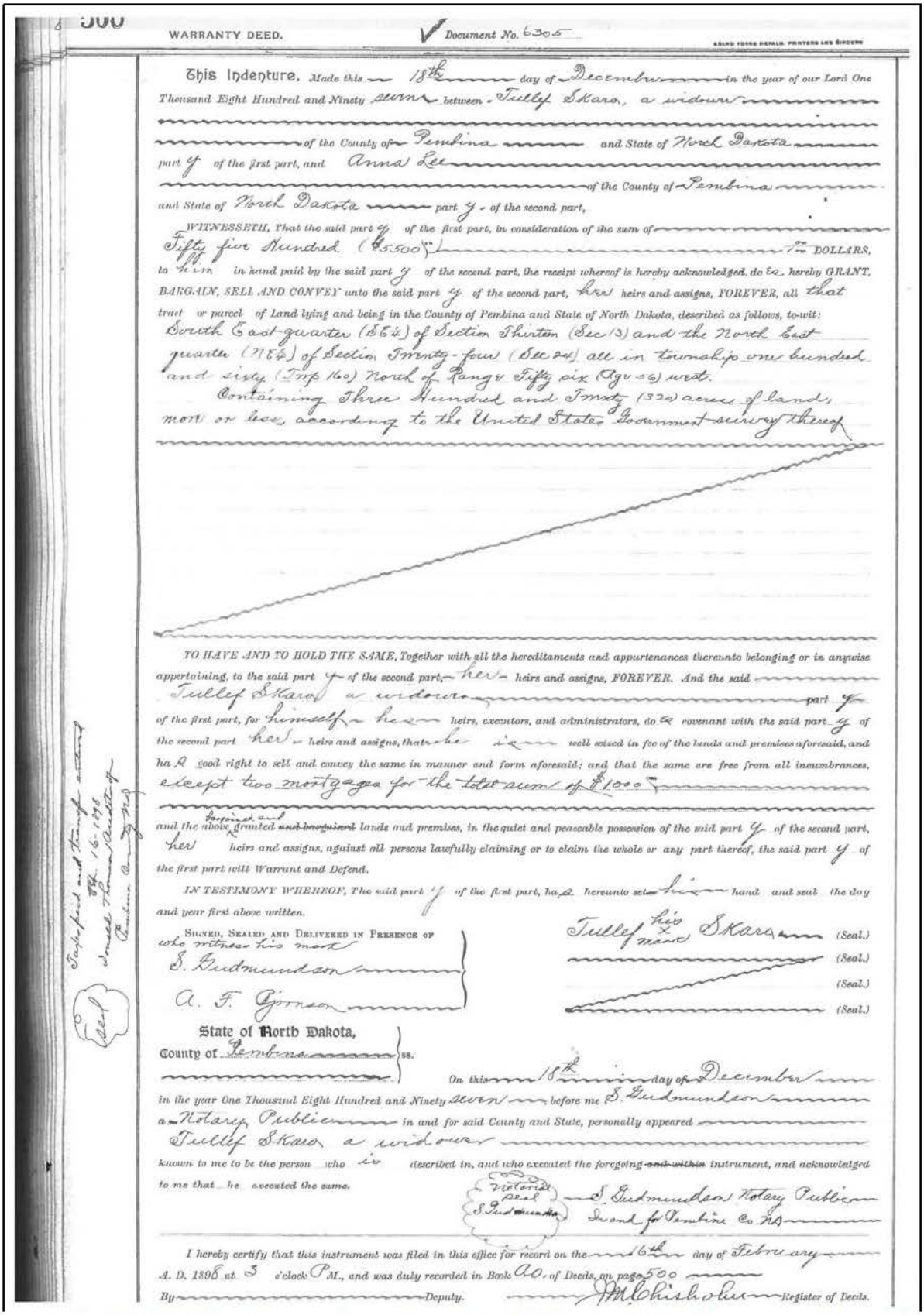
On this 18th day of December in the year One Thousand Eight Hundred and Ninety Seven, before me S. Sudmundson a Notary Public in and for said County and State, personally appeared Kristen T. Lee and Anna Lee his wife known to me to be the person who are described in, and who executed the foregoing ~~and within~~ instrument, and acknowledged to me that they executed the same.

S. Sudmundson, Notary Public
In and for Pembina Co ND

I hereby certify that this instrument was filed in this office for record on the 5th day of February A. D. 1898 at 2 o'clock P. M., and was duly recorded in Book A O of Deeds, on page 488

By Deputy. M. L. Nicholls Register of Deeds.

Figure 20. 1897 Pembina County Recorder of Deeds. Warranty Deed Document No. 6147.



WARRANTY DEED. Document No. 6305

This Indenture. Made this 18th day of December in the year of our Lord One Thousand Eight Hundred and Ninety seven between Tullef Skaro, a widower of the County of Pembina and State of North Dakota part y of the first part, and Anna Lee of the County of Pembina and State of North Dakota part y of the second part,

WITNESSETH, That the said part y of the first part, in consideration of the sum of Fifty five Hundred ($5500) DOLLARS, to him in hand paid by the said part y of the second part, the receipt whereof is hereby acknowledged, do hereby GRANT, BARGAIN, SELL AND CONVEY unto the said part y of the second part, her heirs and assigns, FOREVER, all that tract or parcel of Land lying and being in the County of Pembina and State of North Dakota, described as follows, to-wit:

South East-quarter (SE¼) of Section Thirteen (Sec 13) and the North East quarter (NE¼) of Section Twenty-four (Sec 24) all in township one hundred and sixty (Twp 160) North of Range Fifty six (Rge 56) west.

Containing Three Hundred and Twenty (320) acres of land, more or less, according to the United States Government survey thereof

TO HAVE AND TO HOLD THE SAME, Together with all the hereditaments and appurtenances thereunto belonging or in anywise appertaining, to the said part y of the second part, her heirs and assigns, FOREVER. And the said Tullef Skaro a widower part y of the first part, for himself he heirs, executors, and administrators, do covenant with the said part y of the second part her heirs and assigns, that he is well seized in fee of the lands and premises aforesaid, and has good right to sell and convey the same in manner and form aforesaid; and that the same are free from all incumbrances, except two mortgages for the total sum of $1000

and the above granted ~~and bargained~~ lands and premises, in the quiet and peaceable possession of the said part y of the second part, her heirs and assigns, against all persons lawfully claiming or to claim the whole or any part thereof, the said part y of the first part will Warrant and Defend.

IN TESTIMONY WHEREOF, The said part y of the first part, has hereunto set his hand and seal the day and year first above written.

Signed, Sealed and Delivered in Presence of who witness his mark
S. Gudmundson
A. F. Gjerson

Tullef his x mark Skaro (Seal.)
(Seal.)
(Seal.)
(Seal.)

State of North Dakota, County of Pembina } ss.

On this 18th day of December in the year One Thousand Eight Hundred and Ninety seven before me S. Gudmundson a Notary Public in and for said County and State, personally appeared Tullef Skaro a widower known to me to be the person who is described in, and who executed the foregoing ~~and within~~ instrument, and acknowledged to me that he executed the same.

Victoria Seal S. Gudmundson Notary Public
In and for Pembina Co. N.D.

I hereby certify that this instrument was filed in this office for record on the 16th day of February A. D. 1898 at 3 o'clock P.M., and was duly recorded in Book A.O. of Deeds, on page 500

By Deputy. M. Chisholm Register of Deeds.

Figure 21. 1897 Pembina County Recorder of Deeds. Warranty Deed Document No. 6305.

5.6 ***Engineering Plan Field Investigation:***

Examination of the engineering plans produced three areas for special scrutiny. The North Inlet, Primary and Auxiliary Spillways. All three areas are heavily disturbed with extant water control structures and adjacent to *in use* cropland. All showed evidence of semi-regular high-water events. No shovel testing was performed due to the level of continuous ground disturbance from previously constructed water controls and agricultural use. Ground visibility varied between 50-90 percent.

The North Inlet Channel will replace extant culverting (Figure 22) and will follow the previously excavated area south of Cart Creek, into the agricultural field. Pedestrian survey revealed no cultural material but evidence of heavy erosion due to flood events was apparent. The creek ditching and field are separated by a three-wire barbed wire fence with portions in disrepair. Areas described are readily visible on satellite imagery.

Figure 22. Extant structure at proposed north inlet channel. Image: Google Earth 2019.

The principal spillway will rehabilitate the visible culvert system (Figure 23) and clear and expand the extend the flood zone/drainage infrastructure. Pedestrian survey was hindered due to the knee high, brown grass and “gumbo” like sediment build up on the culverts west side. Prior flood events were apparent due to the quantity of modern detritus (beer cans, Styrofoam, plastic bags) in the area. Ground visibility was less than ideal but the conditions of the area make inadvertent discovery of cultural resources unlikely.

Figure 23. Extant structure and flood zone at proposed principal spillway. Image: Google Earth 2019.

The Auxiliary Spillway will rehabilitate the visible culvert system (Figure 24) and deepen the existing flood zone/drainage infrastructure with a berm on the north side. The extant structure is 8 feet (2.43 m) deep and 35 feet (10.72 m) wide. At the undertaking will not exceed the current footprint, visual examination from the top of the structure was deemed sufficient. Due to the volume of water that transits the canal, inadvertent discovery of cultural resources is unlikely.

Figure 24. Extant ditching at proposed auxiliary spillway. Image Source: Google Earth 2019.

The proposed undertaking in T160N, R55W, S ½ Section 19 consists of deepening the extant drainage canal (Figure 25) between 132ND Avenue and 86th Street NE. The APE will act as improved drainage for flood events into Cart Creek. Overgrown shrub, rubbish removal and culvert replacement will occur within the existing footprint. The structure is a continuation of the drainage canal previously described and shown in figure 23. It is 8 feet (2.43 m) deep and 35 feet (10.72 m) wide No ground disturbance is anticipated beyond the outlined APE (Figure 26).

Figure 25. 2019 satellite view of Section 19 existing drainage improvement. Image Source: Google Earth 2019.

Figure 26. Section 19 existing drainage improvement highlighted in yellow. Image: Google Earth 2019.

6.0 CONCLUSIONS:

A Class I literature review by McFarlane Consulting (2018) and reconfirmed by an SOI qualified NRCS Cultural Resources Specialist discovered no NRHP eligible properties within one mile of the APE. The minor difference in descriptions for 32PBX201 and 32PBX202 are germane for analysis of this report but regarding the APE, irrelevant. The undertaking will have no effect on the sites.

The Class III survey conducted by Christopher Plount, M.A., in 2020 and Janelle Harrison, M.A., RPA, in 2023 resulted in no discovery of cultural resources or properties eligible for the National Register of Historic Places within the APE. The structure visible on LiDAR was resolved to be a manmade water control berm that is regularly reinforced with surrounding topsoil and plant material. It has no historic value.

The destruction of the farmhouse site in Section 24 is unfortunate. The lack of site integrity due to profound ground disturbance precludes any meaningful interpretation of the site or artifacts. Further investigation would be non-productive.

The three areas of direct impact (ADI) are shown on the engineering plans are within the boundaries of extant water control structures. The areas are visibly affected by high water events and erosion.

7.0 RECOMMENDATIONS:

North Branch Park River Cart Creek Site 1 has no cultural resource concerns that may delay action on the undertaking. The farmhouse artifact scatter 32BP263 is unlikely to yield further data that would contribute to its eligibility for the NRHP. The undertaking, as designed, should proceed and a determination of "***No Historic Properties Adversely Affected***" is recommended.

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APPENDIX A

CLASS I LITERATURE SEARCH

NORTH BRANCH PARK RIVER WATERSHED PLAN – ENVIRONMENTAL ASSESSMENT

CAVALIER, PEMBINA, AND WALSH COUNTIES, NORTH DAKOTA

Report Prepared for:

North Branch Park River Watershed District

and

Houston Engineering
6901 East Fish Lake Road, Suite 140
Maple Grove, MN 58369

James Cummings
Principal Investigator

McFarlane Consulting LLC
684 Orleans Street
Saint Paul, MN 55107

Report Authors:

Joseph McFarlane and James Cummings
Project Report 2018.012
September 2018

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1.0 EXECUTIVE SUMMARY

The North Branch Park River Water Resource District (NBPR-WD) is preparing the North Branch Watershed Plan – Environmental Assessment (EA) for the North Branch Park River in northeastern North Dakota (Exhibit 1). The North Branch Watershed Planning Project (Project) is located within portions of Cavalier, Pembina, and Walsh counties, North Dakota. The purpose of the project is to reduce flood damages, resulting from a 10-year rainfall event, that occur to agricultural lands and public infrastructure with the communities that reside along the North Branch Park River. Also, the purpose is to increase flood resiliency during the 100-year rainfall event for the community of Crystal, ND.

The Project is subject to review by the North Dakota State Historic Preservation Office (ND-SHPO). To ensure compliance with ND-SHPO regulatory requirements, Houston Engineering, Inc. (HEI), on behalf of NBPR-WD, contracted with McFarlane Consulting, LLC to perform a Class I Literature Search of the Project area. The purpose of the Literature Search is to identify all known historic cultural resources within the NBPR-WD. Literature search results will be used to develop management plans and to evaluate adverse effects posed to cultural resources within the watershed district.

Class I Inventory Search Results

Two NRHP properties, 11 architectural structures, 46 historic sites, 16 historic cemeteries and 18 archaeological sites were identified within the watershed district (Exhibits 2 through 4).

Based on the high number of known cultural resources within the watershed district, only general cultural resource management recommendations are being posed in this report. Detailed site-specific information will be provided as the North Branch Park River Watershed Plan – Environmental Assessment (EA) is formalized. In general, Class II Archaeological survey is warranted for all areas where ground disturbing activities and/or inundation are likely to occur.

James Cummings
Principal Investigator

9/18/2018
Date

The indiscriminate disclosure or publication of cultural resource data herein may result in unnecessary damage to the resources. The public release of site specific locational data provided by the State Historical Society of North Dakota requires the written permission of the Director thereof.

2.0 INTRODUCTION

The North Branch Park River Watershed District (NBPR-WD) is preparing the North Branch Park River Watershed Plan Environmental Assessment (EA) for the North Branch Park River in northeastern North Dakota (Exhibit 1). The North Branch Park River Watershed Planning Project (Project) is located within portions of Cavalier, Pembina, and Walsh counties, North Dakota. The purpose of the project is to reduce flood damages, resulting from a 10-year rainfall event, that occur to agricultural lands and public infrastructure within the communities that reside along the North Branch Park River. Also, the purpose is to increase flood resiliency during the 100-year rainfall event for the community of Crystal, ND.

The Project is subject to review by the North Dakota State Historic Preservation Office (ND-SHPO). To ensure compliance with ND-SHPO regulatory requirements, Houston Engineering, Inc. (HEI), on behalf of NBWD, contracted with McFarlane Consulting, LLC to perform a Class I Literature Search of the Project area. The purpose of the Literature Search is to identify all known historic cultural resources within the NBWD. Literature search results will be used to develop management plans and to evaluate adverse effects posed to cultural resources within the watershed district.

The literature search was conducted by James Cummings, Principal Investigator. The literature search results were compiled by staff archaeologist Joe McFarlane.

3.0 PROJECT INFORMATION

3.1 Class I Study Area

The NBPR-WD encompasses approximately 260 square miles of study area (Exhibit 1).

3.2 Area of Potential Effect (APE)

For archaeological purposes, an APE is defined as any area where ground disturbing activities are likely to occur. Ground disturbing activities typically associated with watershed management projects include the construction of embankments, diversion ditches, outlet ditches, holding ponds, and discharge from outlet ditches with the potential to affect river bank stability.

4.0 RESEARCH DESIGN

4.1 Research Objectives

Research objectives were designed to meet survey requirements of the Secretary of the Interior's Standards for Identification and Evaluation, and the *North Dakota SHPO Guidelines Manual for Cultural Resource Inventory Projects, Revised Edition* (2012, updated 4/21/2017). The objectives included:

- Identify all historic properties within the Project area.
- Delineate areas with high archaeological potential.
- Provide recommendations to guide Project layout designs and develop strategies to minimize the adverse effects on all, if any, historic cultural resources within the Project area.

4.2 Methodology

Background research was conducted to identify all recorded historic properties within the project area. Historic and environmental contexts were also reviewed to identify areas likely to contain cultural materials. Archival records checked included but are not limited to:

- Archaeological Site Files and report inventories of the ND-SHPO.
- NRHP listings of the National Park Service.
- Original Public Land Survey records, U.S. Department of the Interior.
- Historical Atlases and Plat books.
- Environmental literature of the project area.

5.0 BACKGROUND RESEARCH RESULTS

Information regarding cultural resources sites is being provided for use in Project planning and evaluating impacts to resources. The public release of site specific locational data provided by the State Historical Society of North Dakota requires the written permission of the Director thereof.

5.1 National Register Properties

The NRHP inventory maintained by the National Park Service lists two NRHP properties within the NBPR-WD (Table 1, Exhibit 2).

Table 1: National Register Properties.

County	NRHP #	ND Site #	Legal Description	Name
[redacted]				

5.2 Architectural Structures

The Architectural Structures database maintained by the ND-SHPO lists 11 architectural structures within the NBPR-WD (Table 2. Exhibit 2).

Table 2: Architectural Structures.

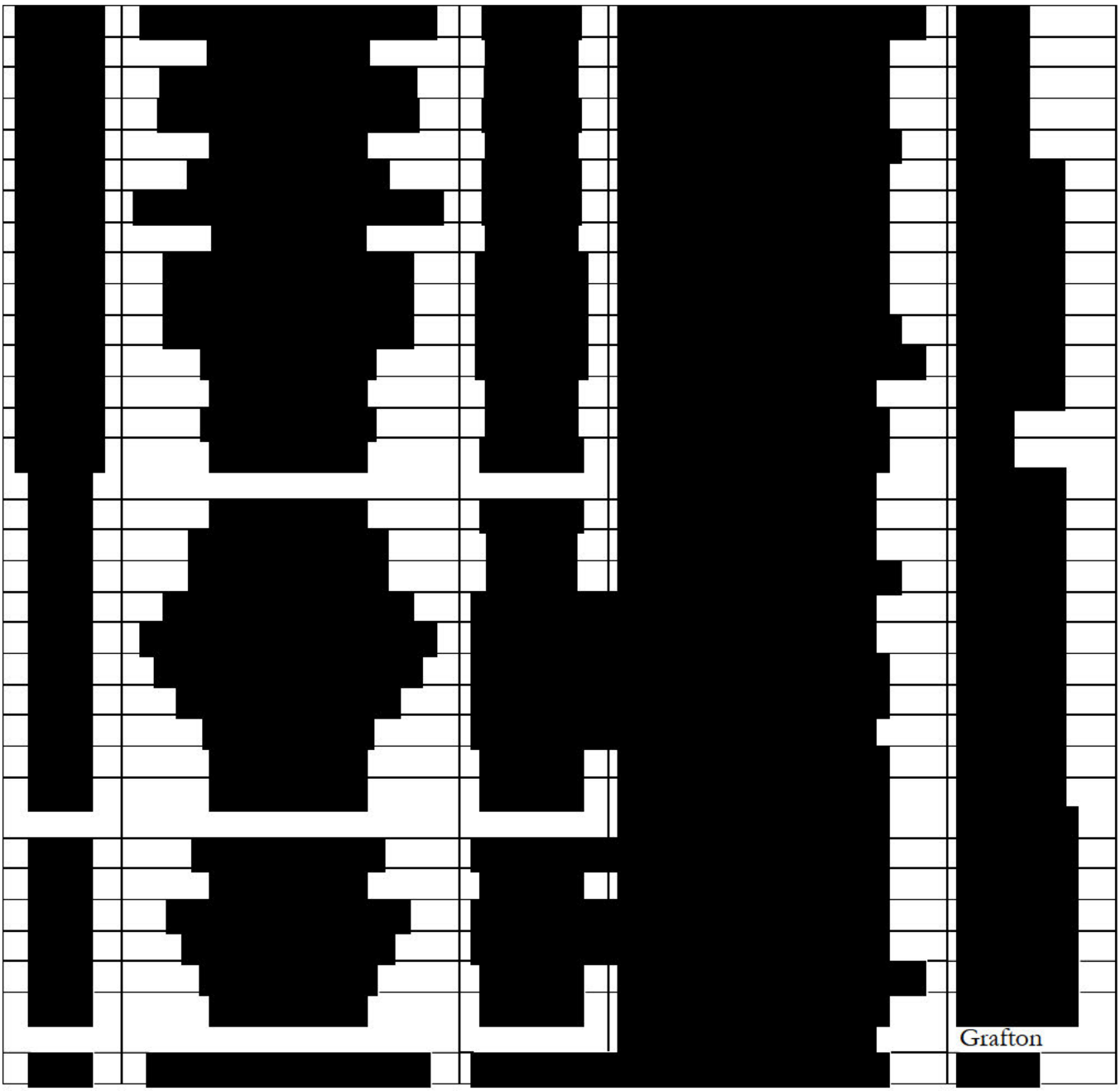
County	Structure Name	Structure #	Location	Township
[redacted]				

5.3 Historic Sites

The historic sites database maintained by the ND-SHPO lists 46 historic sites within the NBPR-WD (Table 3. Exhibit 2).

Table 3: Historic Sites.

County	Site Name	Site #	Location	Township
[redacted]				



5.4 Cemeteries

Sixteen historic cemeteries were identified within the NBPR-WD (Table 4. Exhibit 2).

Table 4: Historic Cemeteries.

County	Name	ND-SHPO #	Legal Description	Township Name
Cavalier	Dovre	32CV137	T160N, R58W, Section 14	Alma
Cavalier	Union	32CV136	T160N, R58W, Section 21	Alma
Cavalier	Milton Memorial		T160N, R57W, Section 32	East Alma
Cavalier	St. Clothilda		T159N, R57W, Section 5	Montrose
Pembina	Gardar	32PB140	T159N, R56W, Section 16	Gardar
Pembina	Mountain	32PBX32	T160N, R56W, Section 16	Thingvalla
Pembina	Mountain #2	32PBX52	T160N, R56W, Section 16	Thingvalla
Pembina	Eyford		T160N, R56W, Section 34	Thingvalla
Pembina	Stokesville		T159N, R55W, Section 7	Crystal
Pembina	West Point		T159N, R55W, Section 9	Crystal

Pembina	Crystal		T159N, R55W, Section 13	Crystal
Pembina	Crystal #2		T159N, R54W, Section 18	Elora
Pembina	St. John's Church		T159N, R54W, Section 8	Elora
Pembina	Pioneer Church		T159N, R56W, Section 21	Gardar
Walsh	Hoople		T158N, R54W, Section 5	Glenwood
Walsh	Hvideso Church		T159N, R55W, Section 8	Dundee

5.5 Archaeological Sites

The North Dakota archaeological site database maintained by the SHPO was examined to identify all known archaeological sites within the NBPR-WD. The literature search identified a total of 18 archaeological sites (Table 5, Exhibit 2).

Table 5: Archaeological Sites.

County	Site Number	Description	Legal Description	Township
[redacted]				

6.0 CONCLUSION

Two NRHP properties, 11 architectural structures, 46 historic sites, 16 historic cemeteries and 18 archaeological sites were identified within the watershed district (Exhibits 2 through 4).

Based on the high number of known cultural resources within the watershed district, only general cultural resource management recommendations are being posed in this report. Detailed site-specific information will be provided as the North Branch Park River Watershed Plan – Environmental Assessment (EA) is formalized. In general, Class II Archaeological survey is warranted for all areas where ground disturbing activities and/or inundation are likely to occur.

7.0 REFERENCES

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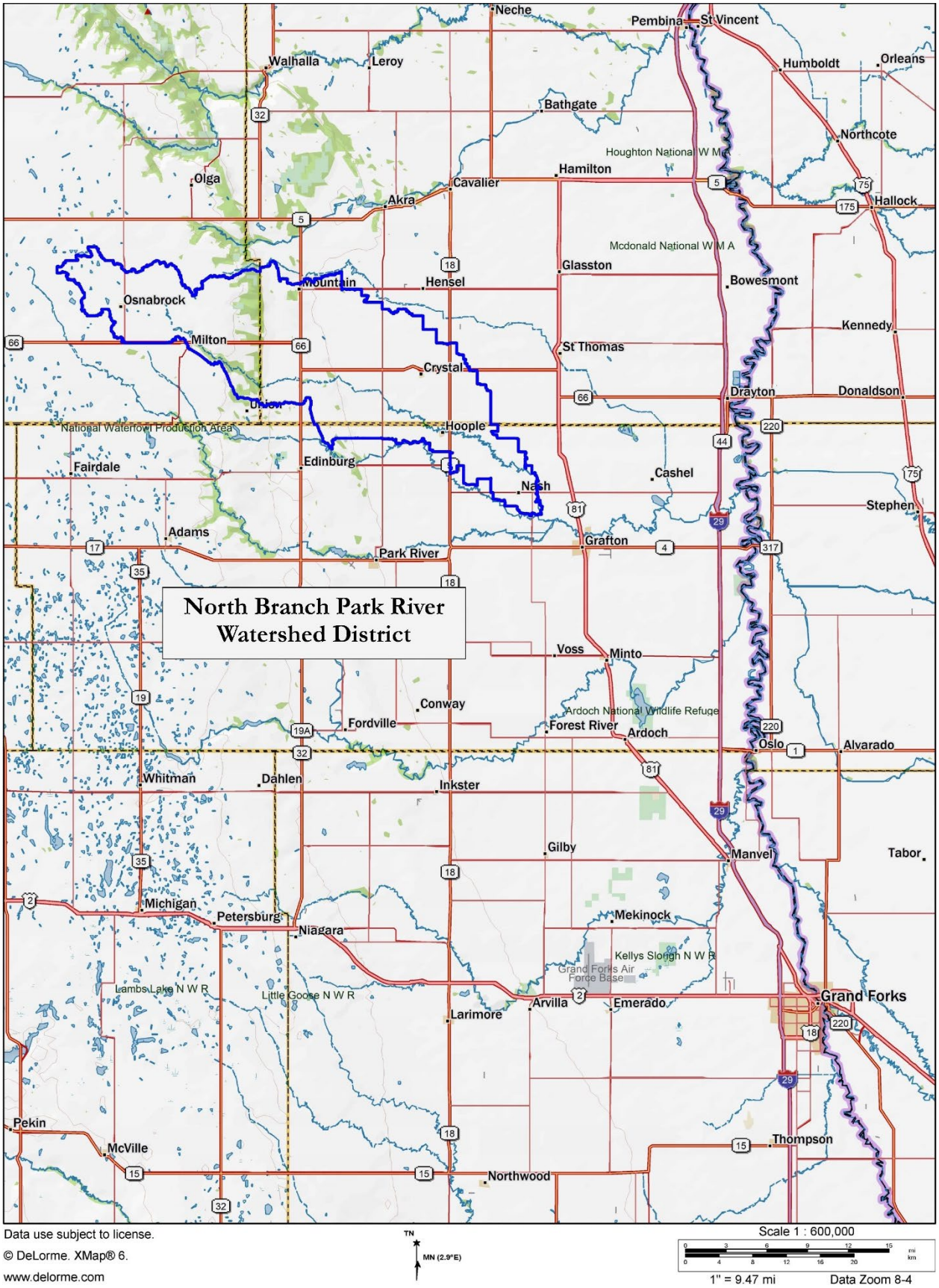
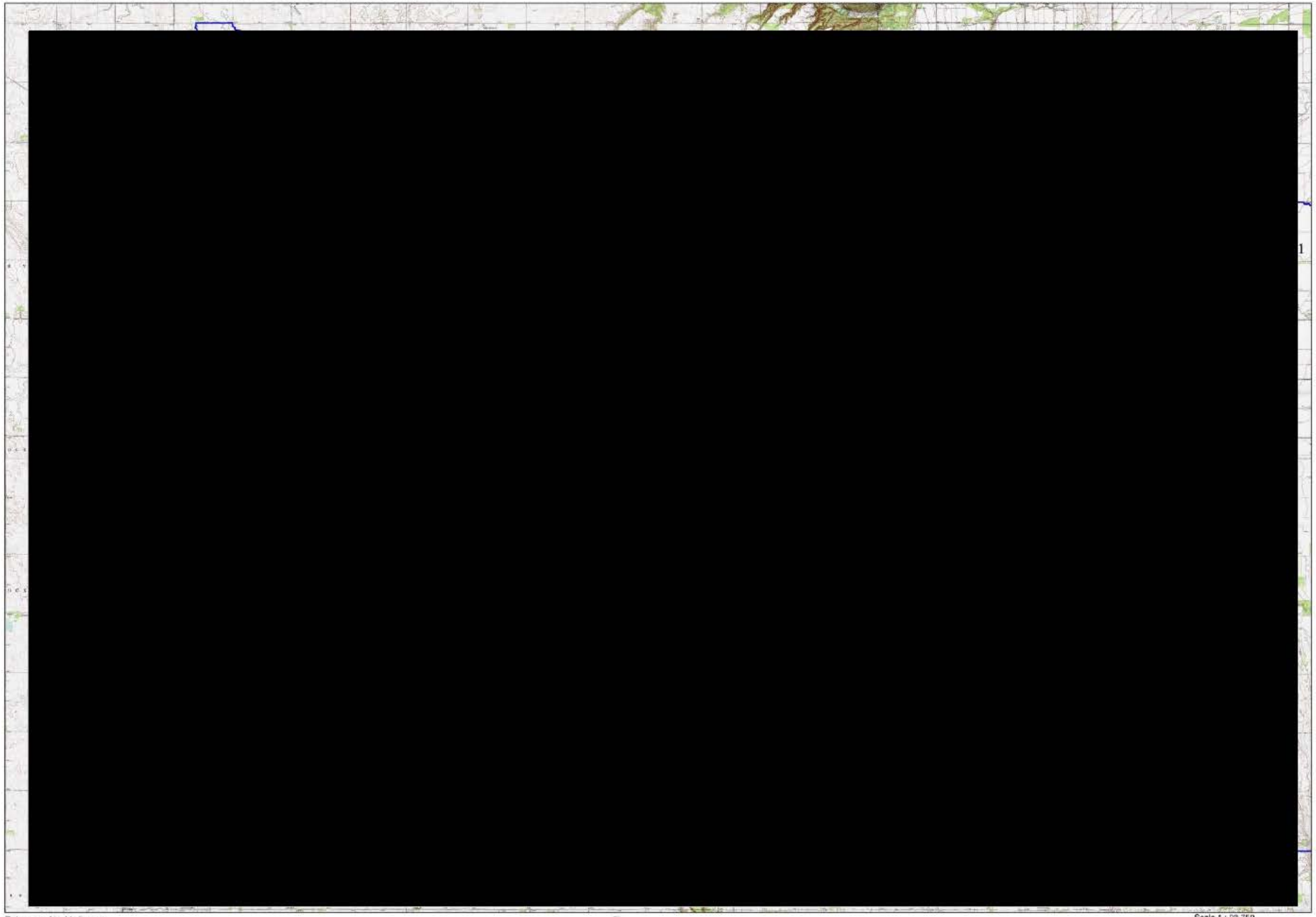
8.0 EXHIBITS

8.1 Exhibit 1: North Branch Park River Watershed Resource District

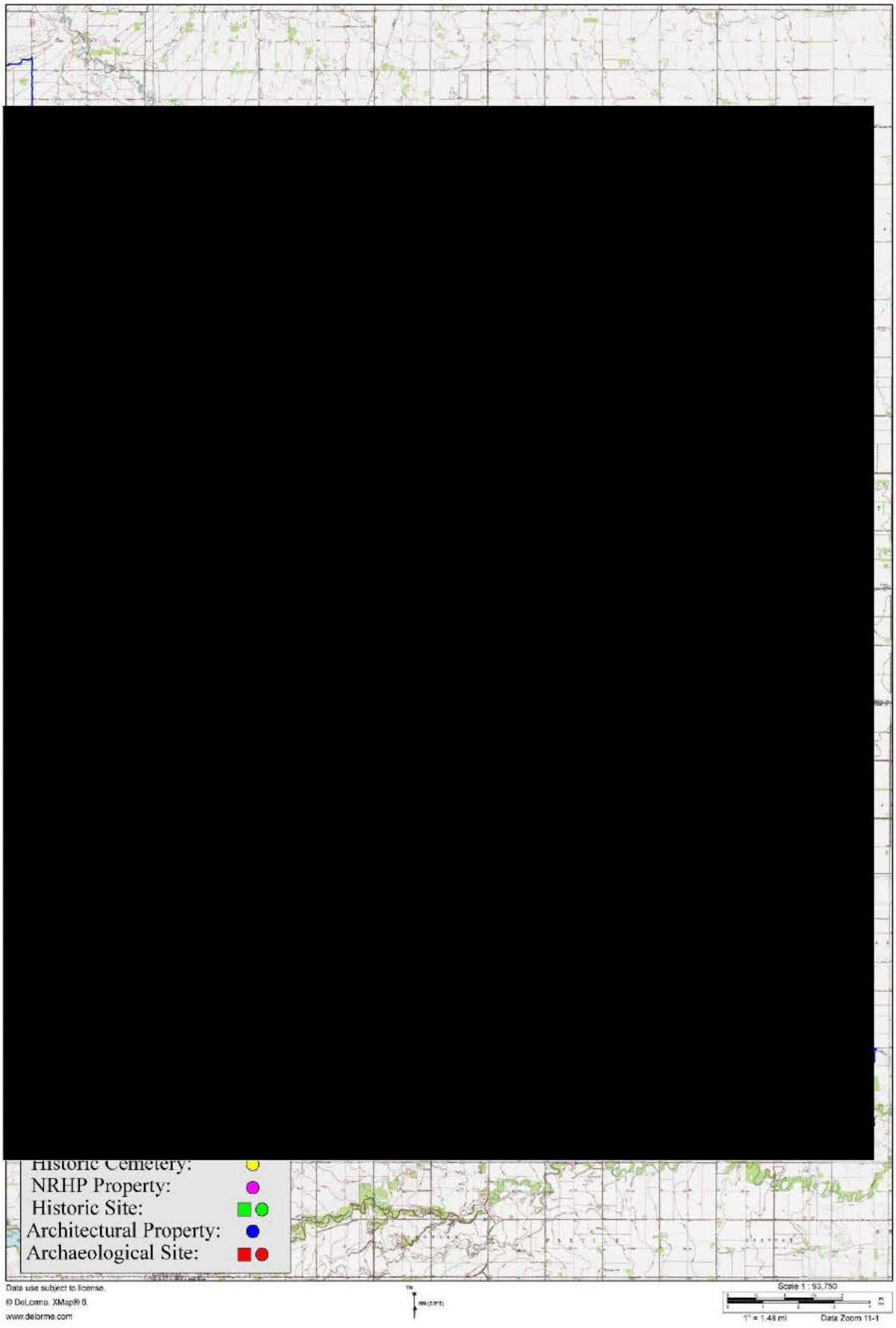


8.2 Exhibit 2: Historic Resources

8.3 *Exhibit 3: Historic Resources West*



8.4 *Exhibit 4: Historic Resources East*



APPENDIX B

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

DIKE

(Feet)

CODE 356

DEFINITION

A barrier constructed of earth or manufactured materials.

PURPOSES

- To protect people and property from floods.
- To control water level in connection with crop production, fish and wildlife management, or wetland maintenance, improvement, restoration or construction.

CONDITIONS WHERE PRACTICE APPLIES

All sites that are subject to damage by flooding or inundation and where it is desired to reduce the hazard to people and to reduce damage to land and property.

Sites where the control of water level is desired.

The dike standard does not apply to sites where the Pond, Water and Sediment Control Basin, Diversion, or Terrace standards are appropriate. Dikes used to reduce flooding are normally constructed adjacent and/or parallel to a stream, river, wetland or water body and are not constructed across the stream, river or water body. Dikes used to control water levels usually have small interior drainage areas in comparison to the surface area of the regulated water level.

CRITERIA

General Criteria Applicable to All Purposes

Classification. The dike classification is determined by the hazard to life and the value of the protected land, crops, and property. Classification must consider land use changes likely to occur over the life of the dike.

Class I dikes are located on sites where failure of the dike may cause loss of life or serious damage to homes, primary highways, industrial buildings, commercial buildings, major railroads, or important public utilities.

All dikes with a design water height of more than 12 feet (3.7m) above normal ground surface, exclusive of crossings of sloughs, old channels, or low areas shall be Class I.

Class II dikes are located on sites where failure of the dike may cause damage to isolated homes, secondary highways, minor railroads, relatively important public utilities, high value land, or high value crops.

Class III dikes are located on sites where damage likely to occur from failure will be minimal.

Constructed Elevation. The constructed elevation of a dike whose purpose is to prevent flooding shall be the sum of the following:

- The water elevation attained by a flood or high tide of the design frequency in Table 1 with the critical duration and timing. This is the design high water.
- The larger of the minimum freeboard in Table 1 or the wave height caused by wind or boat traffic.
- The allowance for settlement.

The constructed elevation of a dike whose purpose is to control water level shall be the sum of the following:

- The water elevation at the highest water level control.
- The rise in water height above the highest water level control caused by a flood of the design frequency in Table 1. This is the design high water.
- The larger of the minimum freeboard in Table 1 or the wave height caused by wind of the design frequency in Table 1.
- The allowance for settlement.

Settlement. The allowance for settlement of compacted earth fill material shall be a minimum of 5 percent of the dike height unless an analysis shows that a lesser amount is adequate. For fill material that is hauled from off-site, dumped, and shaped (referred to as "dumped and shaped"), the allowance for settlement shall be a minimum of 15 percent of the dike height. For fill material that is excavated adjacent to the dike and dropped from the excavator (referred to as "dropped"), the allowance for settlement shall be a minimum of 20 percent of the dike height. The allowance for settlement of dumped and shaped or dropped organic soil fill material shall be a minimum of 40 percent of the dike height.

For the purpose of this standard, organic soils are described as follows:

- Soil layers that are not saturated with water for more than a few days at a time are organic if they have 20 percent or more organic carbon.
- Layers that are saturated for longer periods, or were saturated before being drained, are organic if:

  they have 12 percent or more of organic carbon and no clay, or

  18 percent or more organic carbon and 60 percent or more clay, or

  a proportional amount of organic carbon, between 12 and 18 percent, if the clay content is between 0 and 60 percent.

- All soils described in the local soil survey as an organic soil.

Top Width and Side Slopes. The minimum top widths and side slopes for earth embankments shall be that shown in Table 1.

Berms. The need for a constructed berm on an embankment will be based on the results of an embankment and foundation stability analysis. If a stability analysis is not done, all earth dikes shall have berms either constructed or occurring naturally on both sides meeting the following criteria:

- Constructed berms shall be at a constant elevation and sloped away from the dike.
- Where dikes cross channels, ditches, borrow areas, streams, sloughs, swales, gullies, etc. they shall have a berm constructed on each side. The top elevation of these berms will be at least 1 foot above the average ground surface on each side of the channel, ditch, borrow area, stream, slough, swales, gully, etc. and slope away from the dike.
- The minimum top width of natural or constructed berms shall be as shown in Table 1.
- The minimum side slope ratio of constructed berms shall be 2:1.
- Slope protection shall be determined and installed based on site conditions.

Dike Materials. Manufactured materials are non-erosive materials such as concrete, PVC, and steel that provides the structural strength for the dike. Manufactured dike materials shall have a structural analysis completed for the various loads the dike will be subjected to during its life. These include hydrostatic, ice, uplift, earth, and equipment. The dike shall be analyzed for stability using acceptable safety factors for each loading condition.

Earth dike materials should be a well-graded mineral soil with a minimum of 95 percent passing the Standard Number 4 Sieve and no fraction being larger than 6 inches in diameter.

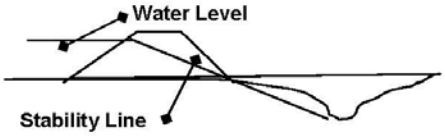
Embankment and Foundation Seepage. Embankment and foundation drainage and seepage control shall be designed on the basis of site investigation, laboratory data, seepage analysis, and stability analysis. The resulting design shall minimize seepage, prevent piping or undermining, and provide a stable embankment and foundation.

In the absence of more detailed data and analysis, the following criteria for a foundation cutoff apply for Class I dikes less than 6 feet in height, Class II dikes less than 8 feet in height and Class III dikes (H = dike height):

- Minimum of H feet deep for $H<3$ feet
- Minimum of 3 feet deep for $H\geq3$ feet
- Minimum of 4 feet bottom width
- 1:1 or flatter side slopes

A stream, channel, ditch, borrow area, slough, swale, gully, etc. shall be far enough away from the dike so that the extension of a line drawn from the design high water elevation on one side of the dike to the dike toe on the opposite side shall not intersect any stream, channel, etc. This line criterion applies to both sides of the

dike. This criterion will minimize the hazard to the dike caused by piping through the foundation.



Interior Drainage. Dikes to prevent flooding shall be provided with interior drainage systems for the area being protected. The interior drainage system shall prevent flood damage to the interior area from a flood of the design frequency in Table 1 for both the 1-day and the 10-day storm duration. The interior drainage system may include storage areas, gravity outlets, and pumping plants as needed to provide the required level of flood protection.

Pipes. Pipes through a Class I dike below the design high water with a dike height greater than 12 feet shall meet the requirements for principal spillways as found in NRCS Technical Release 60 - Earth Dams and Reservoirs, except for the minimum size requirements.

Pipes through all other Class I and Class II dikes shall meet the requirements for a principal spillway in Practice Standard 378, Ponds.

Dikes shall be protected from scour at pipe inlet and outlet locations by appropriate measures. A pump discharge pipe through a dike shall be installed above design high water, if feasible. Pump discharge pipes shall be equipped with a flexible connection or similar coupling to prevent vibration of the pumping plant being transmitted to the discharge pipe.

Protection. Dikes shall be protected from sheet, rill, and gully erosion, erosion from flowing floodwaters, and wave action created by wind and/or boat traffic.

A protective cover of grasses shall be established on exposed surfaces of the dike and other disturbed areas, as needed to prevent erosion. Seedbed preparation, seeding, fertilizing, mulching, and fencing shall comply with the recommendations in the standard for Critical Area Planting (342).

If grass vegetation will not control erosion, rock riprap, sand-gravel, soil cement, or special vegetation shall be utilized as needed.

Regulatory Requirements. This practice must conform to all Federal, State, and local laws and regulations. Laws and regulations of particular concern include those involving water rights, land use, land disturbance by construction, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

CONSIDERATIONS

Flood of Record. When establishing top of dike elevation for Class I dikes, the flood of record should be considered if it exceeds the minimum 100 year design frequency.

Location. When locating the site for the dike, consider the foundation soils, property lines, setbacks from property lines, exposure to open water, distance to streambanks, availability of outlets by gravity or pumping, buried, utilities, cultural resources, and natural resources such as wetlands, natural areas, and fish and wildlife habitat.

Fluvial geomorphological concepts contained in NEH Part 653, Stream Corridor Restoration Principles, Processes, and Practices should be evaluated when placing a dike near a stream.

Access. All dikes must be accessible for maintenance activities. Typically, this may be along the top of the dike or along the berm. Access roads shall provide adequate width for the maintenance equipment and inspection vehicles. The minimum width for one-way traffic should be 12 feet. Provide wider areas for passing and turning around at regular intervals. Access roads may need to be controlled to prevent vandalism, accidents, and damage.

Berms. Give special consideration to wider berms, additional setbacks, or protecting the berm side slope when adjacent to actively eroding or moving streams to protect the dike for its design life.

Adverse Impacts. Adverse environmental impacts from the proposed dike will be evaluated. Any increases in flood stage caused by dike induced flow restrictions will be evaluated for adverse impacts to unprotected areas. Adverse impacts should be minimized.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and

shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

For Class I dikes with a height greater than 12 feet, an emergency action plan meeting the requirements of 500.70 of the National Operation and Maintenance Manual shall be completed prior to construction of the dike.

For Class I and Class II dikes, a detailed Operation and Maintenance Plan in accordance with 500.40 through 500.42 of the National Operation and Maintenance Manual shall be completed and provided to the owner.

Typical items related to proper operations of a dike include, but are not limited to, the following:

- Inspect regularly for damage, especially after storm events. Items to monitor include settlement, seepage, soil cracking, animal burrows and trails, pipe structures, and control gates.

Typical items related to proper maintenance of a dike include, but are not limited to, the following:

- Vegetation should be maintained by removing or reseeding as needed. Earth fill, riprap, and other structural components need to be repaired in a timely manner.

Table 1 – Minimum Design Criteria

Minimum Dike Class	Dike Material[1]	Height (H) in Feet[2]	Minimum Design Frequency in Years	Minimum Freeboard in Feet	Minimum Top Width in Feet	Minimum Side Slope Ratio[3]	Berm Width in Feet
Class I	Earth	0 to 6	100	H/3	10	2:1	12
		>6 to 12	100	2	10	Note 4	Note 4
		>12 to 25	100	3	12	Note 4	Note 4
		>25	100	3	14	Note 4	Note 4
	Manufactured	0 to 8	100	H/4	N/A	N/A	Note 4
		>8 to 12	100	2	N/A	N/A	Note 4
		>12	100	3	N/A	N/A	Note 4
Class II	Earth	0 to 6	25	H/3	6	2:1	12
		>6 to 12	25	2	8	2:1	15
	Manufactured	0 to 8	25	H/4	N/A	N/A	Note 4
		>8 to 12	25	2	N/A	N/A	Note 4
Class III	Mineral Soils	0 to 3	10	H/3	4	2:1	8
		>3 to 6	10	1	6	2:1	8
		>6 to 12	25	2	8	2:1	8
	Organic Soils[5]	0 to 2	10	H/2	4	2:1	10
		>2 to 4	10	1	6	2:1	10
		>4 to 6	10	2	8	2:1	15

[1] Earth includes rock. Manufactured materials are non-erosive materials such as concrete, PVC, and steel that provides the structural strength for the dike.
[2] Height is the difference between normal ground elevation at the dike centerline and the design high water elevation. When determining normal ground elevation, exclude crossings of channels, sloughs, small low areas, small ridges, swales, or gullies
[3] Minimum side slope ratios are for compacted earth fill. Dumped earth fill without compaction will be flatter.
[4] Side slope ratios and berm widths shall be determined by a stability analysis.
[5] Organic soils are permitted only for Class III dikes 6 feet or less in height. Higher dike heights result in excessive settlement and decomposition.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

DIVERSION

Code 362

(ft)

I. DEFINITION

A channel generally constructed across the slope with a supporting ridge on the lower side.

II. PURPOSE

This practice may be applied to support one or more of the following purposes:

- Break up concentrations of water on long slopes, on undulating land surfaces and on land that is generally considered too flat or irregular for terracing.
- Divert water away from farmsteads, agricultural waste systems, and other improvements.
- Collect or direct water for storage, water-spreading, or water-harvesting systems.
- Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.
- Intercept surface and shallow subsurface flow.
- Reduce runoff damages from upland runoff.
- Reduce erosion and runoff on urban or developing areas and at construction or mining sites.
- Divert water away from active gullies or critically eroding areas.
- Supplement water management on conservation cropping or stripcropping systems.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where surface runoff water control and management are needed, and where soils and topography are such that the diversion can be constructed and a suitable outlet is available or can be provided.

This practice does not apply to:

- **Natural stream channels, except those that meet the NEH Part 654, Chapter 8 definition of threshold channels.**

IV. CRITERIA

Compliance

The installation and operation of this practice shall be planned, designed, and constructed to comply with all Federal, State, and local laws and regulations. Construction specifications and/or drawings will specify that NRCS be provided copies of all required permits prior to construction. Excavation or ridge work within or near streams and wetlands may require a permit from the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act (Bismarck Regulatory Office 701-255-0015). Projects that disturb more than 1 acre are required to develop a Stormwater Pollution Prevention Plan, and submit it along with a Notice of Intent to the ND Department of Health

(stormwater@nd.gov). Projects within the ordinary high water mark of navigable lakes and streams require a Sovereign Lands Permit from the ND State Water Commission (sovereignlands@nd.gov). Ensure that proposed ridges and/or overall site gradings involving fill do not increase the Base Flood (100-year recurrence interval) Elevation within Special Flood Hazard Areas (SFHA) by more than the allowable as defined by the local County Floodplain Administrator. Obtain a floodplain development permit through the local County Floodplain Administrator and the ND State Water Commission Floodplain Management Regulatory Program as necessary.

In addressing the National Environmental Policy Act (NEPA) for conservation practices within or near wetlands, sequencing must be conducted as per Executive Order 11990 included in Section G. Wetlands of the NRCS-CPA-052. Sequencing must include avoiding impacts if feasible. If avoidance is not feasible, a determination will be made using the North Dakota Minimal Effect Evaluation Worksheet. If the effects are determined to be minimal, the determination will be included in the NRCS-CPA-052. If the determination is not minimal, wetland mitigation must be completed. Implementation of the conservation practice(s) impacting the wetland(s) may begin upon obtaining all signatures on the wetland mitigation plan and agreement.

Capacity

Diversions as temporary measures, with an expected life-span of less than 2 years, will be designed for a minimum capacity for the peak discharge from the 2-year frequency, 24-hour-duration storm.

Diversions that protect agricultural land must have a minimum capacity for the peak discharge from a 10-year frequency, 24-hour-duration storm.

Diversions designed to protect areas such as urban areas, buildings, roads, and animal waste management systems require a minimum capacity for the peak discharge from a storm frequency consistent with the hazard involved but not less than a 25-year frequency, 24-hour-duration storm. Freeboard minimum depth is 0.3 ft. **Consider use of 0.5 feet of freeboard for diversions associated with animal waste management systems.**

Design depth is the channel storm-flow depth plus freeboard.

The design storm peak flow should be determined from appropriate methods considering location, drainage basin size, and watershed parameters. Statistical analysis can be used if a streamflow gage is near the site for reasonable number of years for the applicable design storm frequency. Peak discharge for ungaged sites should be calculated from the ND Supplement to NEH Part 650, Chapter 2 (EFH-2) for drainage areas less than 2,000 acres. Refer to USGS ND StreamStats for larger drainage areas where a stream channel is present and the drainage area falls within the regional parameters. Use TR-55 or HEC-HMS when watershed parameters are outside the range of USGS ND StreamStats. Apply Tables 5-1, 5-2, and 5-3 flow adjustment factors for ponding/wetlands present in the drainage area.

Cross Section

The channel may be parabolic, V-shaped, or trapezoidal. The diversion side slopes are based on stability and access requirements for maintenance. **Side slopes and bottom widths shall be selected based on equipment available for construction and maintenance.**

The minimum top width of the supporting ridge is 4 feet **except** for diversions with less than 10 acres of drainage area above cropland, pastureland, or woodland, where the minimum top width of the supporting ridge may be 3 feet.

The top of the constructed ridge at any point must not be lower than the design depth plus the specified overfill for settlement. **The minimum settlement height shall be proportioned from total ridge height at 5% for compacted fill, 15% for dumped and shaped, 20% for dropped, and 40% for organic fill. Organic soils are described CPS 356- Dike.**

The diversion design depth at a culvert crossing must equal the headwater depth for the culvert design storm plus freeboard.

The front and cut slopes for permanent diversions should not be steeper than 3:1 for maintenance purposes and preferably 4:1. The back slope of the ridge is not to be steeper than 2:1 and preferably 4:1. For temporary diversions, the side slope should not be steeper than 1:1 under any conditions.

Farmed diversions should have front slopes, back slopes, and cut slopes which are 5:1 or flatter. Where agricultural equipment must cross, slopes of 8:1 or flatter are recommended.

Channel Stability and Capacity

Channel grades may be uniform or variable. Determine minimum depth and width requirements for channel stability by using the procedures in the National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 9, Diversions; or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-Lined Open Channels (Sept. 1987); or other equivalent methods. The ARS handbook can be found on the USDA National Agricultural Library Digital Collections Web site.

When a retardance class method is used to determine capacity (Q) of the diversion by the relationship

$$Q=AV,$$

and, the velocity (V) is calculated by using Manning's Equation; use the highest expected value of Manning's "n", which represents the flow retardance due to the height, density and type of vegetation.

For vegetated channels, the flow retardance and vegetal cover factor for stability design shall be based on the sparsest and shortest vegetation expected. Vegetal cover factors and retardance values for various vegetative covers and conditions are given in Table 9-2 and Table 9-7, respectively, of the Engineering Field Handbook Chapter 9 – Diversions. A vegetal cover of 0.75 and a Class "D" retardance value shall not be exceeded.

See CPS 468- Lined Waterway or Outlet for roughness values and design criteria for concrete, rock, grid paver, turf reinforcement map, or articulated concrete block lined diversion channels.

Stability of unvegetated, unlined, earthen channels shall be designed utilizing methods outlined in NEH Part 654 Chapter 8.

Protection Against Sedimentation

Diversions normally should not be used below high sediment-producing areas. When they are, a practice or combination of practices for the drainage area are needed to prevent damaging accumulations of sediment in the channel. This may include practices such as land treatment erosion control practices, cultural or tillage practices, vegetated filter strip, or structural measures. Install needed sediment control practices in conjunction with or before the diversion construction.

If movement of sediment into the channel is a problem, include extra capacity for sediment accumulation in the design and instructions for periodic removal in the operation and maintenance plan. **A minimum design**

velocity of 1.5 feet per second during the design storm event is recommended to facilitate sediment transport within channel.

Outlets

Each diversion must have a safe and stable outlet with adequate capacity. The outlet may be a grassed waterway, a lined waterway, vegetated or paved area, a grade stabilization structure, an underground outlet, a stable watercourse, a sediment basin, or a combination of these practices. The outlet must convey runoff to a point where outflow will not cause damage. Install vegetative outlets before diversion construction to insure establishment of stable vegetative cover in the outlet channel.

When using an underground outlet, the diversion ridge must contain the design storm runoff combined with an underground outlet release rate to protect from overtopping. To prevent the diversion from overtopping, the designed outflow capacity of the outlet(s) must be achieved at, or below, the design depth of the diversion at their junction.

Vegetative Establishment

Vegetate diversions according to NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342) **and the North Dakota ND-CPA-9 – Planning or Data Sheet for Grass and/or Legume Seeding Job Sheet**. Select species suited to the site conditions and intended uses. Use plant species that exhibit the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the diversion.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close-growing crop, (e.g., small grains or millet), on the contributing watershed prior to construction of the diversion can significantly reduce the flow through the diversion during establishment.

Lining

If the soils or climatic conditions preclude the use of vegetation for erosion protection, nonvegetative linings such as concrete, gravel, rock riprap, cellular block, or other approved manufactured lining systems may be used.

Design diversion channel liners in accordance with CPS Lined Waterway or Outlet (Code 468).

V. CONSIDERATIONS

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped.

At noncropland sites, consider planting native vegetation in areas disturbed due to the diversion construction.

Diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology. In analyzing downslope impacts, minimize adverse effects to existing wetland functions and values. Similarly consider how to maximize wetland functions and values with the diversion design.

Provide construction inspection to ensure that the top of the constructed ridge at any point meets the design depth plus the specified overfill for settlement.

Any construction activities should minimize disturbance to wildlife habitat. Opportunities should be explored to restore and improve wildlife habitat, including habitat for threatened, endangered, and other species of concern.

For vegetated diversions, avoid areas where unsuitable subsurface, subsoil, substratum material that limits plant growth such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where these areas cannot be avoided, seek recommendations from a soil scientist for improving the condition or, if not feasible, consider stock piling the topsoil, over excavating the diversion and replace the topsoil over the excavated area to facilitate vegetative establishment.

VI. PLANS AND SPECIFICATIONS

Prepare plans and specifications for diversions that describe the requirements for applying the practice according to this standard. As a minimum, the plans and specifications must include—

1. A plan view of the layout of the diversion.
2. Typical cross sections of the diversion(s).
3. Profile(s) of the diversion(s) that include both the channel bottom and supporting ridge top.
4. Disposal requirements for excess soil material.
5. Vegetative establishment requirements.

VII. OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for use by the client. Include specific instructions for maintaining diversion capacity, storage of runoff water, ridge height, and outlets in the plan.

The minimum requirements to be addressed in the operation and maintenance plan are—

1. Provide periodic inspections, especially immediately following significant storms.
2. Promptly repair or replace damaged components of the diversion as necessary.
3. Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment-yielding regions are in the drainage area above the diversion. Establish necessary clean-out requirements.
4. Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.
5. Redistribute sediment as necessary to maintain the capacity of the diversion.
6. Maintain vegetation and trees and control brush by hand, chemical, and mechanical means. Maintenance of vegetation will be scheduled outside of the primary nesting season for grassland birds.
7. Control pests that will interfere with the timely establishment of vegetation.
8. Keep machinery away from steep-sloped ridges. Keep equipment operators informed of all potential hazards.

VIII. REFERENCES

USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.

USDA, NRCS. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 9, Diversions.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STRUCTURE FOR WATER CONTROL

Code 587

(No.)

I. DEFINITION

A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water.

II. PURPOSE

Apply this practice as a component of a water management system to control the stage, discharge, distribution, delivery, or direction of water flow.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies to a permanent structure needed as an integral part of a water control system to serve one or more of the following functions:

Convey water from one elevation to a lower elevation within, to, or from a water conveyance system such as a ditch, channel, canal, or pipeline. Typical structures include drops, chutes, turnouts, surface water inlets, head gates, pump boxes, and stilling basins.

Control the elevation of water in drainage or irrigation ditches. Typical structures include checks, flashboard risers, and check dams.

Control the division or measurement of irrigation water. Typical structures include division boxes and water measurement devices.

Keep trash, debris or weed seeds from entering pipelines. Typical structures include trash racks and debris screens.

Control the direction of channel flow resulting from tides and high water or backflow from flooding. Typical structures include tide and water management gates.

Control the water table level, remove surface or subsurface water from adjoining land, flood land for frost protection, or manage water levels for wildlife or recreation. Typical structures include water level control structures, flashboard risers, pipe drop inlets, and box inlets.

Convey water over, under, or along a ditch, canal, road, railroad, or other barriers. Typical structures include bridges, culverts, flumes, inverted siphons, and long span pipes.

Modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures include chutes, cold water release structures, and flashboard risers.

Provide silt management in ditches or canals. Typical structures include sluice gates and sediment traps.

Supplement a resource management system on land where organic waste or commercial fertilizer is applied.

Create, restore, or enhance wetland hydrology.

IV. CRITERIA

All structures designed under this standard must comply with applicable Federal, Tribal, State, and local laws, rules, and regulations. Obtain all required permits before construction begins.

Construction specifications and/or drawings will specify that NRCS be provided copies of all required permits prior to construction. Excavation or embankment work within or near streams and wetlands may require a permit from the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act (Bismarck Regulatory Office 701-255-0015). Projects that disturb more than 1 acre are required to develop a Stormwater Pollution Prevention Plan, and submit it along with a Notice of Intent to the ND Department of Health (stormwater@nd.gov). Projects within the ordinary high water mark of navigable lakes and streams require a Sovereign Lands Permit from the ND State Water Commission (sovereignlands@nd.gov). Ensure that proposed embankments and/or overall site gradings involving fill do not increase the Base Flood (100-year recurrence interval) Elevation within Special Flood Hazard Areas (SFHA) by more than the allowable as defined by the local County Floodplain Administrator. Obtain a floodplain development permit through the local County Floodplain Administrator and the ND State Water Commission Floodplain Management Regulatory Program as necessary.

In addressing the National Environmental Policy Act (NEPA) for conservation practices within or near wetlands, sequencing must be conducted as per Executive Order 11990 included in Section G. Wetlands of the NRCS-CPA-052. Sequencing must include avoiding impacts if feasible. If avoidance is not feasible, a determination will be made using the North Dakota Minimal Effect Evaluation Worksheet. If the effects are determined to be minimal, the determination will be included in the NRCS-CPA-052. If the determination is not minimal, wetland mitigation must be completed. Implementation of the conservation practice(s) impacting the wetland(s) may begin upon obtaining all signatures on the wetland mitigation plan and agreement.

Follow the North Dakota Century Code Section 61-04-02 requirement that structures with a water storage capacity (spillway elevation) exceeding 12.5 acre-feet secure a water permit from the SWC prior to construction or modification activities. The SWC Water Appropriates Division oversees Applications for Conditional Water Permits (SFN 60157). In these instances, construction specifications developed for the project should specify that NRCS be provided a copy of the water permit prior to construction.

Follow the North Dakota Century Code Section 61-04-02 requirement that structures with a water storage capacity (spillway elevation) less than 12.5 acre-feet notify the state engineer (SWC) of the location and capacity of such constructed works, dams, or dugouts. The SWC Water Regulatory Division oversees notifications of structure constructions (SFN 51695). In these instances, construction specifications developed for the project should specify that NRCS be provided a copy of the notification prior to construction.

A. <u>General Criteria Applicable to All Purposes</u>

Seed or sod the exposed surfaces of earthen embankments, earth spillways, borrow areas, and other areas disturbed during construction in accordance with the criteria in NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342). When necessary to provide surface protection where climatic conditions preclude the use of seed or sod, use the criteria in CPS Mulching (Code 484) to install inorganic cover material such as gravel. **The structure shall be fenced, if cattle are grazed in the area, to protect the vegetation.**

Do not raise the water level upstream of water control structures on adjacent landowners without their permission. **Structures shall not be installed that have an adverse effect on septic filter fields. Structures must be designed to control erosion, keep upstream water levels within planned limits, and take into account the effects of freezing ambient temperatures. Where manufactured structures are used, the hydraulic design shall be provided by the manufacturer. Reinforcement products such as articulated concrete block and turf reinforcement mats, can be used in exit channels- see CPS 468 (Lined Waterway**

Outlet) for design guidance.

All water impoundment structures built under this practice shall meet the requirements of practice standard Pond (378).

All stream crossing structures built under this practice shall meet the requirements of practice standard Stream Crossing (578).

All irrigation water control structures built under this practice shall be designed to supply or measure the irrigation application rates as determined by CPS 443- Irrigation System Surface and Subsurface, CPS 442- Irrigation System Sprinkler, or CPS 441- Irrigation System Microirrigation.

B. Criteria for Drainage Water Management/Subsurface Drainage Systems

The drainage water management system shall be designed in accordance with practice standard Drainage Water Management (554). A water management strategy shall be developed, including target water levels, for applicable crop rooting depths, while meeting non-cropped period operational requirements from practice standard 554. Operational requirements are for managed drainage model within 30 days after season's final field operation, and until at least 30 days before commencement of the next season's field operations.

The rate of outflow and the level of the water table shall be controlled by structures or pumps. Structures or pumps shall be located where they are accessible and subject to convenient control. Designs of critical components shall be in accordance with pertinent NRCS Practice Standards.

Water level control structures shall be sized to provide adequate drainage flow and not to restrict drainage capacity. Drainage flows shall be calculated to adequately design the system. Applicable computer models (i.e. DrainMod) or drainage equations (i.e. van Schilfgaarde or those outlined in Chapter 4 of NEH Section 16, Drainage of Agricultural Land) shall be used for subsurface drain system outflows. The water level control structure shall be designed so as to allow the water table to fluctuate to satisfy the intended purpose. Connect at least 20 feet of solid pipe to the control structure on both the upstream and downstream sides.

C. Structural Design Criteria

Structure designs shall be based on site surveys, required hydraulic function during normal operations and anticipated internal/external loads including hydrostatic uplift, surcharge loads, surface and impact loads, stability during flood and ice jam events, avoidance of downstream erosion, sediment transport, and efficient operation and maintenance.

1. **Geologic investigations for foundations shall be completed, as outlined in NEH Part 631, and appropriate for the project. The geologic investigation shall provide adequate data to support foundation design computations, and evaluate the need for structure cutoffs, drainage, foundation reinforcement, or slope stabilization measures.**
2. **Foundation design will address bearing capacity, sliding, overturning, uplift, settlement, and piping potential. Cutoff requirements shall be determined by use of NEH Section 11, Lane's Theory of Weighted Creep, or flow net procedures outlined in NRCS Soil Mechanics Technical Note 5, Flow Net Construction and Use.**
3. **Lateral earth pressures should be calculated based on NRCS Technical Release 210-74. Small structures may be designed utilizing presumptive lateral earth pressure values in CPS 313- Waste Storage Facility or Table 6.2-1 NEH Section 6.**
4. **Concrete structures shall be designed based the American Concrete Institute 350 Code Requirements for Environmental Engineering Concrete Structures.**
5. **Steel structures shall be galvanized or epoxy coated, and be designed based on the Manual for Steel Construction (American Institute of Steel Construction) or the Handbook of Steel Drainage and Highway Construction Products (American Iron and Steel Institute).**
6. **Timber structures will be designed based on the National Design Specification for Wood Construction.**

D. Safety

Design measures necessary to prevent serious injury or loss of life in accordance with requirements of Title 210, National Engineering Manual (NEM), Part 503, Safety.

E. Cultural Resources

Evaluate the existence of cultural resources in the project area and any project impacts on such resources. Provide conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

V. CONSIDERATIONS

Consider the following items when planning, designing, and installing this practice:

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Potential for a change in the rate of plant growth and transpiration because of changes in the volume of soil water.
3. Effects on downstream flows or aquifers that would affect other water uses or users.
4. Effects on the field water table to ensure that it will provide a suitable rooting depth for the anticipated crop.
5. Potential use for irrigation management to conserve water.
6. Effect of construction on aquatic life.
7. Effects on stream system channel morphology and stability as it relates to erosion and the movement of sediment, solutes, and sediment-attached substances carried by runoff.
8. Effects on the movement of dissolved substances below the root zone and to ground water.
9. Effects of field water table on salt content in the root zone.
10. Short term and construction-related effects of this practice on the quality of downstream water.
11. Effects of water level control on the temperatures of downstream waters and their effects on aquatic and wildlife communities.
12. Effects on wetlands or water-related wildlife habitats.
13. Effects on the turbidity of downstream water resources.
14. Conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.
15. **Saturated buffer and denitrifying bioreactors as primary outlet from structure for water control. These shall be designed in accordance with practice standard Saturated Buffer (604) and Denitrifying Bioreactor (605), respectively. Saturated buffer and denitrifying bioreactors reduce nitrate levels from subsurface agricultural drainage flow to improve water quality of receiving water bodies. Saturated buffer can be used to create, restore, and enhance wetlands; therefore, can be used in conjunction with practice standards Wetland Restoration (657), Wetland Creation (658), and Wetland Enhancement (659).**
16. **Where necessary, design seepage collars or filter diagrams along outlet conduits to reduce likelihood of internal erosion failure mode along conduit.**

VI. PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, include—

1. A plan view of the layout of the structure for water control.
2. Typical profiles and cross sections of the structure for water control.
3. Structural drawings adequate to describe the construction requirements.
4. Requirements for vegetative establishment and mulching, as needed.
5. Safety features.
6. Site-specific construction and material requirements.

VII. OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

1. Periodic inspections of all structures, earthen embankments, spillways, and other significant appurtenances.
2. Prompt removal of trash from pipe inlets and trash racks.
3. Prompt repair or replacement of damaged components.
4. Prompt removal of sediment when it reaches predetermined storage elevations.
5. Periodic removal of trees, brush, and undesirable species.
6. Periodic inspection of safety components and immediate repair if necessary.
7. Maintenance of vegetative protection and immediate seeding of bare areas as needed.

REFERENCES

USDA NRCS. National Engineering Handbook (NEH), Part 636, Structural Engineering. Washington, DC.

USDA NRCS. NEH, Part 650, Engineering Field Handbook. Washington, DC.

USDA NRCS. National Engineering Manual. Washington, DC.

USDA SCS. May 1971. National Engineering Handbook, Section 16. Washington, D.C.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SUBSURFACE DRAIN

(Ft.)

CODE 606

I. DEFINITION

A conduit installed beneath the ground surface to collect and/or convey excess water.

II. PURPOSE

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Remove or distribute excessive soil water.
- Remove salts and other contaminants from the soil profile.

III. CONDITIONS WHERE PRACTICE APPLIES

This standard applies to agricultural land where a shallow water table exists and where a subsurface drainage system can mitigate the following adverse conditions caused by excessive soil moisture:

- Poor health, vigor and productivity of plants.
- Poor field trafficability.
- Accumulation of salts in the root zone.
- Health risk and livestock stress due to pests such as flukes, flies, or mosquitoes.
- Wet soil conditions around farmsteads, structures, and roadways.

This standard also applies where collected excess water can be distributed through a subsurface water utilization or treatment area.

IV. CRITERIA

All necessary local, state, and federal permits shall be obtained by the producer or their designee. Construction specifications and/or drawings will specify that NRCS be provided copies of all required permits prior to construction. Subsurface drainage systems which drain a watershed of 80 acres or more are required to secure a permit from the North Dakota State Water Commission prior to installation. Excavation or embankment work within or near streams and wetlands may require a permit from the U.S. Army Corps of Engineers in accordance with Section 404 of the Clean Water Act (Bismarck Regulatory Office 701-255-0015). Projects that disturb more than 1 acre are required to develop a Stormwater Pollution Prevention Plan, and submit it along with a Notice of Intent to the ND Department of Health (stormwater@nd.gov). Projects within the ordinary high water mark of navigable lakes and streams require a Sovereign Lands Permit from the ND State Water Commission (sovereignlands@nd.gov).

In addressing the National Environmental Policy Act (NEPA) for conservation practices within or near wetlands, sequencing must be conducted as per Executive Order 11990 included in Section G. Wetlands of the NRCS-CPA-052. Sequencing must include avoiding impacts if feasible. If avoidance is not feasible, a determination will be made using the North Dakota Minimal Effect Evaluation Worksheet. If the effects are determined to be minimal, the determination will be included in the NRCS-CPA-052. If the determination is not minimal, wetland mitigation must be completed. Implementation of the conservation practice(s) impacting the wetland(s) may begin upon obtaining all signatures on the wetland mitigation plan and agreement.

Capacity. Design capacity shall be based on the following, as applicable:

- Application of a locally proven drainage coefficient for the acreage drained. **The minimum coefficient for design of drainage systems shall be ¼ inch per day for the area to be served. Reference Red River Basin Technical and Scientific Advisory Committee Technical Paper #3: Water Management Options for Surface Drainage commended drainage coefficients for the Red River Valley.**
- **Subsurface drain systems that serve crop fields shall be designed with minimum drainage coefficients of 3/8 inch per day for mineral soils and 1//2 inch per day for organic soils.**
- **Open inlets may not be utilized on subsurface drain systems designed in crop fields.**
- Yield of groundwater based on the expected deep percolation of irrigation water from the overlying fields.
- Comparison of the site with other similar sites where subsurface drain yields have been measured.
- Measurement of the rate of subsurface flow at the site during a period of adverse weather and groundwater conditions.
- Application of Darcy's law to lateral or artesian subsurface flow.
- Contributions from surface inlets based on hydrologic analysis or flow measurements

Size. The size of subsurface drains shall be computed by applying Manning's formula, using roughness coefficients recommended by the manufacturer of the conduit. The size shall be based on the maximum design flow rate and computed using one of the following assumptions:

1. The hydraulic grade line parallel to the bottom grade of the subsurface drain with the conduit flowing full at design flow (normal condition, no internal pressure).
2. Conduit flowing partly full where a steep grade or other conditions require excess capacity.
3. Conduit flowing under internal pressure with hydraulic grade line set by site conditions, which differs from the bottom grade of the subsurface drain.

For assumptions 1 or 2 above, the minimum size of drains may be determined using the drainage charts in EFH14. Use Figure 14-34 for corrugated plastic pipe, or Figure 14-35 for clay and concrete tile.

All subsurface drains shall have a nominal diameter that equals or exceeds 3 inches. **When 3-inch diameter drains are used, any single line shall not exceed 1000 ft in length. When 4-inch diameter drains are used, any single line shall not exceed 1320 ft in length. In organic soils, when using clay or concrete tile, consider using the longest individual section available.**

Internal Hydraulic Pressure. Drains are normally designed to flow with no internal pressure, and the flow is normally classified as open channel. The design internal pressure of drains shall not exceed the limits recommended by the manufacturer of the conduit.

Horizontal Alignment. A change in horizontal direction of the subsurface drain shall be made by one of the following methods:

1. The use of manufactured fittings.
2. The use of junction boxes or manholes.
3. A gradual curve of the drain trench on a radius that can be followed by the trenching machine while maintaining grade.

Location, Depth, and Spacing. The location, depth, and spacing of the subsurface drain shall be based on site conditions including soils, topography, groundwater conditions, crops, land use, outlets, saline or sodic conditions, and proximity to wetlands.

The minimum depth of cover over subsurface drains may exclude sections of conduit near the outlet or through minor depressions, providing these sections of conduit are not subject to damage by frost action or equipment travel.

In mineral soils, the minimum depth of cover over subsurface drains shall be 2.0 feet.

In organic soils, the minimum depth of cover after initial subsidence shall be 3.0 feet. If water control structures are installed and managed to limit oxidation and subsidence of the soil, the minimum depth of cover may be reduced to 2.5 feet.

For flexible conduits, maximum burial depths shall be based on manufacturer's recommendations for the site conditions, or based on a site-specific engineering design consistent with methods in NRCS National Engineering Handbook (NEH), Part 636, Chapter 52, Structural Design of Flexible Conduits.

For computation of maximum allowable loads on subsurface drains of all materials, use the trench and bedding conditions specified, and the compressive strength of the conduit. The design load on the conduit shall be based on a combination of equipment loads, trench loads, and road traffic, as applicable.

Equipment loads shall be based on the maximum expected wheel loads for the equipment to be used, the minimum height of cover over the conduit, and the trench width. Equipment loads on the conduit may be neglected when the depth of cover exceeds 6 feet. Trench loads shall be based on the type of backfill over the conduit, the width of the trench, and the unit weight of the backfill material.

Continuous pipe shall be used where it is not feasible to obtain cover as noted above, such as where drain lines cross waterways, road ditches, the outlet end of mains, or near structures.

Minimum Velocity and Grade. In areas where sedimentation is not a hazard, minimum grades shall be based on site conditions and a velocity of not less than 0.5 feet per second. If a sedimentation hazard exits, a velocity of not less than 1.4 feet per second shall be used to establish the minimum grades. Otherwise, provisions shall be made for preventing sedimentation by use of filters or by collecting and periodically removing sediment from installed traps, or by periodically cleaning the lines with high-pressure jetting systems or cleaning solutions.

Minimum design grades where no sediment hazard exists are as follows:

Drain Diameter	Minimum Grade
3 to 6 inches	0.10 %
8 to 10	0.07
> 12	0.05

Maximum Velocity. Design velocities for perforated or open joint pipe shall not exceed those given in Table 1, unless special protective measures are installed. Design velocities with protective measures shall not exceed manufacturer's recommended limits.

Table 1. Maximum Flow Velocities by Soil Texture.

Soil Texture	Velocity, ft./sec.
Sand and sandy loam	3.5
Silt and silt loam	5.0
Silty clay loam	6.0
Clay and clay loam	7.0
Coarse sand or gravel	9.0

Ref: NEH 624, Chapter 4, Subsurface Drainage.

On sites where topographic conditions require drain placement on steep grades and design velocities greater than indicated in Table 1, special measures shall be used to protect the conduit or surrounding soil.

Protective measures for high velocities shall include one or more of the following, as appropriate:

1. Enclose continuous perforated pipe or tubing with fabric type filter material or properly graded sand and gravel.
2. Use non-perforated continuous conduit or a watertight pipe, and sealed joints.
3. Place the conduit in a sand and gravel envelope, or initial backfill with the least erodible soil available.
4. Select rigid butt end pipe or tile with straight smooth sections and square ends to obtain tight fitting joints.
5. Wrap open joints of the conduit with tar-impregnated paper, burlap, or special fabric-type filter material.
6. Install larger diameter drain conduit in the steep area to help assure a hydraulic grade line parallel with the conduit grade.
7. Install open air risers for air release or entry at the beginning and downstream end of the high velocity section.

Releases from drainage water management structures shall not cause flow velocities in perforated or open joint drains to exceed allowable velocities in Table 1, unless protective measures are installed. **See CPS 468- Lined Waterway or Outlet.**

Thrust Control. Follow pipe manufacturer's recommendations for thrust control or anchoring, where the following conditions exist:

- Axial forces that tend to move the pipe down steep slopes.
- Thrust forces from abrupt changes in pipeline grade or horizontal alignment, which exceed soil bearing strength.
- Reductions in pipe size.

In the absence of manufacturer's data, thrust blocks shall be designed in accordance with NEH, Part 636, Chapter 52, Structural Design of Flexible Conduits.

Outlets. Drainage outlets shall be adequate for the quantity and quality of water to be discharged.

Outlets to surface water shall be designed to operate without submergence under normal conditions.

For discharge to streams or channels, the outlet invert shall be located above the elevation of normal flow and at least 1.0 foot above the channel bottom.

Outlets shall be protected against erosion and undermining of the conduit, entry of tree roots, damaging periods of submergence, and entry of rodents or other animals into the subsurface drain.

A continuous section of pipe without open joints or perforations, and with stiffness necessary to withstand expected loads, shall be used at the outlet end of the drain line. Minimum lengths for the outlet section of conduit are provided in Table 2. Single-wall Corrugated Plastic Pipe is not suitable for the section that outlets into a ditch or channel.

For outlets into sumps, the discharge elevation shall be located above the elevation at which pumping is initiated.

Table 2. Minimum Length of Outlet Pipe Sections.

Pipe Diameter, in.	Min. Section Length, ft.
8 and smaller	10
10 to 12	12
15 to 18	16
Larger than 18	20

The use and installation of outlet pipe shall conform to the following requirements:

- If burning vegetation on the outlet ditch bank is likely to create a fire hazard, the material from which the pipe is fabricated must be fireproof.
- At least two-thirds of the pipe section shall be buried in the ditch bank, and the cantilever section must extend to the toe of the ditch side slope, or the side slope shall be protected from erosion.
- If ice or floating debris may damage the outlet pipe, the outlet shall be recessed to the extent that the cantilevered part of the pipe will be protected from the current of flow in the ditch or channel.
- Headwalls used for subsurface drain outlets must be adequate in strength and design to avoid washouts and other failures.

Open channel or pumped outlets shall have adequate capacity to remove surface water runoff from the watershed in a period of time sufficient to prevent serious crop damage. Continuously submerged outlets are acceptable if planned and designed according to CPS 554- Drainage Water Management.

Protection from Biological and Mineral Clogging. Drains in certain soils are subject to clogging of drain perforations by bacterial action in association with ferrous iron, manganese, or sulfides. Iron ochre can clog drain openings and can seal manufactured (fabric) filters. Manganese deposits and sulfides can clog drain openings.

Where bacterial activity is expected to lead to clogging of drains, access points for cleaning the drain lines shall be provided.

Where possible, outlet individual drains to an open ditch to isolate localized areas of contamination and to limit the translocation of contamination throughout the system.

Protection from Root Clogging. Problems may occur where drains are in close proximity to perennial vegetation. Drain clogging may result from root penetration by water-loving trees, such as willow, cottonwood, elm, soft maple, some shrubs, grasses, and deep-rooted perennial crops growing near subsurface drains.

The following steps may reduce the incidence of root intrusion:

- Install a continuous section of non-perforated pipe or tubing with sealed joints, through the root zone.
- Remove water-loving trees for a distance of at least 100 feet on each side of the drain, and locate drains a distance of 50 feet or more from non-crop tree species.
- Provide for intermittent submergence of the drain to limit rooting depth by installing a structure for water control (e.g. an inline weir with adjustable crest) that allows for raising the elevation of the drain outlet.

Water Quality. Septic systems shall not be directly connected to the subsurface drainage system, nor shall animal waste be directly introduced into the subsurface drainage system.

Materials. Subsurface drains include flexible conduits of plastic, bituminized fiber, or metal; rigid conduits of vitrified clay or concrete; or other materials of acceptable quality.

The conduit shall meet strength and durability requirements for the site. All conduits shall meet or exceed the minimum requirements of the appropriate specifications published by the American Society for Testing and Materials (ASTM), American Association of State Highway Transportation Officials (AASHTO), or the American Water Works Association (AWWA).

Foundation. If soft or yielding foundations are encountered, the conduits shall be stabilized and protected from settlement. The following methods are acceptable for the stabilization of yielding foundations:

- Remove the unstable material and provide a stable bedding of granular envelope or filter material.
- Provide continuous cradle support for the conduit through the unstable section.
- Bridge unstable areas using long sections of conduit having adequate strength and stiffness to ensure satisfactory subsurface drain performance.
- Place conduit on a flat, treated plank. This method shall not be used for flexible (e.g. Corrugated Plastic Pipe) without proper bedding between the plank and conduit.

Filters and Filter Material. Filters shall be used around conduits, as needed, to prevent movement of the surrounding soil material into the conduit. The need for a filter shall be determined by the characteristics of the surrounding soil material, site conditions, and the velocity of flow in the conduit. A suitable filter shall be used if any of the following conditions exist:

- Local experience with soil site conditions indicates a need.
- Soil materials surrounding the conduit are dispersed clays, silts with a Plasticity Index less than 7, or fine sands with a Plasticity Index less than 7.
- The soil is subject cracking by desiccation.
- The method of installation may result in inadequate consolidation between the conduit and backfill material.

If a sand-gravel filter is specified, the filter gradation shall be designed in accordance with NEH, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters.

Specified filter material must completely encase the conduit such that all openings are covered with at least 3 inches of filter material, except where the top of the conduit and side filter material are be covered by a sheet of plastic or similar impervious material to reduce the quantity of filter material required. In all cases, the resulting flow pattern through filter material shall be a minimum of 3 inches in length.

Geotextile filter materials may be used, provided that the effective opening size, strength, durability, and permeability are adequate to prevent soil movement into the drain throughout the expected life of the system. Geotextile filter material shall not be used where the silt content of the soil exceeds 40 percent.

Envelopes and Envelope Material. Envelopes shall be used around subsurface drains if needed for proper conduit bedding or to improve flow characteristics into the conduit.

Materials used for envelopes do not need to meet the gradation requirements of filters, but they must not contain materials that will cause an accumulation of sediment in the conduit, or materials that will render the envelope unsuitable for bedding of the conduit.

Envelope materials shall consist of sand-gravel, organic, or similar material. 100 percent of sand-gravel envelope materials shall all pass a 1.5-inch sieve; not more than 30 percent shall pass a Number 60 sieve; and not more than 5 percent shall pass the Number 200 sieve.

Organic or other compressible envelope materials shall not be used below the centerline of flexible conduits. All organic or other compressible materials shall be of a type that will not readily decompose.

Placement and Bedding. Placement and bedding requirements apply to both excavation trenching and plow type installations.

Place the conduit on a firm foundation to ensure proper alignment.

Conduits shall not be placed on exposed rock, or on stones greater than 1½ inches for conduits 6 inches or larger in diameter, or on stones greater than ¾ inch for conduit less than 6 inches in diameter. Where site conditions do not meet this requirement, the trench must be over-excavated a minimum of 6 inches and refilled to grade with a suitable bedding material.

If installation will be below a water table or where unstable soils are present, special equipment, installation procedures, or bedding materials may be needed. These special requirements may also be necessary to prevent soil movement into the drain or plugging of the envelope, if installation will be made in materials such as soil slurries.

For the installation of Corrugated Plastic Pipe with diameters of 8 inches or less, one of the following bedding methods shall be specified:

1. A shaped groove providing an angle of support of 90 degrees or greater shall be provided in the bottom of the trench for tubing support and alignment.
2. A sand-gravel envelope, at least 3 inches thick, to provide support.
3. Compacted bedding material beside and to 3 inches above the conduit.

For the installation of Corrugated Plastic Pipe with diameters larger than 8 inches, the same bedding requirements shall be met except that a semi-circular or trapezoidal groove shaped to fit the conduit with a support angle of 120 degrees will be used rather than a V-shaped groove.

For rigid conduits installed in a trench, the same requirements shall be met except that a groove or notch is not required. For trench installations where a sand-gravel or compacted bedding is not specified, the initial backfill for the conduit shall be selected material containing no hard objects (e.g. rocks or consolidated chunks of soil) larger than 1.5 inches in diameter. Initial backfill shall be carried to a minimum of 3 inches above the conduit.

Auxiliary Structures and Protection. The capacity of any structure installed in the drain line shall be no less than that of the line or lines feeding into or through them.

Structures for water table management, with provisions to elevate the outlet and allow submergence of the upstream drain, shall meet applicable design criteria in NRCS Conservation Practice Standards, Structure for Water Control (587), and Drainage Water Management (554).

If the drain system is to include underground outlets, the capacity of the surface water inlet shall not be greater than the maximum design flow in the downstream drain line or lines. Covers or trash racks shall be used to ensure that no foreign materials are allowed in the drain lines. Inlets shall be protected from entry of animals or debris. If sediment may pose a problem, sediment traps shall be installed.

The capacity of a relief well system shall be based on the flow from the aquifer, the well spacing, and other site conditions, and shall be adequate to lower the artesian water head to the desired level. Relief wells shall not be less than 4 inches in diameter.

Junction boxes, manholes, catch basins, and sand traps must be accessible for maintenance. A clear opening of not less than 2.0 feet will be provided in either circular or rectangular structures.

The drain system shall be protected against turbulence created near outlets, surface inlets or similar structures. Continuous non-perforated or closed-joint pipe shall be used in drain lines adjoining the structure where excessive velocities will occur.

Junction boxes shall be installed where three or more lines join or if two lines join at different elevations. If the junction box is buried, a solid cover should be used, and the junction box should have a minimum of 1.5 feet of soil cover. Buried boxes shall be protected from traffic.

If not connected to a structure, the upper end of each subsurface drain line will be closed with a tight-fitting cap or plug of the same material as the conduit, or other durable materials.

Watertight conduits designed to withstand the expected loads shall be used where subsurface drains cross under irrigation canals, ditches, or other structures.

V. CONSIDERATIONS

When planning, designing, and installing this practice, the following items should be considered:

- Protection of shallow drains, auxiliary structures, and outlets from damage due to freezing and thawing.
- Proper surface drainage to reduce the required intensity of the subsurface drainage system.
- Designs that incorporate drainage water management practices (or facilitate its future incorporation) to reduce nutrient loading of receiving waters.
- Drainage laterals oriented along elevation contours to improve the effectiveness of drainage water management structures.
- The effects of drainage systems on runoff volume, seepage, and the availability of soil water needed for plant growth.
- Confirmation of soil survey information with site investigation, including auguring and shallow excavations to identify soil profile hydraulic characteristics, soil texture layering, water table depth, etc.
- The effects of drainage systems on the hydrology of adjacent lands.
- Subsoiling or ripping of soils with contrasting texture layers to improve internal drainage.
- Installations in dry soil profile to minimize problems of trench stability, conduit alignment, and soil movement into the drain.
- The effects to surface water quality.
- Use of temporary flow blocking devices to reduce risk of drain water contamination from surface applications of manure.

VI. PLANS AND SPECIFICATIONS

Plans and specifications for installing subsurface drains shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

At a minimum, plans specifications shall include, as applicable: location of drainage system; wetland delineation(s); conduit lengths, grades, sizes, and type of materials; structure locations, dimensions, and elevations; outlet locations, elevations, and protection required; and normal water level elevations in outlet ditches or streams.

VII. OPERATION AND MAINTENANCE

The Operation and Maintenance (O&M) Plan shall provide specific instructions for operating and maintaining the system to insure proper function as designed. At a minimum, the O&M Plan shall address:

- Necessary periodic inspection and prompt repair of system components (e.g. structures for water control, underground outlets, vents, drain outlets, trash and rodent guards).
- Winterization protection from freezing conditions for drainage systems in cold climates.

REFERENCES

USDA-NRCS, National Engineering Handbook, Part 624, Chapter 4, Subsurface Drainage.

USDA-NRCS, National Engineering Handbook, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters.

USDA-NRCS, National Engineering Handbook, Part 636, Chapter 52, Structural Design of Flexible Conduits.

Red River Basin Technical and Scientific Advisory Committee Technical Paper #3: Water Management Options for Surface Drainage, International Water Institute, 2014.

APPENDIX C

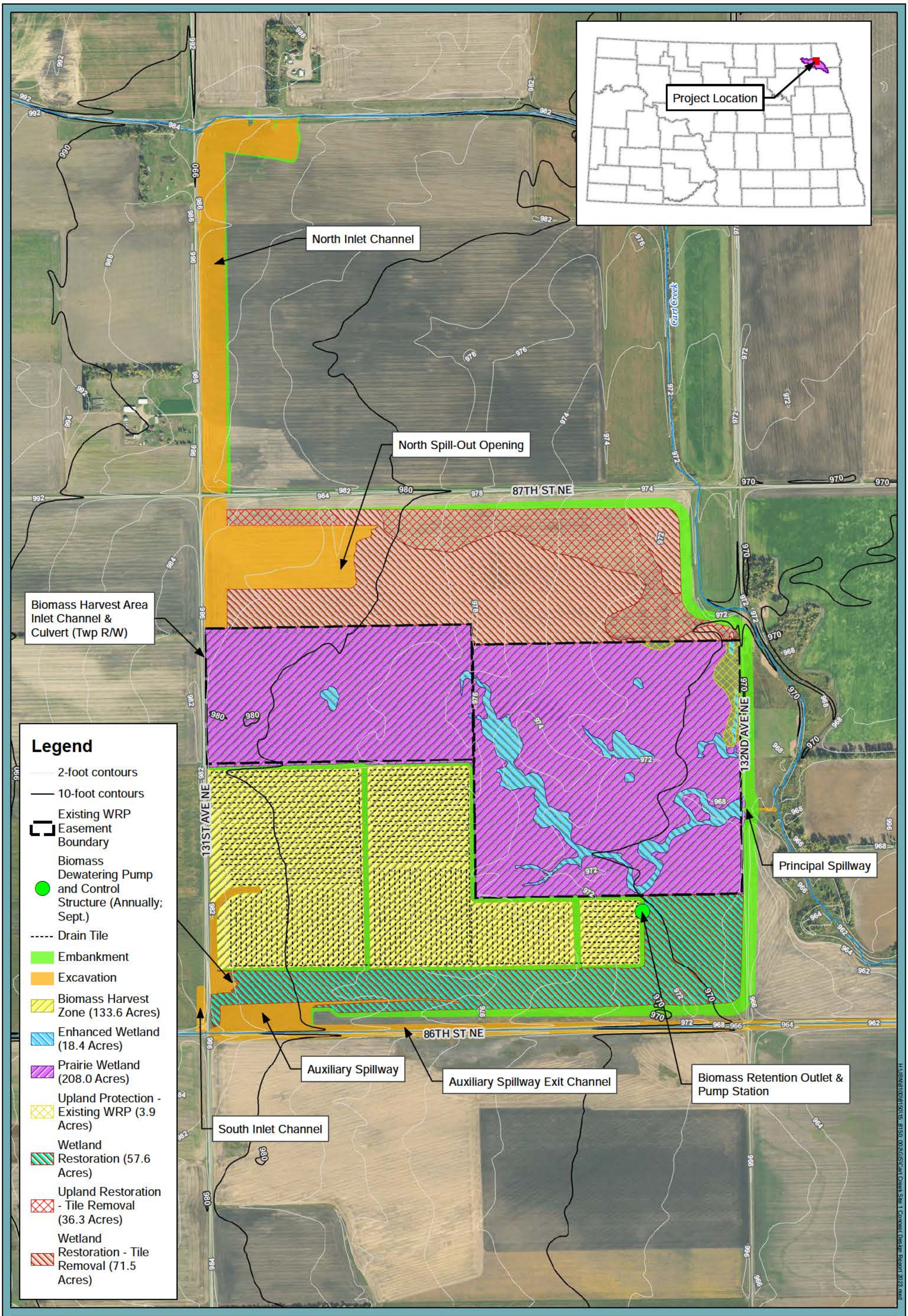


Figure B-1: Preferred Alternative Project Map

North Branch Park River Watershed
Environmental Impact Statement
Park River Joint Water Resource District