

Natural Resources Conservation Service
FINDING OF NO SIGNIFICANT IMPACT
for
Environmental Assessment; Upper Wahoo Creek Watershed
Upper Wahoo Creek Watershed Plan in Saunders County, Nebraska

The Natural Resources Conservation Service (NRCS) has prepared an Environmental Assessment in compliance with the National Environmental Policy Act (NEPA), as amended. Pursuant to the implementing regulations for NEPA (40 CFR parts 1500-1508); the USDA Departmental Policy for the NEPA (7 CFR part 1b); the NRCS Regulations (7 CFR part 650); and the NRCS policy (General Manual Title 190, Part 410); the NRCS gives notice that an environmental impact statement is not being prepared for constructing 10 single-purpose floodwater retarding dams in the Upper Wahoo Creek Watershed in Saunders County, Nebraska. The Environmental Assessment was developed in coordination with the sponsoring local organization (Lower Platte North Natural Resources District) for 10 single-purpose floodwater retarding dams in the Upper Wahoo Creek Watershed to enhance flood risk reduction within the watershed. Upon consideration of the affected environment, alternatives, environmental consequences, and comments and coordination with concerned public and agencies, the State Conservationist for NRCS, Nebraska found that based on the significance and context and intensity as defined in 40 CFR parts 1508.27, that the proposed action is not a major federal action significantly affecting the quality of the human environment. Thus, a Finding of No Significant Impact (FONSI) is being made.

The Lower Platte North Natural Resources District concurs with this determination and supports the proposed project to construct 10 single-purpose floodwater retarding dams to current NRCS requirements and for a design life expectancy of 50 years. The following action is proposed to construct a combination of low and significant-hazard design class dams to control a combined drainage area of approximately 26-square miles in an agricultural setting and capture and store 2,080 acre-feet of sediment over their lifespan.

For information regarding this finding, contact: Robert Lawson, State Conservationist, U.S. Department of Agriculture, Natural Resources Conservation Service, Federal Building, Room 152, 100 Centennial Mall North, Lincoln Nebraska 68508-3866; telephone (402) 437-5300.

Conclusion: I find that the proposed action is not a major federal action significantly affecting the quality of the human environment. Thus, a Finding of No Significant Impact (FONSI) has been made.

ROBERT
LAWSON

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LAWSON
Date: 2022.09.19 14:46:52 -05'00'

ROBERT LAWSON
State Conservationist

9/19/2022

Date

Final Watershed Plan- Environmental Assessment

Upper Wahoo Creek Watershed
Saunders County, Nebraska



LOWER PLATTE NORTH
Natural Resources District

April 2022



FINAL
WATERSHED PLAN & ENVIRONMENTAL ASSESSMENT
For
Upper Wahoo Creek Watershed
Saunders County, Nebraska

AUTHORITY

This watershed work plan has been prepared under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended. The construction of this Project is authorized under Public Law 83-566 (as amended) and in accordance with Section 102(2) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 U.S.C. 4321 et seq.).

ABSTRACT

The purpose of the proposed action is to provide flood damage reduction to agricultural and rural lands within the Upper Wahoo Creek watershed and below the confluence of Cottonwood Creek and Wahoo Creek (Figure 1-1) within the Wahoo Creek watershed. Rural and agricultural areas experience flood damage from frequent precipitation events. The recommended plan consists of 10 single-purpose floodwater retarding dams at locations identified to enhance flood risk reduction. Incidental benefits of the Plan are reducing sedimentation and scour, landowner recreation, enhanced fish and wildlife habitat, and improved water quality. Total project costs are \$19,667,600 of which \$11,661,000 (59 percent) will be paid by Public Law 566 funds and \$8,006,600 (41 percent) will be paid by the Sponsor. This document is intended to fulfill requirements of the National Environmental Policy Act and to be considered for authorization of Public Law 566 funding.

Prepared by: FYRA Engineering
Responsible Agency: U.S. Department of Agriculture, Natural Resources Conservation Service
Sponsor: Lower Platte North Natural Resources District
Cooperating Agency: United States Army Corps of Engineers

ADDITIONAL INFORMATION

For additional information, contact:

Allen Gehring, State Conservation Engineer
Natural Resources Conservation Service
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508

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Upper Wahoo Creek Watershed Agreement

For Upper Wahoo Creek Watershed

between the

Lower Platte North Natural Resources District

(Referred to herein as Sponsor)

and the

Natural Resources Conservation Service,

United States Department of Agriculture

(Referred to herein as NRCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsor for assistance in preparing a plan for works of improvement for the Upper Wahoo Creek Watershed, State of Nebraska, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. 1001 to 1008, 1010, and 1012); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the Sponsor and NRCS a watershed project plan and environmental assessment for works of improvement for the Upper Wahoo Creek Watershed, State of Nebraska, hereinafter referred to as the watershed project plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the Sponsor, hereby agree on this watershed project plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this plan and including the following:

1. Term. The term of this agreement is for the installation period and evaluated life of the project (58 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.

2. Costs. The costs shown in this plan are preliminary estimates. Final costs are to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.

3. Real Property. The Sponsor will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the Sponsor and NRCS are as shown in the cost-share table in section 5 hereof.

The sponsors agree that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

Adequate controls on future development will be maintained within the breach inundation areas for all low and significant hazard dams such that the hazard class does not increase during the evaluated project life.

4. Uniform Relocation Assistance and Real Property Acquisition Policies Act. The Sponsor hereby agrees to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the sponsor is legally unable to comply with the real property acquisition requirements, it agrees that, before any Federal financial assistance is furnished, it will provide a statement to that effect, supported by an opinion of the chief legal officer

of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. Cost-share for Watershed Project Plans. The following table will be used to show cost-share percentages and amounts for watershed project plan implementation.

Project Costs ¹	PL 83-566 Funds		Other funds		Total
	Dollars	Percent	Dollars	Percent	Dollars
Construction ²	9,167,400	86%	1,491,600	14%	10,659,000
Engineering ^{3,4}	2,163,600	76%	674,100	24%	2,837,700
Real Property Rights ⁵	0	0%	5,518,400	100%	5,518,400
Project Administration	330,000	51%	322,500	49%	652,500
TOTAL COSTS	11,661,000	59%	8,006,600	41%	19,667,600

¹Price base: 2020

²Includes mitigation

³Includes construction observation

⁴Includes permit acquisition

⁵Includes cost of legal fees and land appraisals

6. Land Treatment Agreements. The sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsors will encourage landowners and operators to continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

7. Floodplain Management. Before construction of any project for flood prevention, the Sponsor must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs. For plans approved as of the date of this revised manual the Sponsor is required to have development controls in place below low and significant hazard dams prior to NRCS or the Sponsor entering into a construction contract.

8. Water and Mineral Rights. The Sponsor will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

9. Permits. The sponsors will obtain and bear the cost for all necessary Federal, State, and local permits required by law, ordinance, or regulation for installation of the works of improvement.

10. NRCS Assistance. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

11. Additional agreements. A separate agreement will be entered into between NRCS and the sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. Amendments. This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsors or recoveries by NRCS must

be in accordance with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsors having specific responsibilities for the measure involved.

13. Prohibitions. No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.

14. Operation and Maintenance (O&M). The Sponsor will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M agreement. An O&M agreement will be entered into before Federal funds are obligated and will continue for the project life (50 years). Although the Sponsor's responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

15. Emergency Action Plan. Prior to construction, the Sponsor must prepare an emergency action plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP must meet the minimum content specified in NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the sponsors annually.

16. Nondiscrimination Provisions. In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

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17. Certification Regarding Drug-Free Workplace Requirements (7 CFR Part 3021). By signing this Watershed Agreement, the Sponsor is providing the certification set out below. If it is later determined that the Sponsor knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

Controlled substance means a controlled substance in schedules I through V of the Controlled Substances Act (21 U.S.C. Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15);

Conviction means a finding of guilt (including a plea of *nolo contendere*) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

Employee means the employee of a grantee directly engaged in the performance of work under a grant, including (i) all direct charge employees, (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant, and (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement, consultants or independent contractors not on the grantees' payroll, or employees of subrecipients or subcontractors in covered workplaces).

Certification

A. The sponsors certify that they will or will continue to provide a drug-free workplace by—

- (1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.
- (2) Establishing an ongoing drug-free awareness program to inform employees about—
 - (a) The danger of drug abuse in the workplace.
 - (b) The grantee's policy of maintaining a drug-free workplace.
 - (c) Any available drug counseling, rehabilitation, and employee assistance programs.
 - (d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.
- (3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).
- (4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—
 - (a) Abide by the terms of the statement; and
 - (b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than 5 calendar days after such conviction.
- (5) Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must include the identification numbers of each affected grant.
- (6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4)(b), with respect to any employee who is so convicted—
 - (a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
 - (b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.
- (7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The sponsors may provide a list of the sites for the performance of work done in connection with a specific project or other agreement.

C. Agencies will keep the original of all disclosure reports in the official files of the agency.

18. Certification Regarding Lobbying (7 CFR Part 3018) (for projects > \$100,000)

A. The sponsors certify to the best of their knowledge and belief, that—

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned must complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The sponsors must require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. Section 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

19. Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017).

A. The sponsors certify to the best of their knowledge and belief, that they and their principals—

- (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and
- (4) Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. Assurances and Compliance.

As a condition of the grant or cooperative agreement, the sponsor assures and certifies that it is in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as are specifically set forth herein.

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**Summary of Watershed Plan – Environmental Assessment
for
Upper Wahoo Creek Watershed
Saunders County, Nebraska
Lower Platte North Natural Resources District
1st CONGRESSIONAL DISTRICT**

Authorization: Public Law 830-566 Stat. 666 as amended (16 U.S.C. Section 1001 et. Seq.) 1954

Sponsor: Lower Platte North Natural Resources District (LPNNRD)

Proposed Action: The proposed action is the construction of 10 single-purpose floodwater retarding dams to provide flood reduction benefits in the Wahoo Creek Watershed (Figure B-1, Appendix B).

Purpose and Need for Action: The purpose of the proposed action is to provide flood damage reduction to agricultural and urban lands within the Upper Wahoo Creek watershed (watershed) and below the confluence of Cottonwood Creek and Wahoo Creek within the Wahoo Creek Watershed (Figure S-1). Rural and urban areas experience flood damage from frequent precipitation events, with damages beginning at the half-year flood event.

Description of the Preferred Alternative/Plan: The preferred alternative would include the installation of 10 single-purpose floodwater retarding dams with permanent pools throughout the Upper Wahoo Creek watershed. The dam sites are in locations selected to maximize the flood risk reduction for the watershed. The 10 dam sites include a combination of low and significant-hazard design classes and would control a combined drainage area of approximately 26-square miles.

Resource Information

Table S-1. Upper Wahoo Creek Watershed

Eight-Digit Hydrologic Unit Number	10200203
Latitude, Longitude (decimal degrees)	41.2, -96.8
Upper Wahoo Creek Watershed (acres)	63,030
– Cropland	43,500
– Grassland	13,690
– Forest	2,750
– Developed	3,050
– Miscellaneous	40
Floodplain Land Use (acres)	4,770
– Cropland	2,950
– Grassland	730
– Forest	880
– Developed	200
– Miscellaneous	10
Land Ownership	Private 98%, State-Local 2%
Prime Farmland and Farmland of Statewide Importance (acres)	47,100

Table S-2. Census Data

Saunders County	
2010 Census	
Total population	20,780
Percent minority	3%
Percent of population below poverty level	8%
Percent of children below poverty level	10%
2017 Agricultural Census	
Number of Farms	1,118
Average size (acres)	429
Number of Minority Farmers	7

Climate:

Characterized by mild and wet springs, mild and dry autumns, hot summers, and cold winters.

According to the NOAA Regional Climate Centers AgCIS, MEAD 6S, NE Station the mean summer and winter temperatures between 1970 and 2018 are about 74° F and 25° F respectively. Average annual precipitation is approximately 29-inches with approximately 75 percent of the rainfall occurring between April and September.

Topography:

Watershed has rolling hills with steeper slopes in the upland areas and flatter slopes near the floodplain.

Threatened and Endangered Species:

May affect, but not likely to adversely affect the northern long-eared bat, pallid sturgeon, Interior least tern, and piping plover by applying conservation measures. There will be no effect on all other listed and proposed species.

Archeological and Historical Resources (within area of potential effect):

Two historic properties are located within the area of potential effects of two of the proposed structures. However, the proposed structures will have no adverse effect on either historic property.

Wetlands:

There is a total of 19-acres of wetlands delineated within the project sites' affected resource areas. Approximately 16-acres of these wetlands are palustrine emergent wetlands. Approximately 12-acres of the wetlands have a riverine hydrogeomorphic classification and 6-acres have a depressional hydrogeomorphic classification.

Table S-3. Alternative Plans Considered

Alternative	Meets Purpose	Carried forward for Detailed Study
No-Action	--	Yes
Wet Dams (NED)	Yes	Yes
Dry Dams	Yes	Yes
Levees	Yes	No ¹
Wetland/Stream Restoration	No ²	No
Cropland Conversion	Yes	No ¹
Alternate Locations	Yes	No ¹
Raise Existing Roads and Bridges	No ³	No

¹Not reasonable, see Chapter 4.0 for explanations.

²Does not provide sufficient flood storage

³Would not reduce flooding on agricultural lands

Mitigation

There will be a minimum of approximately 12.3-acres of lacustrine fringe wetlands created surrounding the permanent pools to mitigate for the loss of palustrine emergent wetlands. Palustrine emergent will be replaced at a 1:1 ratio for in-kind (lacustrine fringe) wetlands and a 4:1 ratio for out-of-kind wetlands. A minimum of 1.4-acres of forested wetlands and 0.2-acres of scrub-shrub wetlands will be created near the project sites to mitigate in-kind for impacts to forested and scrub-shrub wetlands at a 4:1 mitigation ratio.

Compensatory stream mitigation will be based on the existing stream conditions and calculated by the loss of stream functional units attributable to project implementation. A stream assessment based on the Nebraska Stream Condition Assessment Procedure (NeSCAP) will be performed to determine the existing stream functional units. The streams are largely incised and will therefore likely only require mitigation for the stream lengths lost due to earthen fill.

Trees will be planted to mitigate for woodlands lost due to embankment and auxiliary spillway limits, clearing and grubbing limits, and permanent pool extents. Desired trees are to be replaced at a ratio of 3:1 for those greater than 12-inches diameter at breast height (DBH) and 2:1 for those less than 12-inches DBH. Undesirable trees are replaced at a ratio of 1:1 for all trees and invasive trees are not being replaced since removal will improve overall quality of a woodland community. A tree inventory will be completed to determine the existing trees and the required woodland mitigation.

Project construction will be timed to avoid impacts to migratory birds and the Northern long-eared bat.

Project Costs:

Table S-4 summarizes the distribution of project costs between the Sponsor and NRCS for the installation of Sediment Basin 14-2.

Table S-4. Distribution of Total Project Costs¹

Project Costs	PL 83-566 Funds		Other funds		Total Dollars
	Dollars	Percent	Dollars	Percent	
Construction ²	9,167,400	86%	1,491,600	14%	10,659,000
Engineering ^{3,4}	2,163,600	76%	674,100	24%	2,837,700
Real Property Rights ⁵	0	0%	5,518,400	100%	5,518,400
Project Administration	330,000	51%	322,500	49%	652,500
TOTAL COSTS	11,661,000	59%	8,006,600	41%	19,667,600

¹Price base: 2020

²Includes mitigation

³Includes construction observation

⁴Includes permit acquisition

⁵Includes cost of legal fees and land appraisals

Project Benefits:

Project benefits include flood risk reduction within the Wahoo Creek watershed and cost savings for infrastructure improvement.

Table S-5. Economic Benefits (dollars)¹

Works of Improvement	Average Annual Benefits	Average Annual Cost ²	Benefit : Cost Ratio
10 Floodwater Retarding Structures	772,100	625,600	1.23

¹Price base: 2020

²Includes installation and operation and maintenance, amortized over 58 years at a discount rate of 2.5 percent

Period of Analysis: 58 years

Project Life: 50 years

Environmental Effects and Impacts:

Table S-6 summarizes resource elements that were identified during scoping and summarizes potential impacts related to the installation of the Project.

S-6. Summary of Resources of Concern and Impacts of Wet Dams Alternative (NED)

Environmental Concern	Wet Dams Alternative (NED)
Soils	
Erosion	Will help stabilize degrading stream banks and provide grade control.
Sedimentation	Will capture and store 2,080 acre-feet of sediment over the 50-year lifespan of the structures.
Prime Farmland	Will directly and indirectly impact 700-acres of prime farmland and farmland of statewide importance. No Farmland Protection Policy Act (FPPA) significant concerns.
Water	
Water Quality	Enhanced water quality.
Water Quantity	Will provide flood risk reduction.
Wetlands and other Waters of the U.S.	Net gain of 150-acres of wetlands.
Floodplain Management	Increased flood risk reduction.
Clean Water Act	USACE Section 404 permit is anticipated.
Plants	
Woodlands	Net loss of 80-acres of woodlands.
Grasslands	Net increase of 46-acres of grasslands.
Animals	
Threatened and Endangered Species	May affect, not likely to adversely affect any species by applying conservation measures.
Fish and Wildlife Habitat	Enhanced habitat with development of wetlands and ponds
Humans	
Flood Damages	Reduced damages from flooding
Cultural Resources	No adverse effect to historic properties.



Major Conclusions:

Implementation of this Plan had the greatest benefit to cost ratio and presented no significant negative impacts to the environment. The 10 single-purpose dams will provide flood damage reduction within the watershed, passive recreation, and reduce the cost of infrastructure improvements. This proposed action will also provide incidental benefits of improved fish and wildlife habitat and enhanced water quality.

Areas of Controversy and Issues to be Resolved:

The planning process included public meetings, coordination with interested agencies and groups, and printed public information to raise issues, resolve conflicts, and recommend the most desirable plan features. No significant unresolved controversy remains.

Evidence of Unusual Congressional or Local Interest:

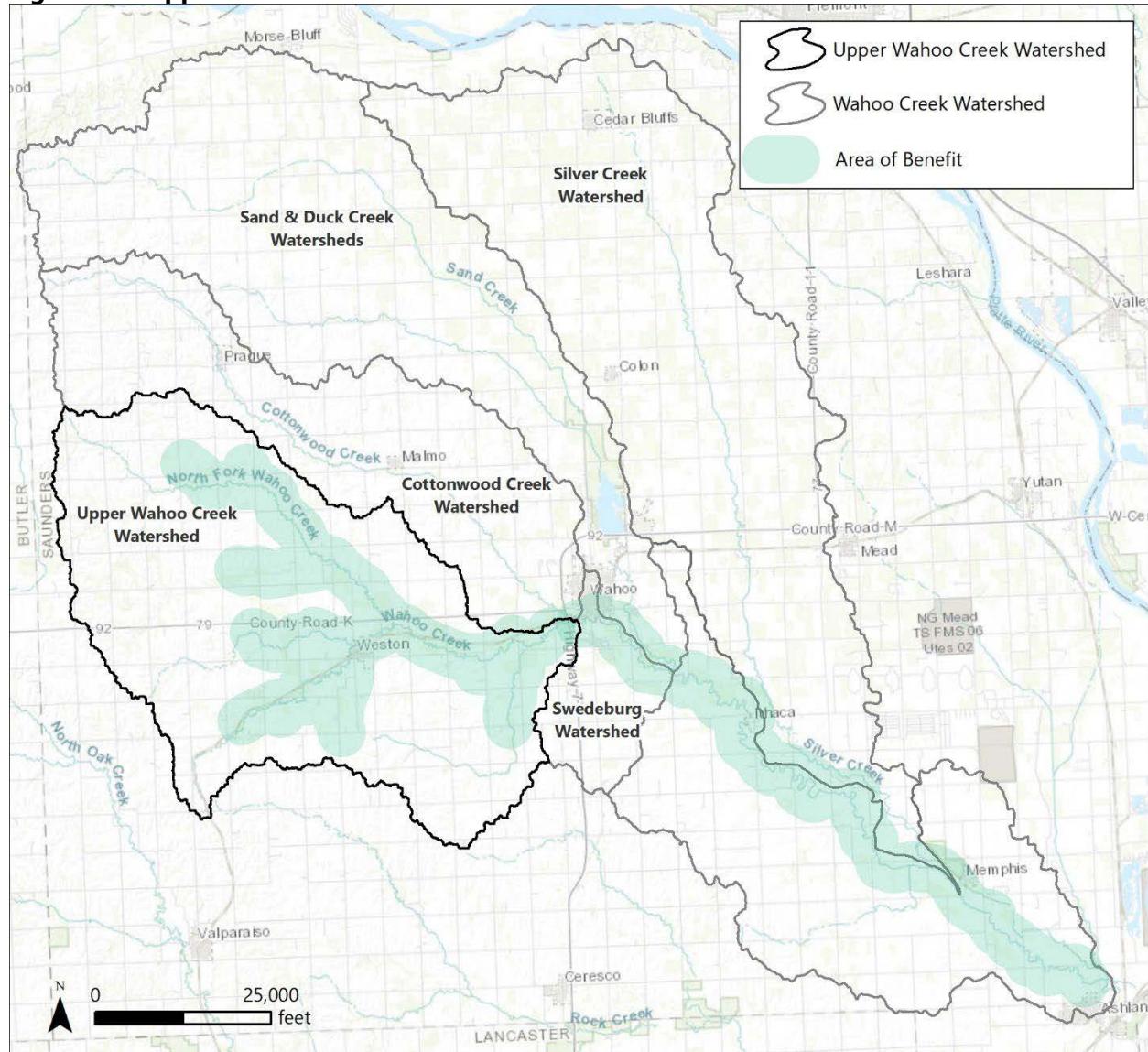
This report is in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects.

1.0 PURPOSE AND NEED FOR ACTION

1.1 Purpose and Need

The purpose of the proposed action is to provide flood damage reduction to agricultural and urban lands within the Upper Wahoo Creek watershed (watershed) and below the confluence of Cottonwood Creek and Wahoo Creek (Figure 1-1, "Area of Benefit") within the Wahoo Creek Watershed. Rural and urban areas experience flood damage from frequent precipitation events, with damages beginning at the half-year flood event. Further discussion demonstrating the underlying need for the proposed action is presented in Section 1.3.

Figure 1-1. Upper Wahoo Creek Watershed



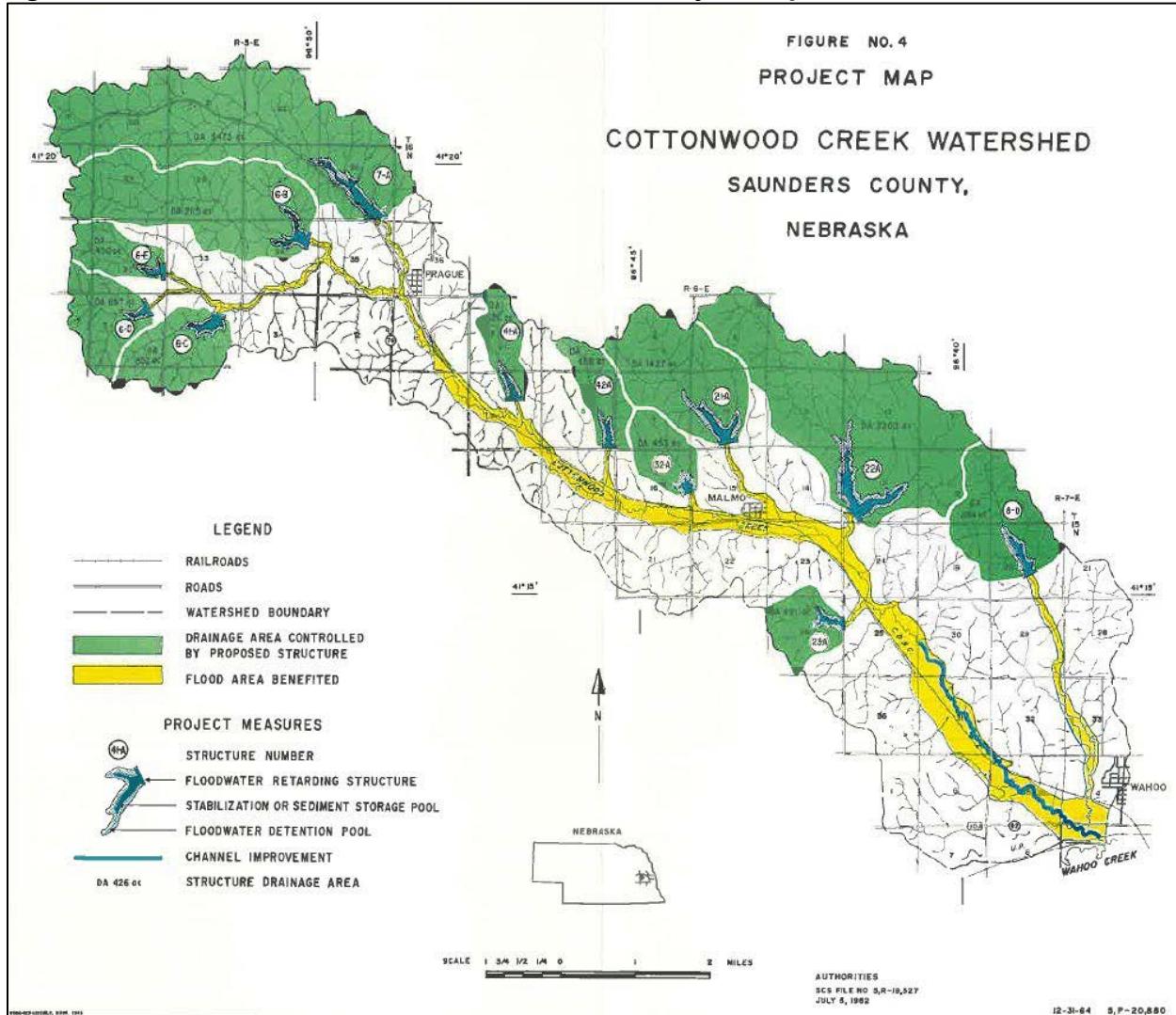
Upper Wahoo Creek watershed consists of the 12-Digit Hydrologic Unit Codes (HUC 12s) of North Fork Wahoo Creek, Dunlop Creek-Wahoo Creek, and Miller Branch-Wahoo Creek.

1.2 Watershed History

Swedeburg watershed drains into the benefited area of lower Wahoo Creek (Figure 1-1, 1-3). A Natural Resources Conservation Service (NRCS, formerly SCS) Work Plan was completed for the Swedeburg watershed in 1954. The seven dams and two drop structures included in the plan were constructed from 1954 to 1957, providing flood control and grade stabilization. The Swedeburg Watershed Work Plan was closed in 1969.

Cottonwood Creek also drains into the benefited area of lower Wahoo Creek (Figure 1-1, 1-2, 1-3). An NRCS Watershed Work Plan that included 12 floodwater retarding dams was completed for this watershed in 1965. These structures were constructed between 1967 and 1990.

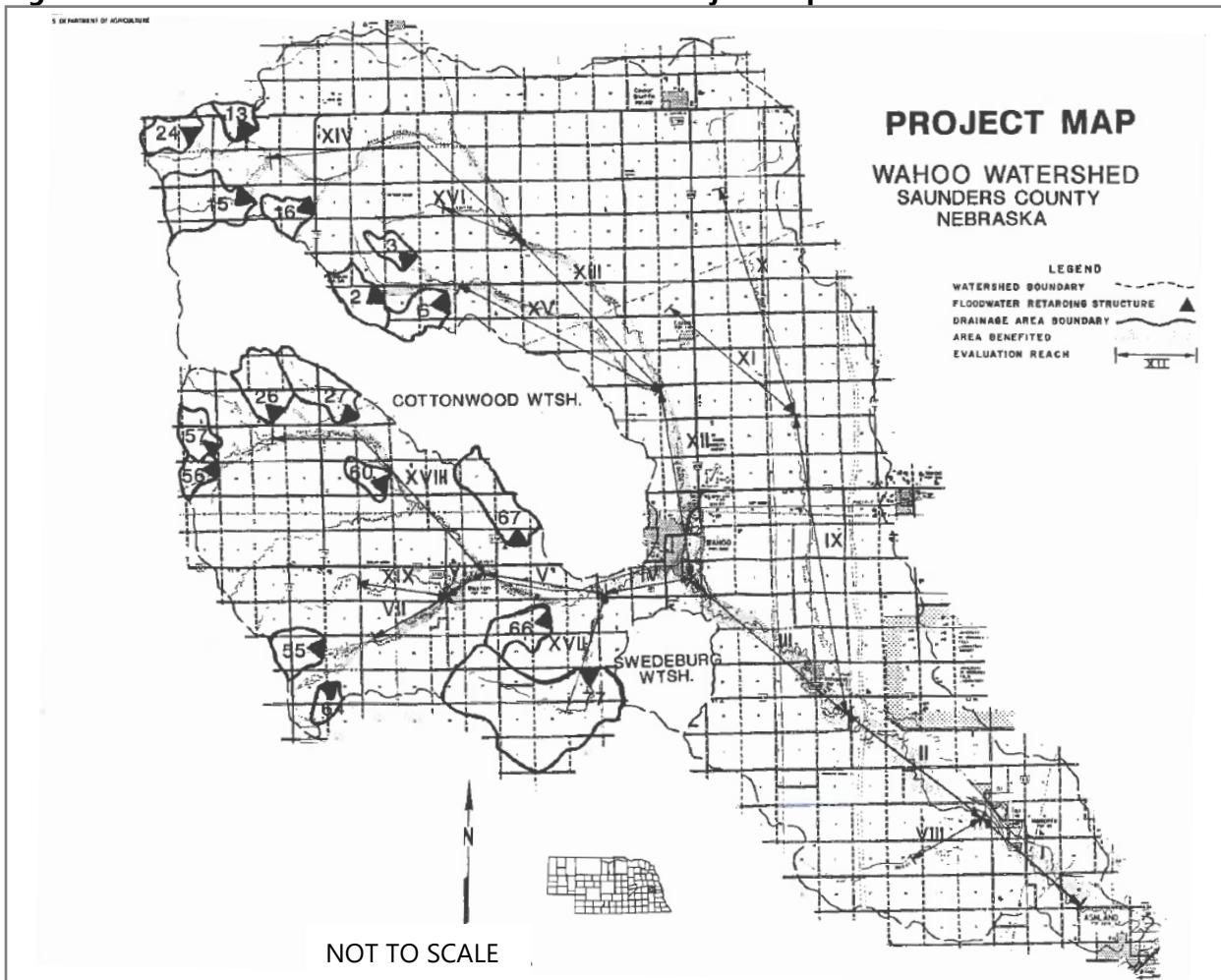
Figure 1-2. 1965 Cottonwood Creek Watershed Plan Project Map



An NRCS Watershed Work Plan and Environmental Impact Statement (1998 Plan-EIS) for the Wahoo Creek Watershed (Figure 1-3) was developed in 1998 in partnership with the Lower Platte North Natural Resource District (LPNNRD, Sponsor). Sixteen single-purpose flood risk reduction structures and one multi-purpose

flood risk reduction and recreation structure (Site 77, Figure 1-1 and 1-2) were identified as the recommended plan. The PL-566 Watershed Plan developed by NRCS and the Sponsor (the 1998 Plan-EIS) was not signed by the Sponsor due to delays in planning and Sponsor funding priorities at the time.

Figure 1-3. 1998 Wahoo Creek Watershed Plan-EIS Project Map



Seven of the seventeen sites recommended in the 1998 Plan-EIS (Duck Creek sites 2, 3, 6 and Sand Creek Sites 13, 15, 16, 24, Figure 1-3) have since been implemented as part of the United States Army Corps of Engineers (USACE) Sand Creek Restoration Project funded through the Section 206 Environmental Restoration Program. Also implemented as part of the USACE Project was a larger site named Lake Wanahoo, which was studied as part of the 1998 Plan-EIS but was removed because the storage of the structure was too large for the NRCS program. Lake Wanahoo was completed in 2009 and is a 639-acre lake with 20,206 acre-feet of flood storage situated on Sand Creek, north of the city of Wahoo and above the confluence of Sand and Wahoo Creeks (Figure 1-1). Implementation of these sites provided flood reduction within the Sand and Duck Creek watersheds and minimal benefits downstream of the confluence of Wahoo and Sand Creeks for the 10-year and more frequent storm events.

Flooding remains the main concern within the Upper Wahoo Creek watershed and downstream of the confluence of Cottonwood and Wahoo Creek.

1.3 Problems and Opportunities

1.3.1 Problems

Flood damage is a major concern within the watershed. At the Wahoo Creek at Ithaca, Nebraska (ITHN1) stream gauge, minor lowland flooding begins at 18-feet and flood stage begins at 19-feet. Years of historic crests at this gauge are shown in Table 1-1. Recent crests are provided in Table 1-2, which shows that the flood stage was exceeded in eight of the last ten years.

Table 1-1. Historic Crests at Ithaca, NE¹

Date	Crest (feet)
August 2, 1959	23.2
June 24, 1963	22.9
June 20, 1960	22.5
June 15, 1982	22.4
May 31, 1951	22.3
August 29, 2014	22.3
August 13, 1982	22.2
August 26, 1987	22.1
August 29, 2007	22.1
September 4, 1977	22.0

¹Gauge ID: ITHN1

(P) Preliminary values subject to further review, as of June 2019

Source: <https://water.weather.gov>

Urban flooding occurs within the communities of Weston, Wahoo, Ithaca, and Memphis. Approximately 170 buildings would be damaged with the 100-year flood within the communities of Weston, Wahoo, Ithaca, and Memphis. The average annual flood damage for these urban areas is \$310,700 (Table 1-3).

Agriculture is the primary land use within the watershed and impacts to crops and pasture represent the majority of flood damages within the watershed. Crop and pasture damages occur with frequent events. Estimates of these damages within the Upper Wahoo Creek watershed and along Wahoo Creek below the confluence of Wahoo Creek and Cottonwood Creek are shown in Table 1-3 (\$1,277,700). Farmsteads and private roads can also be damaged by floodwaters which can bring debris in the form of trees, sediment, and other items from upstream. Estimated average annual damages to these other agricultural properties is \$127,800 (Table 1-3).

Flood damages can also occur due to floodplain deposition when floodwaters deposit infertile sediment on cropland. Scour damages occur when floodwaters remove topsoil from fields which can result in gullies and reduced field accessibility. Average annual damages due to deposition and scour are approximately \$115,000 (Table 1-3). Damage due to flooding of roads and bridges can significantly reduce productivity, delay emergency services, and threaten the safety of the community. Damage can include impacts to the structural integrity of bridge abutments, piers, and decks as well as erosion, submersion, and sediment deposition on roads. There are miles of federal and state roadways and county roads within the watershed

Table 1-2. Recent Crests at Ithaca, NE

Date	Crest (feet)
March 14, 2019 (P)	21.5
September 5, 2018	19.7
October 7, 2017	19.9
May 11, 2016	21.2
May 7, 2015	20.7
August 29, 2014	22.3
May 30, 2013	15.1
May 20, 2011	19.9
July 15, 2010	20.4



with estimated average annual flood damages of \$2,401,000 (Table 1-3). Future conditions are not anticipated to change without a watershed project.

Table 1-3. Average Annual Flood Damages¹

Item	Estimated Average Annual Flood Damage ²
Urban	\$ 310,700
Crop and Pasture	\$ 1,277,700
Erosion and Sediment	\$ 115,000
Other Agriculture	\$ 127,800
Roads and Bridges	\$ 2,401,000

¹Price base: 2020

²Estimated average annual flood damages provided for the Upper Wahoo Creek watershed and along Wahoo Creek below the confluence of Wahoo and Cottonwood Creek ("Area of Benefit" shown in Figure 1-1)

1.3.2 Opportunities

There are many opportunities to improve quality of life and environmental conditions with this watershed project. Reduced flooding will improve the economic conditions of the community and decrease the threat to human safety. Incidental benefits include improved water quality, grade stabilization, improved terrestrial and aquatic habitat, higher functioning streams, wetland creation, and passive recreation.



2.0 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The scope of the Environmental Assessment (EA) is based on an evaluation of resources and potential concerns identified during scoping by NRCS, the Sponsor, and interested agencies and individuals. The following chapter identifies the resources of concern that were deemed relevant to decision making as well as resources that were considered but not studied in detail.

A scoping meeting was held with the Sponsor, NRCS, and USACE as the cooperating agency in March 2018 to discuss problems and opportunities within the watershed and to identify potential resource concerns. Additional scoping meetings were held between the Sponsor and NRCS.

Public and agency scoping meetings were held in December 2017 and June 2018 to give agencies and the public opportunities to express concerns in person, by email, and through comment cards and resources of concern questionnaires provided at the meetings. Feedback provided at these meetings was used to assist in scoping the resources of concern for this EA. Landowner communication was extensive throughout the planning process and land use is not expected to change for the duration of the project life. Please refer to Chapter 6.0 for additional information on public and agency meetings.

A summary of scoping is provided in Table 2-1, which identifies resources that are relevant to the project and studied in further detail within this EA.

Table 2-1. Summary of Scoping

Item/Concern	Relevant to the proposed action?		Rationale
	Yes	No	
Soils			
Sheet, rill, gully, and streambank erosion	X		Erosion contributes to crop damages and water quality impairments.
Sedimentation	X		Aggradations of eroded sediment contributes to sedimentation of the reservoirs and affects the severity and frequency of flooding.
Prime and Unique Farmland	X		Streambank erosion threatens prime and unique farmland and alternatives could impact prime and unique farmland.
Water			
Surface Water Quality	X		Water quality within the streams of the Wahoo Creek Watershed is reduced due to sedimentation and the influx of nutrients.
Regional Water Mgt. Plans and Coastal Zone Management Areas		X	No watershed management plans exist for the Upper Wahoo Creek watershed and it is not within a coastal zone management area.
Floodplain Management	X		Agricultural and urban areas are located within the floodplain. Any and all development in the

Item/Concern	Relevant to the proposed action?		Rationale
	Yes	No	
			regulatory floodplain or floodway will require a local Floodplain Development Permit
Streams	X		USACE Section 404 permit is anticipated.
Wetlands	X		USACE Section 404 permit is anticipated.
Wild and Scenic Rivers		X	No designated rivers within the watershed.
Air			
Air Quality		X	An increase in the emission rate of any regulated air pollutant is not expected.
Plants			
Threatened and Endangered Species	X		Listed species have known ranges in or near the watershed.
Essential Fish Habitat		X	There is no Essential Fish Habitat within the watershed.
Invasive Species		X	The introduction and/or spread of invasive species is not anticipated.
Natural Areas		X	No Natural Areas are designated within the watershed.
Riparian Areas	X		Riparian areas may be impacted.
Habitats			
Grasslands	X		Grasslands are present and could be impacted.
Woodlands	X		Woodlands are present and could be impacted.
Animals			
Fish and Wildlife Habitat	X		Potential to impact fish and wildlife habitat.
Threatened and Endangered Species	X		Listed species have known ranges in or near the watershed.
Coral Reefs		X	The watershed is not near any coral reefs or associated water bodies.
Invasive Species		X	The introduction and/or spread of invasive species is not anticipated.
Migratory Birds/Bald and Golden Eagles	X		Migratory birds and bald eagles may be impacted.
Humans			



Item/Concern	Relevant to the proposed action?		Rationale
	Yes	No	
Flood Damages	X		Flood damages are a major concern within the watershed.
Cost	X		Required by the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G)
Cultural and Historical Resources	X		Potential impact to cultural resources. Studies to determine impacts are included as part of this Plan-EA and a summary is included within this document.
Environmental Justice	X		The potential environmental impacts of the alternatives were studied with respect to the demographic and socioeconomic composition of the watershed and project area to ensure no minority or low-income populations would be affected by implementation of any of the alternatives.
Potable Water Supply		X	Sufficient potable water.
Public Health and Safety	X		Potential safety concerns due to flooding.
Recreation		X	There is no need for recreation in the area.
Scenic Beauty and Parklands		X	No specifically designated unique or valuable scenic landscapes within the area.

3.0 AFFECTED ENVIRONMENT

Below is a summary of existing conditions identified as relevant during project scoping. The project area being considered is the Upper Wahoo Creek watershed, as shown in Figure 1-1. The following sections describe these resources as they currently exist. The land use within the watershed is predominantly agricultural.

3.1 Soil Erosion

Approximately 776,200 tons of soil erode annually, resulting in resource problems within the Upper Wahoo Creek watershed. Erosion losses are shown in Table 3-1.

Table 3-1. Annual Erosion within Upper Wahoo Creek Watershed

Erosion Source	Amount of Erosion (tons/year)
Sheet and Rill	671,200 ¹
Ephemeral and Gully	97,500 ²
Channel/Streambank	7,500 ²
Total	776,200

¹See Table D5-1

²See Table D5-2

Note: Values rounded to the nearest 100 tons/year

Sediment is produced from all parts of the watershed from all land uses. The largest single contributor is untreated cropland, with sediment deriving from sheet and rill erosion, followed by ephemeral gully erosion. Sheet and rill erosion reduces crop yields and lowers long-term productivity of cropland due to depletion of topsoil. Crops are destroyed or damaged as sediment is redistributed on fields, especially where sediment laden runoff moves across areas of reduced slope or encounters roads and fence lines. Farm machinery is subjected to additional wear and tear during farming operations in these areas. Ephemeral and gully erosion is produced mostly by inadequately protected or untreated cropland. Ephemeral and gully erosion are minor compared to sheet and rill erosion; however, this still decreases farming efficiency by damaging crops. Streambank erosion represents approximately 1 percent of watershed erosion and is therefore not a major concern as the overall impact is not significant.

3.2 Sedimentation

Sediment is the portion of total erosion that is transported from its point of origin and delivered to a specific location such as the stream system of the watershed outlet. Sediment transport occurs primarily by water, either as overland runoff or channelized flow. Sediment is produced from all parts of the watershed and from all land uses.

The largest erosion process contributing to delivered sediment is sheet and rill erosion and the largest contributing land use is cropland. However, sheet and rill erosion has a low sediment delivery efficiency because overland runoff leaves much of the material behind as depositions on fields, at field boundaries, in road ditches, and at other obstacles. An estimated 29 percent of sheet and rill erosion produced annually moves through the stream system. Ephemeral and gully erosion are somewhat more efficient at sediment delivery due to the proximity to flow channels with an estimated 65 percent delivery rate. Streambank



erosion is much more efficiently delivered due to the greater carrying capacity of channelized flow with an estimated 90 percent delivery rate. Based on the estimated sediment delivery rates, the total sediment produced annually in the Upper Wahoo Creek watershed is approximately 266,900 tons of sediment per year (Table 3-2).

Table 3-2. Sediment Produced Annually within Upper Wahoo Creek Watershed

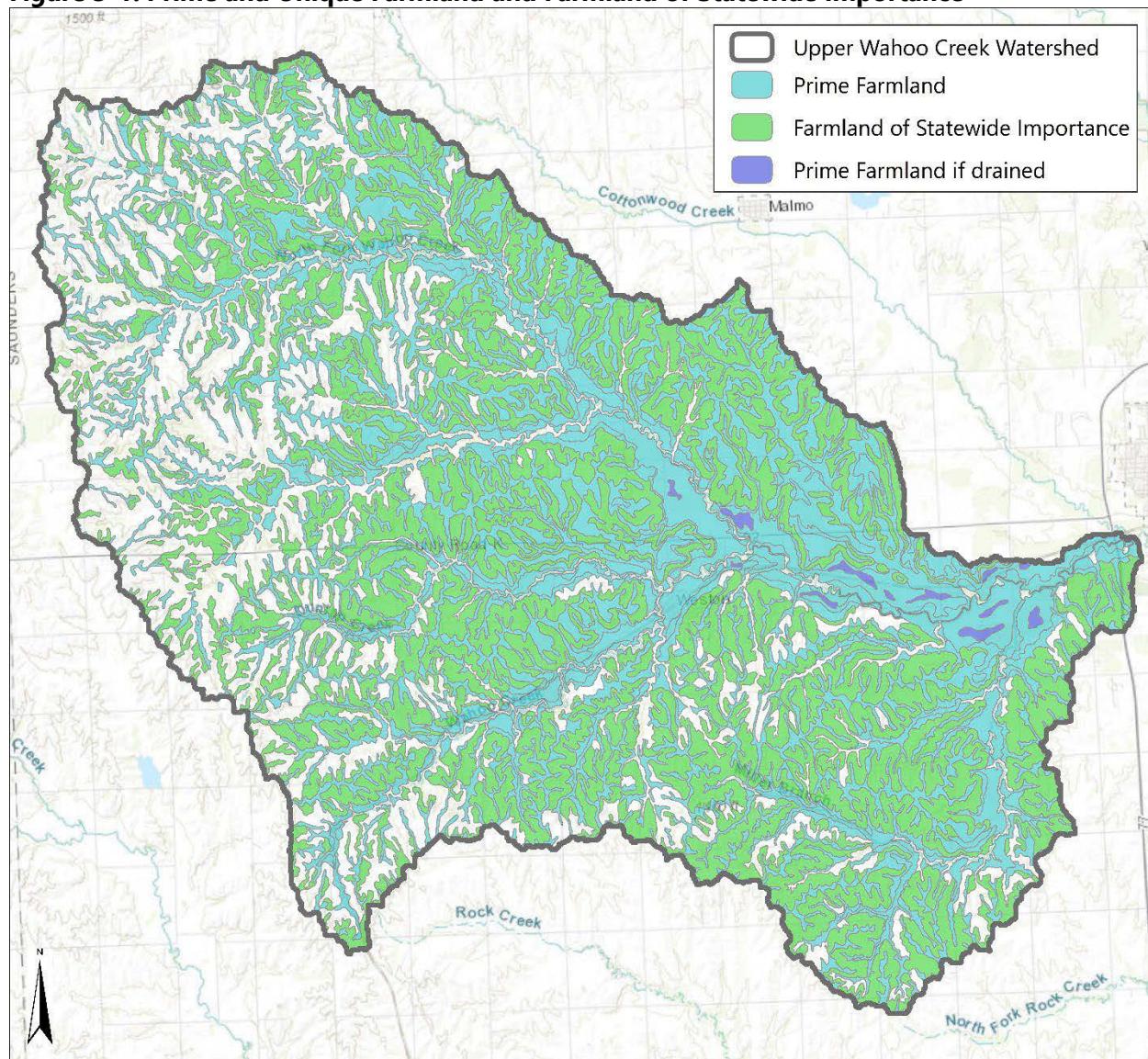
Erosion Source	Sediment Transported Downstream (tons/year)
Sheet and Rill	196,800
Ephemeral and Gully	63,400
Channel/Streambank	6,800
Total	266,900

Note: Values rounded to the nearest 100 tons/year

3.3 Prime and Unique Farmlands

The Farmland Protection Policy Act (FPPA) was established to avoid significant, irreversible losses of farmland. Prime farmland (defined under the FPPA) and farmland of statewide importance are lands that exhibit the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses (SSM 2017). These lands have the soil quality, growing season, and moisture supply needed to produce economically sustainable high yields of crops. The use of acceptable farming methods, including water management, can be used to attain the sustainable yields. Prime farmlands generally have an adequate and dependable water supply (from precipitation or irrigation), are not excessively erodible or saturated for long periods of time, and do not flood frequently (SSM 2017). Prime farmland is land that is available for farming, but could currently be cropland, pastureland, rangeland, forestland, or other land, but not urban built-up land or water. More information about the criteria for prime farmland and farmland of statewide importance is available at the local office of the NRCS.

There are approximately 44,500-acres of prime farmland and farmland of statewide importance within the Upper Wahoo Creek watershed or approximately 71 percent of the watershed. Figure 3-1 shows the extents of the prime farmland and farmland of statewide importance within the Upper Wahoo Creek watershed. The soil types and areas of NRCS soil map units within the Upper Wahoo Creek watershed that are prime farmland or farmland of statewide importance are listed in Table 3-3 below.

Figure 3-1. Prime and Unique Farmland and Farmland of Statewide Importance

Source: United States Department of Agriculture (USDA). Web Soil Survey. Saunders County, Nebraska (NE155). Last updated: September 2018.

Table 3-3. Prime and Farmlands of Statewide Importance within Upper Wahoo Creek Watershed

Map Unit Symbol	Map Unit Name	Rating	Area (acres)
3518	Lamo silty clay loam, occasionally flooded	Prime farmland if drained	8
7049	Kenridge silty clay loam, occasionally flooded	All areas are prime farmland	2,731
7061	Muscotah silty clay loam, occasionally flooded	Prime farmland if drained	214
7205	Aksarben silty clay loam, 0 to 2 percent slopes	All areas are prime farmland	364



Map Unit Symbol	Map Unit Name	Rating	Area (acres)
7230	Judson silt loam, 0 to 2 percent slopes	All areas are prime farmland	693
7231	Judson silt loam, 2 to 6 percent slopes	All areas are prime farmland	5,052
7646	Yutan, eroded-Judson complex, 6 to 11 percent slopes	Farmland of statewide importance	23,020
7647	Yutan, eroded-Aksarben silty clay loams, 2 to 6 percent slopes	All areas are prime farmland	10,467
8119	Pohocco silty clay loam, 11 to 17 percent slopes, eroded	Farmland of statewide importance	1,959

Source: United States Department of Agriculture (USDA). Web Soil Survey. Saunders County, Nebraska (NE155). Last updated: September 2018.

3.4 Surface Water Quality

In Nebraska, beneficial uses are designated for perennial stream segments and publicly owned lakes based on which uses are attainable due to the physical, chemical, and biological characteristics of each water body. Water quality criteria are assigned to protect each use. These beneficial uses can include:

- Primary Contact Recreation
- Aquatic Life: Coldwater (Class A and B), Warmwater (Class A and B)
- Water Supply: Public Drinking Water, Agriculture, Industrial
- Aesthetics

The downstream section of Wahoo Creek is the only stream classified a Class A Warmwater Aquatic Life use by the Nebraska Department of Environmental Quality (NDEQ). Class A Warmwater Aquatic Life indicates that these waters provide, or could provide, a habitat suitable for maintaining one or more identified key species (Channel Catfish) on a year-round basis. These waters are also capable of maintaining year-round populations of a variety of other warmwater fish and associated vertebrate and invertebrate organisms and plants. The remaining stream segments within Upper Wahoo Creek watershed, including Miller Branch, North Fork Wahoo Creek, Dunlap Creek, and an unnamed creek are tributaries to Wahoo Creek and are classified as Class B Warmwater Aquatic Life use. A classification of Class B Warmwater Aquatic Life indicates that these are waters where the variety of warmwater biota is presently limited by water volume or flow, water quality (natural or irretrievable human-induced conditions), substrate composition, or other habitat conditions. These waters are only capable of maintaining year-round populations of tolerant warmwater fish and associated vertebrate and invertebrate organisms and plants. Key species may be supported on a seasonal or intermittent basis, but year-round populations cannot be maintained.

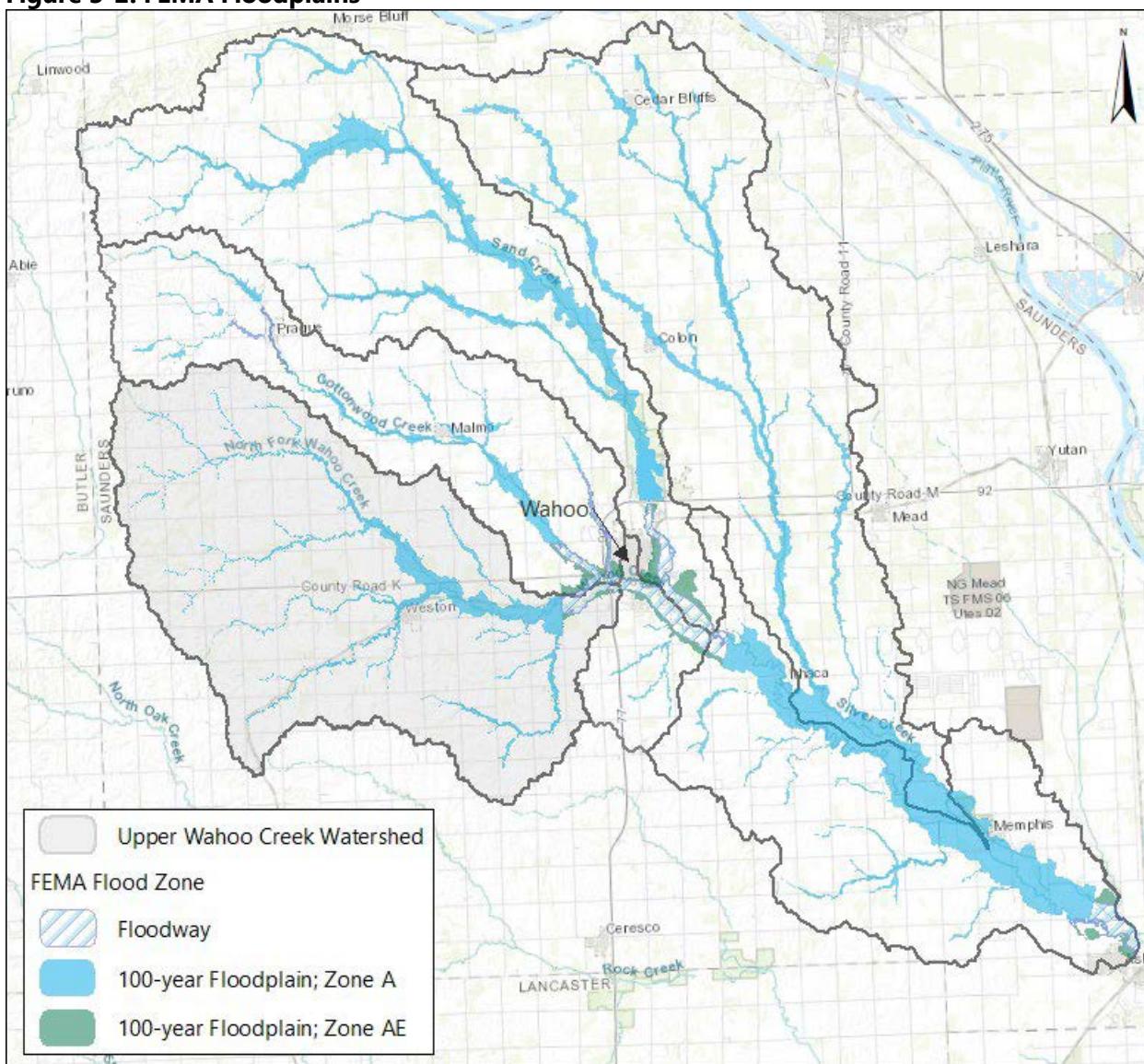
All waters within Upper Wahoo Creek watershed are classified for Class A Agriculture Water Supply use. Designation for Water Supply means that these waters can be used for general agricultural purposes such as irrigation and livestock watering without treatment. Nitrate and nitrite as nitrogen cannot exceed 100 mg/l, selenium cannot exceed 0.02 mg/l, and conductivity cannot exceed 2,000 umhos/cm between April 1 and September 30.



These waters are also protected for an Aesthetic Beneficial Use, meaning they must be free from human induced pollution which causes noxious odors, floating, suspended, colloidal, or settleable materials that produce objectionable film, colors, turbidity, or deposits, and the occurrence of undesirable or nuisance aquatic life such as algal blooms (NDEQ 2014).

3.5 Floodplain Management

The Federal Emergency Management Agency (FEMA) 100-year floodplain encompasses areas with a 1 percent chance of being inundated by a flood event in any given year and are mapped by FEMA along major streams within the watershed. The 100-year floodplain is broken down into five types of zones, two of which are included in the Upper Wahoo Creek watershed. Zone A, which does not include base flood elevations and Zone AE, which includes base flood elevations. Zone A is the dominant zone within the watershed and Zone AE is generally located near the city of Wahoo. All areas outside of the 100-year floodplain have less than a 1 percent chance of inundation in any given year. The FEMA floodway includes areas with restrictions on cumulatively raising the water surface elevation above a designated height. Development in the FEMA floodways must be regulated to ensure that there are no increases in upstream flood elevations. A FEMA floodway is present in the southeast corner of the watershed, near the city of Wahoo. Any and all development in the regulatory floodplain or floodway will require a local Floodplain Development Permit (Neb. Rev. Stat. § 31-1021 & Title 455 Nebraska Administrative Code, Chapter 1). This includes all Special Flood Hazard Areas identified on FEMA's Flood Insurance Rate Maps, and any other area adopted by the local jurisdiction. Development is defined as "Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations or storage of equipment or materials." Figure 3-2 shows the extents of the 100-year floodplain and the FEMA floodway.

**Figure 3-2. FEMA Floodplains**

United States Department of Homeland Security. FEMA Flood Map Service Center. Saunders County NFHL Data. Latest Study Effective Date: August 2016.

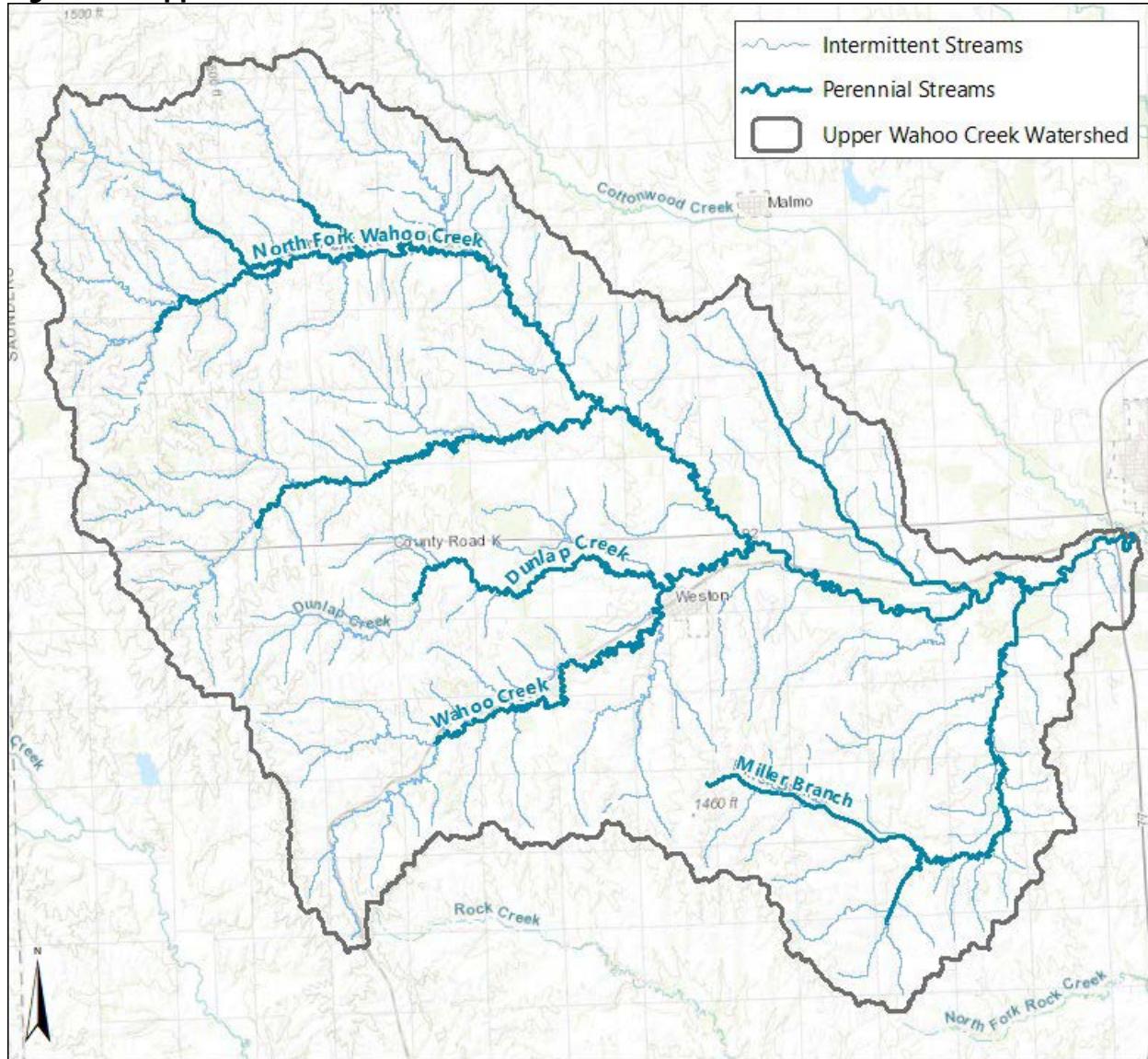
3.6 Streams

North Fork Wahoo Creek, Dunlap Creek, and Miller Branch are the three main perennial streams within the Upper Wahoo Creek watershed. These three streams are tributaries to Wahoo Creek, which flows in the overall southeast direction through the Upper Wahoo Creek watershed. Dunlap Creek and Miller Branch generally flow in the northeast direction and North Fork Wahoo Creek generally flows in the southeast direction. All four of these streams are predominantly perennial while the headwaters and tributaries of North Fork Wahoo Creek, Wahoo Creek, and Dunlap Creek are ephemeral and intermittent. The creek lengths and drainage areas of the major perennial streams are included in Table 3-4 and shown in Figure 3-3.

Table 3-4. Stream Lengths within Upper Wahoo Creek Watershed

Streams	Length (mi)	Drainage Area (sq. mi)
Dunlap Creek	6.0	8.7
Miller Branch	10.8	15.1
North Fork Wahoo Creek	14.8	43.6
Wahoo Creek	18.9	31.1
Totals for Upper Wahoo Creek Watershed	50.5	98.5

Source: USGS, National Hydrography Dataset (NHD). Accessed: 2020.

Figure 3-3. Upper Wahoo Creek Watershed Streams

Source: USGS, National Hydrography Dataset (NHD). Accessed: 2020.



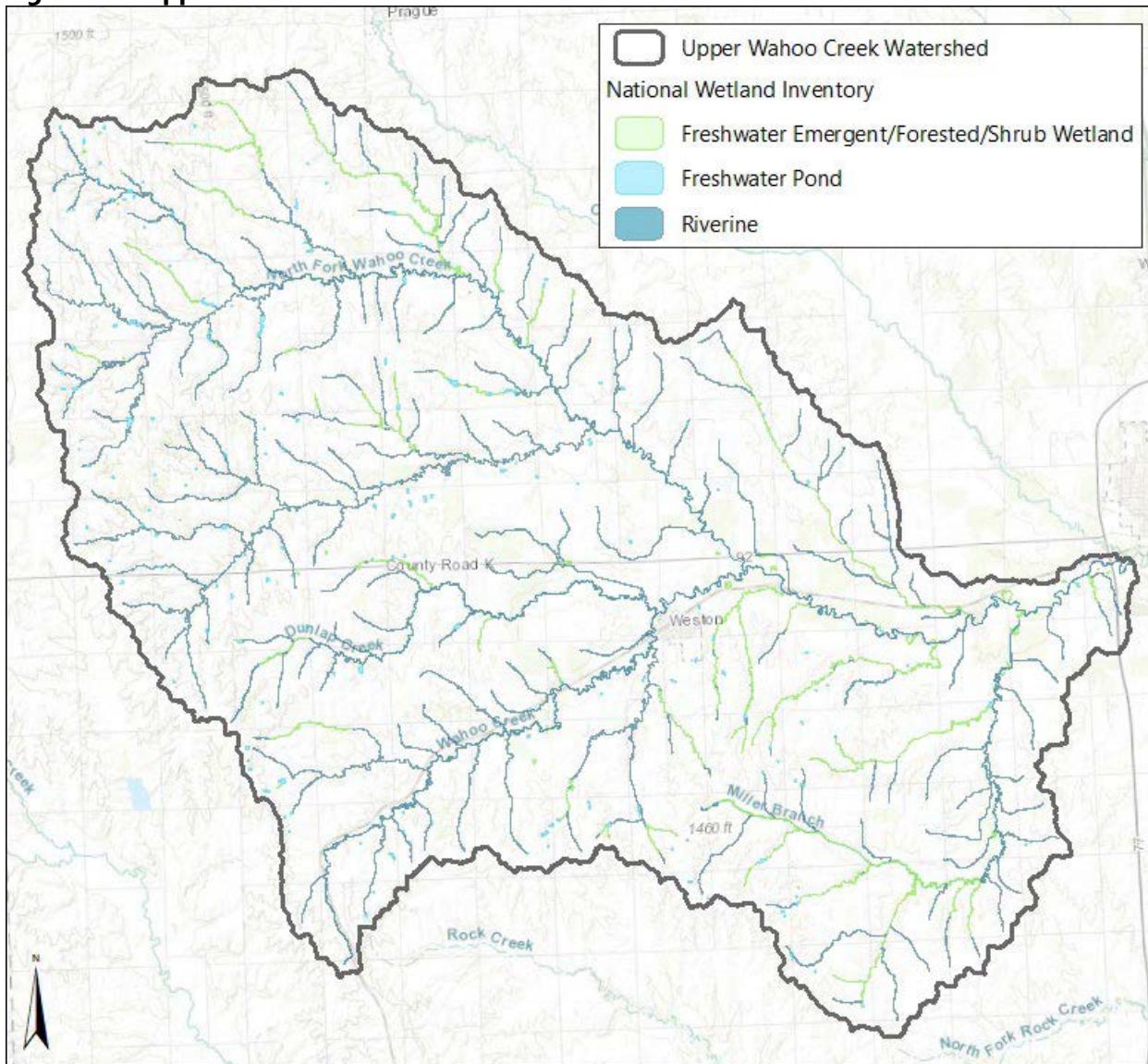
3.7 Wetlands

The United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) provides detailed information on the abundance, characteristics, and distribution of wetlands within the United States. There are approximately 800-acres of NWI areas within the Upper Wahoo Creek watershed, which makes up approximately 1 percent of the watershed. Approximately 65 percent of these NWI areas are riverine wetlands within and along the streams and tributaries. Freshwater emergent wetlands in this area are typically represented by *Phalaris arundinacea* and *Echinochloa crus-galli* and freshwater forested/shrub wetlands are typically dominated by *Salix species* and *Populus deltoides*. The acreage within the Upper Wahoo Creek watershed of each type of wetland and the Cowardin classification (as classified by the NWI) are included in Table 3-5 below and shown in Figure 3-4.

Table 3-5. NWI Areas within the Upper Wahoo Creek Watershed

Wetland Type	Cowardin Classification	Area (ac)
Freshwater Emergent Wetland	Palustrine emergent, temporarily flooded	19
	Palustrine emergent, seasonally flooded	61
	Palustrine emergent, semi-permanently flooded	2
	Subtotal	81
Freshwater Forested/Shrub Wetland	Palustrine forested, temporarily flooded	61
	Palustrine scrub-shrub, temporarily flooded	15
	Subtotal	76
Freshwater Pond	Palustrine aquatic bed, semi-permanently flooded	13
	Palustrine unconsolidated bottom, semi-permanently flooded	94
	Palustrine unconsolidated bottom, intermittently exposed	9
	Palustrine unconsolidated shore, temporarily flooded	2
	Palustrine unconsolidated shore, seasonally flooded	2
	Subtotal	120
Riverine	Riverine Streambed, seasonally flooded	512
	Riverine unconsolidated bottom, permanently flooded	11
	Subtotal	522
Total		800

United States Fish and Wildlife Service (USFWS). National Wetlands Inventory. NE Wetlands East. Last updated October 2018.

Figure 3-4. Upper Wahoo Creek Watershed NWI Areas

United States Fish and Wildlife Service (USFWS). National Wetlands Inventory. NE Wetlands East. Last updated October 2018.

3.8 Threatened and Endangered Species

There are 12 state and federally listed endangered, threatened, proposed, and candidate species within Saunders County, Nebraska (as of August 2018). Two of these, the Salt Creek Tiger Beetle and Saltwort, occur outside of the Upper Wahoo Creek watershed. Wahoo Creek flows into Salt Creek approximately 12 river miles downstream of Salt Creek Tiger Beetle and Saltwort range and these species would not be impacted by hydrologic changes to tributaries of Wahoo Creek. Therefore, these two species are not included in this section. The remaining 10 species and their habitat requirements are described below based on information available from the USFWS, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Rare Species Education for Conservation.

Northern Long-Eared Bat (*Myotis septentrionalis*) – Federally threatened

This medium-sized bat is approximately 3- to 3.7-inches in length with a wingspan of 9- to 10-inches and is distinguished by its long ears, particularly as compared to other bats in its genus. Their fur color can be medium to dark brown on the back and tawny to pale-brown on its underside. These bats spend winters hibernating in caves and mines (called hibernacula) with constant temperatures, high humidity, and no air currents. During the summer, they roost either singly or in colonies underneath bark, in cavities or in crevices in both live and dead trees, and within structures like barns, sheds, and culverts.

Pregnant females spend summer months roosting in small colonies generally composed of 30 to 60 bats at the beginning of summer. Most of these females will give birth at the same time, which may occur from late May to late July. The predominant and most immediate threat to the Northern long-eared bat is white-nose syndrome, a fungal disease that affects hibernating bats. This fungus causes changes in bats that make them more active than usual and in turn they burn up fat needed to survive the winter.

Pallid Sturgeon (*Scaphirhynchus albus*) – Federally endangered

Pallid sturgeon are large, bottom-dwelling fish with a flattened snout, long slender tail, toothless mouth, and rows of bony plates instead of scales. They can weigh up to 80-pounds and reach lengths of 6-feet, but rarely exceed 6- to 8-pounds in Nebraska. The Pallid sturgeon requires large, silty rivers and prefers habitat with varying depths and velocities and braided channels, sand bars, sand flats, and gravel bars. These fish are known to occur in Nebraska in the Missouri River and the lower Platte River below Fremont. The major threat to this species is human-induced habitat modification including channelization and impoundments.

Western Prairie Fringed Orchid (*Platanthera praecox*) – Federally threatened

This orchid is a native perennial forb distinguished by large, white flowers on a single stem that grows up to 3-feet high. Each flower stalk has up to 40 flowers that have fringed margins and are approximately 1-inch long. It was historically found throughout the tallgrass regions of North America and now occurs in 30 counties in Nebraska, including the southeast portion of Saunders County. Habitat includes wet to moist soils with full sunlight in wet unplowed tallgrass prairies and meadows as well as bogs, fens, and sedge meadows.

The greatest threat to the western prairie fringed orchid is habitat loss, predominantly through the conversion of habitat for crop production, grazing, intensive haying, and drainage. Additional threats include overuse of herbicides, livestock overgrazing, and other detrimental practices to native prairies.

Interior Least Tern (*Sternula antillarum athalassos*) – Federally threatened

The interior least tern is a feisty, swallow-like bird 8- to 9-inches long with a wingspan of 20-inches. It is the smallest tern species in North America. It was once called sea swallow for its delicate, graceful, and buoyant flights over water. During the breeding season, least terns typically nest and raise young on dry riverine sandbars in wide, braided rivers, and along the shores of reservoirs and lakes. They can also be found nesting on sand and gravel piles at mining operations near rivers.

Adult least terns have a black crown, white forehead and undersurface, pale gray back and wings, and a black-tipped yellow-orange bill. The short legs and webbed feet of the male are orange while the

females are pale yellow. The long, black outermost wing feathers and the short, deeply forked tail are conspicuous in flight. Immature least terns are darker gray than the adults and have a dark bill, a dark gray eye stripe, a white forehead, and a dusky brown cap.

Piping Plover (*Charadrius melanotos*) – Federally endangered

The piping plover is a migratory shorebird with a length of about 7-inches and a wingspan of about 19-inches and can live to be 8- to 11-years old. However, like most birds, many do not make it past the first year. Piping plovers are found along shorelines, on mud flats, and sand flats. In Nebraska, they can be found along the Platte River east of Lake McConaughy and lower reaches of other major rivers.

Piping plovers are sand-colored birds with white undersides and orange legs. During the breeding season, adults develop an orange bill with a dark tip, and a single black forehead band and breast band. Non-breeding and immature piping plovers do not have the dark bands on their forehead or breast and instead have an all dark bill.

Lake Sturgeon (*Acipenser fulvescens*) – State threatened

Lake sturgeons are bottom-feeding fish with bony plates instead of scales, an elongated snout, toothless mouth, and four barbels or whiskers behind the mouth. They are light brown in color with a whitish belly. These fish are generally larger than other sturgeon, often reaching 100-pounds. Although they were historically abundant in the Missouri and Platte Rivers, they are now limited to the Missouri River and the lower reaches of its major tributaries.

The lake sturgeon habitat includes the bottoms of large, clean, freshwater rivers and lakes and are typically found in large, free-flowing rivers with rocky or sandy substrate. Threats to this species include habitat modification and their slow growth and reproduction rates as they do not spawn until 20 years of age.

Sturgeon Chub (*Macrhybopsis gelida*) – State endangered

The sturgeon chub is a slender minnow an average of 1.7- to 2.5-inches long with small eyes and low ridges on many of the back and side scales. The sides are silvery, the belly is silvery white, the back is light brown with fine, dark specks, and the tail fin has a pronounced notch. The long, flattened snout projects far beyond the upper lip and it feeds on benthic invertebrates. Recent collections indicate that the sturgeon chub has a restricted range of the Missouri River downstream of Fort Calhoun and the lower Platte River downstream of Fremont. The sturgeon chub inhabits the open channels of medium to large turbid rivers in swift currents over a bottom of sand or fine gravel.

Flathead Chub (*Platygobio gracilis*) – Proposed State threatened

The flathead chub has a broad, flat snout that extends beyond its upper lip. It also has a small, distinctive barbel in the corner of its mouth and some males have red on their fins. Flathead chubs are native to all of Nebraska's large rivers except the Blue River System. They prefer large, turbid rivers with relatively fast currents over gravel or sand substrates. Viable populations may require long, relatively natural reaches (approximately 114-miles of unimpounded stream length).

Plains Minnow (*Hybognathus placitus*) – Proposed State threatened

The plains minnow are silver-colored fish with a thin dark line running the length of its tan back and a somewhat transparent belly. They can grow up to 5-inches long. They occur in most major river systems

in Nebraska other than the Blue River System. The plains minnow inhabits permanent streams and backwaters with sandy substrate and moderate currents. They use undercut banks for cover and require sufficient unimpounded stream length to successfully reproduce due to their upstream migratory phase in which they repopulate upstream habitats.

Western Silvery Minnow (*Hybognathus argyritis*) – Proposed State endangered

The western silvery minnow is a fish with a slightly compressed body that is widest just in front of the dorsal fin. It has sides that are silvery-colored or yellowish-white. The western silvery minnow historically inhabited all of the major river systems in the state except the Blue River System. Today, they primarily inhabit the Missouri River System. They use very slow and shallow water within the backwaters, pools, and slow-moving waters of the Missouri River.

3.9 Grasslands

Grassland habitat is scattered throughout the watershed, predominantly located adjacent to streams as small, discontinuous areas. Grasslands in this part of Nebraska were often historically tallgrass prairies that have seen been plowed for cropland. Historically, the primary grass species that were present were big bluestem, Indian grass, switchgrass, little bluestem, and sideoats grama.

3.10 Woodlands

Woodland habitats are commonly located adjacent to streams within the watershed. Woodland communities make up approximately five percent of the Upper Wahoo Creek watershed. The majority of woodland areas are located in fence rows and windbreaks or along stream channels and bottomlands. Woodland areas provide habitat to a diverse range of species and provides protection in the winter for many animals. Eastern Nebraska woodland community types are considered relatively rare.

The woodlands originally found within the Upper Wahoo Creek watershed pre-settlement would probably have been classified by the Eastern Dry-Mesic Bur Oak Forest and Woodland ecological system and the Eastern Riparian Forest community within floodplains and near streams (NGPC 2010). The trees that are typical of the Upper Wahoo Creek watershed include *Ulmus americana* (American elm), *Populus deltoides* (Eastern cottonwood), *Celtis occidentalis* (hackberry), *Morus alba* (white mulberry), *Fraxinus pennsylvanica* (green ash), *Tilia americana* (basswood), and *Juniperus virginiana* (eastern red cedar). Additional less common woodland species include *Quercus macrocarpa* (bur oak), *Juglans nigra* (black walnut), *Acer negundo* (boxelder maple), *Gleditsia triacanthos* (honey locust), and *Salix amygdaloides* (peachleaf willow). The Upper Wahoo Creek watershed is most closely represented by a Dry-Mesic Bur Oak Forest and Woodland community within the Eastern Dry-Mesic Bur Oak Forest and Woodland ecological system. Underlined species represent species that are listed as 'most abundant' within the Dry-Mesic Bur Oak Forest and Woodland community by Rolfsmeier and Steinauer (NGPC 2010). Additional wetland forest and woodland communities within the Upper Wahoo Creek watershed include the Eastern Riparian Forest, Cottonwood-Peachleaf Willow Riparian Woodland, and Eastern Cottonwood-Dogwood Riparian Woodland within floodplains and near streams (NGPC 2010).

3.11 Fish and Wildlife Habitat

The Upper Wahoo Creek watershed is dominated by cropland. Undisturbed land is sparse within the watershed and includes grasslands confined mainly to the upland areas and woodlands scattered

throughout the watershed. Streams in the area are generally deeply incised and experiencing continued degradation and widening. In-stream habitat is lacking due to poor substrate conditions and lack of vegetation and cover. Fish habitat is generally limited to small impoundments throughout the Upper Wahoo Creek watershed.

3.12 Migratory Birds and Eagles

The Migratory Bird Treaty Act (MBTA) of 1918, as amended, Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds), and the Bald and Golden Eagle Protection Act (BGEPA) of 1940, as amended, require NRCS to consider impacts on migratory bird and bald and golden eagle populations and habitats. Migratory birds are essentially all wild birds found in the United States with the exception of the house sparrow, starling, feral pigeon, and resident game birds. The protections under MBTA and BGEPA cover the birds and their parts (including eggs, nests, and feathers) and therefore it is unlawful for private individuals or Federal agencies to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird. The BGEPA includes protections for any disturbance to bald and golden eagles and their nests.

Although the MBTA and BGEPA are applicable year-round, it is accepted that most migratory bird nesting activity occurs in Nebraska during the period of April 1 to July 15. Some migratory birds nest outside of this range. For example, raptors generally nest in woodland habitats during the period of February 1 to July 15 and sedge wrens (occurring in some wetland habitats) generally nest from July 15 to September 15.

Many species of migratory birds could be present and nest within the watershed as the woodlands surrounding tributaries provide ample habitat for birds protected under the MBTA to nest. Golden eagles breed in western Nebraska and are only found within the watershed during winter months. Bald eagles can be found within the watershed year-round.

3.13 Flood Damages

Flood damage is a major concern within the watershed. Urban flooding occurs within the communities of Weston, Wahoo, Ithaca, and Memphis with damages occurring during frequent storm events. The average annual flood damage for these urban areas is \$310,700 (Table 3-6).

Agriculture is the primary land use within the watershed and impacts to crops and pasture represent the majority of flood damages within the watershed. The majority of the crop and pasture damages from riverine flooding occurs from frequent events. Damages within the Upper Wahoo Creek watershed and along Wahoo Creek below the confluence of Wahoo Creek and Cottonwood Creek were calculated using varying storm events and were then annualized. These are shown in Table 3-6 (\$1,277,700). Farmsteads and private roads can also be damaged by floodwaters which can bring debris in the form of trees, sediment, and other items from upstream. Estimated average annual damages to these other agricultural properties is \$127,800 (Table 3-6).

Flood damages can also occur due to floodplain deposition when floodwaters deposit infertile sediment on cropland. Scour damages occur when floodwaters remove topsoil from fields which can result in gullies and reduced field accessibility. Average annual damages due to deposition and scour are approximately \$115,000 (Table 3-6). Damage due to flooding of roads and bridges can significantly reduce productivity,

delay emergency services, and threaten the safety of the community. Damage can include impacts to the structural integrity of bridge abutments, piers, and decks as well as erosion, submersion, and sediment deposition on roads. There are miles of federal, state, and county roads within the watershed with estimated average annual flood damages of \$2,401,000 (Table 3-6). Many county road crossings in the area flood during frequent events. Future conditions are not anticipated to change without a watershed project.

Table 3-6. Average Annual Flood Damages¹

Item	Estimated Average Annual Flood Damage²
Urban	\$ 310,700
Crop and Pasture	\$ 1,277,700
Erosion and Sediment	\$ 115,000
Other Agriculture	\$ 127,800
Roads and Bridges	\$ 2,401,000

¹Price base: 2020

²Estimated average annual flood damages provided for the Upper Wahoo Creek watershed and along Wahoo Creek below the confluence of Wahoo and Cottonwood Creek ("Area of Benefit" shown in Figure 1-1)

3.14 Cultural Resources

Cultural resources are defined as physical or other expressions of human activity or occupation and include archeological sites, buildings, bridges, historic districts, culturally significant landscapes, isolated artifacts or features, culturally sacred places, and objects of cultural and historic significance. Section 106 of the National Historic Preservation Act of 1966, as amended (54 U.S.C. § 306108) and its implementing regulations (36 CFR Part 800) requires federal agencies to identify historic properties that may be affected by federal undertakings. Historic properties are defined as cultural resources that are eligible for listing in the NRHP. In order for a cultural resource to be eligible for the NRHP, it must be at least 50 years in age; retain physical integrity; and be associated with events significant to the broad patterns of history; associated with the lives of persons significant in the past; embody distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic value, or represent a significant and distinguishable entity; and/or must yield or be likely to yield, information important to history or prehistory (36 CFR 60.4). If an undertaking will alter, damage, or destroy a historic property, the agency has a responsibility to avoid, minimize, or mitigate the adverse effect.

The affected environment for cultural resources is identified as the area of potential effect (APE). The APE is the geographic area within which federal actions may directly or indirectly cause alterations in the character or use of historic properties if present (36 CFR 800.16(d)). The APE for the proposed action is 1,973 acres, which includes the areas of all direct and indirect effects including, but not limited to construction of dams and auxiliary spillways, permanent pools, flood pools, staging areas, access routes, and borrow areas, and the visual effects of constructed structures.

A cultural resource inventory of the APE for Structures 26 and 27 was conducted by the NRCS cultural resource specialist in May 2018 (Mackling 2018). A cultural resource inventory of the APE of Structures 55, 66, 77, 82, 84, 85, and 86 was completed by Buried Past Consulting, LLC. in November 2018-January 2019 (Bevitt and Bevitt 2019). Both inventories were conducted by professional archeologists who meet the



Secretary of Interior's Standards for Archeology and Historic Preservation and included background research, pedestrian inventory, and shovel tests. A total of 1,973 acres were inventoried, and 20 cultural resource sites were identified. Cultural resources recorded within the APE include isolated stone artifacts, a bridge, a barn, a wooden latrine, a corncrib, late 19th century farmsteads with both standing and collapsed structures, and historic artifact scatters (glass, metal, and wood).

In accordance with 36 CFR 800.4 and 36 CFR 60.4, sites within the project APE were evaluated to determine eligibility for inclusion in the National Register of Historic Places (NRHP). Eighteen of the sites were determined to not meet any of the criteria for NRHP eligibility. Two of the sites (25SD216 and 25SD219) were determined to be eligible for the NRHP under Criteria A and C (Criterion A: association with Czech immigrant settlement of Nebraska; Criterion C: association with early Czech-American settlement construction patterns).

Site 25SD216 is a late 19th century farmstead containing a barn, a wooden corn crib, modern metal grain bins, a historic farmhouse, a modern residence, and several outbuildings. Site 25SD219 is also a late 19th century farmstead containing a house, a barn, a chicken coop, a corn crib, modern metal grain bins, three wooden sheds, a concrete-block garage, and an extensive artifact scatter of glass, plastic, and metal debris and farm equipment. The house has not been occupied for several years, but some of the outbuildings are still in use.

Copies of the cultural resource inventory reports were submitted to the Nebraska SHPO and Indian tribes that may attach religious or cultural significance to historic properties within the APE for consultation in January 2019, October 2019, and July 2021. The Nebraska State Historic Preservation Office concurred with these determinations of eligibility in letters received January 16, 2019, December 13, 2021, and August 9, 2021 (Appendix A).

3.15 Environmental Justice

There are no major social, cultural, or political factors that may influence major changes in land use or management of the soil, water, air, plant, or animal resources. There is one main population center within the Upper Wahoo Creek watershed and three additional population centers within the area of benefit shown in Figure 1-1. According to 2010 Census data, the City of Wahoo is the largest population center out of the four within the area of benefit. The remaining three population centers (Weston, Ithaca, and Memphis) have small populations compared to the City of Wahoo. Population center and Saunders County population data from the 2010 Census is shown below in Table 3-7. Due to Wahoo's close proximity to Omaha and Lincoln, the commuting population is steadily increasing, which increases the need for transportation infrastructure. The area is well served by Nebraska State and U.S. numbered Highways 77, 79, 92, and 109, which has increased development around the area.

Table 3-7. 2010 Census Data

Category	Population	Category	Population
Saunders County	20,780	Ithaca	148
City of Wahoo	4,508	Memphis	114
Weston	324		

Source: United States Census Bureau. 2010 Census.

In accordance with the Environmental Justice Departmental Regulation, it is imperative that the Project is compliant with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations." Although this project will provide many benefits, it is important to ensure any negative human health and/or environmental impacts are not disproportionately carried by minorities or low-income populations.

Table 3-8 shows the percentage of minorities within Saunders County, the state of Nebraska, and the United States from 2010 Census data (USCB 2018). A minority is a person who is a member of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. As shown in Table 3-8, the percentage of minorities within Saunders County is significantly lower than the percentages within Nebraska and the United States. Due to the low percentage of minority populations within the Project area, this Project will not disproportionately impact minority groups.

Table 3-9 shows the percentage of people of all ages and minors (people under 18-years of age) below the poverty line within Saunders County, the state of Nebraska, and the United States from 2016 Small Area Income and Poverty Estimates data (SAIPE 2016). Low-Income populations are identified as the populations living below the poverty line. As shown in Table 3-9, the percentages of all people and minors living below the poverty line within Saunders County is less than the percentage within Nebraska and significantly less than the percentage within the United States.

Table 3-8. 2010 Census Demographic Data

Category	Saunders County	Nebraska	United States
Percent Minority	2.9%	13.9%	27.6%

Source: United States Census Bureau. 2010 Census.

Table 3-9. 2016 Poverty Data

Category	Saunders County	Nebraska	United States
Percent in Poverty (all ages)	7.4%	11.3%	14.0%
Percent in Poverty (under 18)	8.5%	13.9%	19.5%

Source: 2016 Small Area Income and Poverty Estimates (SAIPE).

The Upper Wahoo Creek watershed is located within the census block groups 311559682001, 311559682002, 311559682003, 311559683004, and 311559683003 on the Environmental Protection Agency's (EPA) Environmental Justice Screening and Mapping Tool (EJ Screen). EJ Screen results are similar to those listed above, with 1 to 7 percent within the minority population and 15 to 34 percent low income (defined as income less than two times the poverty level). The demographic index (a combination of percent minority and percent low-income) varies between 9 and 17 percent within the watershed, which is in the 15th to 43rd percentile for the state of Nebraska.

Agriculture is the principal income-generating industry within the watershed. The principal crops grown in the watershed are corn, soybeans, alfalfa, and wheat. A portion of the crops are retained in the watershed and used for feeding livestock. Approximately 22 percent of the cropland is irrigated. Family-owned farms are predominant in Saunders County, accounting for 86 percent of the farms in 2017. The number of farms has decreased by 7 percent over the 5-year period in Saunders County and the average size of farms has increased by 10 percent. Between 2012 and 2017, the number of farms operated by part owners and tenants



decreased by 1 percent and 7 percent, respectively, while the number of farms operated by full owners increased by 2 percent. The market value of agricultural products sold decreased by 5 percent between 2012 and 2017. During the same period, the crop proportion of this market value of agricultural products stayed relatively constant. In 2017, 1,067 (60 percent) of operators reported some days of work off-farm. This was 5 percent more than corresponding data for the State of Nebraska. The following Tables 3-10 and 3-11 contain the specific agricultural data for Saunders County and Nebraska.

Table 3-10. 2017 Agricultural Census Data

Item	Unit	Saunders County		Nebraska	
		2012	2017	2012	2017
Number of Farms	number	1,204	1,118	49,969	46,332
Value of Land & Bldgs. Per Acre	dollars	5,268	5,641	2,380	2,754
Average Size of Farm	acres	390	429	907	971
Tenure of Operator					
Full Owner	farms	658	674	24,898	24,021
Part Owner	farms	461	456	18,836	16,840
Tenants	farms	85	79	6,235	5,471
Principal Operators by Age Group					
Under 25	number	9	6	456	631
25 to 34	number	90	110	4,291	5,021
35 to 44	number	123	166	6,199	7,113
45 to 54	number	327	273	11,943	10,142
55 and over	number	655	855	-	-
55 to 64	number	-	-	13,903	18,152
65 to 74	number	-	-	8,068	12,903
75 and over	number	-	-	5,109	6,887
Average Age of Principal Operator	years	56.2	Not included	55.7	57.2
Market Value of Sold Ag Products	\$1,000	380,504	360,464	23,068,756	21,983,430
Crops	\$1,000	224,355	225,489	11,377,933	9,311,007
Livestock	\$1,000	156,150	134,975	11,690,823	12,672,422



		Saunders County		Nebraska	
Item	Unit	2012	2017	2012	2017
Days of work off farm					
None	number	444	717	21,662	27,297
Any	number	760	1,067	28,307	33,552
Organization Type					
Individual or Family	farms	1,049	961	42,543	38,200
Partnership	farms	77	63	2,974	2,883
Corporation	farms	55	55	3,784	4,268
Other	farms	23	36	668	981

Source: USDA. 2017 Census of Agriculture. Issued April 2019.

Table 3-11. 2017 Income Data

Income Type	Saunders County	Nebraska
2017 Per Capita Income	\$49,730	\$50,810
Net Cash Farm Income of Operation - Average per Farm	\$82,430	\$108,590

Source: United States Census Bureau. Income and Poverty in the United States: 2017.

3.16 Public Health and Safety

The Upper Wahoo Creek watershed is located in a rural setting that is primarily farmland and county roads with some rural communities, major roads, and railroads. The Upper Wahoo Creek watershed experiences frequent flooding that impacts agricultural land, homes, and public infrastructure. County roads and highways within the watershed are overtapped and/or washed out during frequent storm events, posing a significant public safety concern. Road closures can inhibit emergency services during and for many months after flood events. Agricultural land, structures, and public roads within the area of benefit below the confluence of Wahoo and Cottonwood Creek additionally experience frequent inundation, causing safety concerns for the public and emergency services. Table 3-12 below shows flooding impacts at various storm events.

Table 3-12. Existing Flooding within Area of Benefit¹

Storm Event	Acres of Agricultural Land	Number of Bridges	Number of Buildings				
			Memphis	Ithaca	Wahoo	Weston	Total
5 year	10,232	22	2	7	38	1	48
25 year	13,209	30	6	12	54	8	80
100 year	14,675	33	8	12	57	21	98

¹Area of benefit shown in Figure 1-1

3.17 Riparian Areas

Riparian areas are transitional areas between terrestrial land and a water body, such as streams, lakes, ponds, or wetlands. The unique soils within riparian areas are strongly influenced by free and unbound water and the types and amounts of vegetation reflect this. Riparian areas provide wildlife habitat and act as a buffer to trap sediment, nutrients, and pesticides. They occur within the Upper Wahoo Creek watershed along intermittent and perennial streams and adjacent to existing ponds and wetlands.

4.0 ALTERNATIVES

Project formulation revolved around the identified project purpose and need as well as existing resource conditions. In the formulation of alternatives, effort was made to include elements that provide both positive environmental effects as well as net beneficial National Economic Development (NED). Plans that could be implemented under the authorities of other Federal agencies, state and local entities, and nongovernmental interests were also considered. Accordingly, local, state, regional, Federal, and nongovernmental interests participated in the formulation process. Measures considered in the formulation of alternative plans included those measures believed to be effective, efficient, and acceptable in achieving or satisfying one or more of the problems or opportunities.

4.1 Formulation Process

The formulation process is the basis for selecting combinations of measures to include as alternatives. The combination of alternatives developed are based on measures that could meet the Project purpose as required by National Environmental Policy Act (NEPA) and include a range of structural and non-structural alternatives. The identified alternatives went through an initial screening process to determine whether the alternative satisfies the Project purpose. Alternatives were also screened for reasonability with respect to economics and implementation practicability as required by NEPA. Alternatives that were determined to satisfy the project purpose and were reasonable are carried forward for detailed analysis. Table 4-1 summarizes the alternatives, the screening process summary, and whether each alternative was carried forward for detailed study. Alternatives not carried forward for detailed study are included in Section 4.2. The no-action alternative (future without project) was also carried forward for detailed analysis as is required by guidelines outlined in the NWPM (NRCS, 2015).

Some of these alternatives could require a Clean Water Act (CWA) Section 404 permit from the USACE and may not fit within the limitations of a USACE nationwide permit. To streamline the NEPA and the CWA Section 404 processes, consideration was also given to all alternatives that have recently been included in CWA Section 404(b)(1) alternative analyses for similar projects in this region. This analysis looks at potential alternatives to determine if they meet the overall project purpose, if they are practicable, and their environmental consequences, as required by the USACE for issuance of a Section 404 individual permit. Practicable, as defined for the 404(b)(1) analysis, means that an alternative is capable of being accomplished after taking into consideration cost (not economics), existing technology, and logistics. The USACE cannot issue an individual permit if there is a practicable alternative that would have less adverse impacts on the aquatic ecosystem so long as the alternative does not have other adverse significant environmental consequences. NRCS cannot provide assistance for projects that would be contrary to any other laws, regulations, or executive orders (including projects that are not compliant with CWA Section 404). Therefore, to provide an efficient environmental review under multiple Federal laws, consideration was given to potential alternatives recently considered during CWA Section 404 analyses in addition to potential alternatives required by NEPA regulations.

Table 4-1. Range of Alternatives Considered

Alternative	Summary of Alternative	Meets Purpose	Reasonable	Carried forward for Detailed Study
No Action/Future Without Project	Most likely action if the Sponsor did not receive funding and if existing conditions remain the same.	--	--	Yes
Wet Dams	This alternative includes the construction of 10 single-purpose floodwater retarding dams with permanent pools. Total cost including construction, land easement, mitigation, engineering and project administration is \$19,667,000.	Yes	Yes	Yes
Dry Dams	This alternative involves the construction of 10 single-purpose floodwater retarding dams without permanent pools (dry dams). Total cost including construction, land easement, mitigation, engineering and project administration is \$19,750,300.	Yes	Yes	Yes
Levees	This alternative consists of constructing a system of levees along streams within the watershed to provide flood damage reduction benefits. Estimated construction and land easement cost exceeds \$46,200,000.	Yes	No. Cost is exorbitant.	No
Wetland/Stream Restoration	This alternative consists of developing wetlands along stream channels within agricultural areas within the benefited area to provide flood damage reduction benefits.	No. Does not provide sufficient flood damage reduction.	--	No
Cropland Conversion	This alternative involves converting cropland into grassland. Estimated cost of land acquisition and seeding exceeds \$37,700,000.	Yes	No. Cost is exorbitant.	No
Smaller Structures	This alternative consists of a larger quantity of smaller floodwater retarding dams.	Yes	No. Cost is exorbitant.	No

Alternative	Summary of Alternative	Meets Purpose	Reasonable	Carried forward for Detailed Study
Raise Existing Roads and Bridges	This alternative consists of raising existing roads and bridges to provide flood damage reduction benefits.	No. Does not provide flood damage reduction.	--	No
Increased Channel Capacity	This alternative consists of increasing the channel conveyance capacity to provide flood reduction benefits. Estimated cost exceeds \$129,427,000.	Yes	No. Cost is exorbitant.	No
Large Downstream Dam	This alternative consists of constructing a single floodwater retarding dam at the downstream portion of the Upper Wahoo Creek watershed.	No. Does not provide flood reduction within Upper Wahoo Creek watershed.	--	No
National Economic Development (NED) Alternative	The NED Alternative is the alternative or combination of alternatives that reasonably maximizes the net economic benefits consistent with protecting the nation's resources. The NED Alternative for this project is Wet Dams.	Yes	Yes	Yes

4.2 Alternatives Eliminated from Detailed Study

The following alternatives either did not satisfy the project purpose or were considered unreasonable and therefore eliminated from detailed study.

4.2.1 Levees

This alternative involves implementing levees along major streams within the watershed to meet the purpose and need. To meet the purpose and need, levees would be constructed along the downstream stretches of North Fork Wahoo Creek, Dunlap Creek, and Miller Branch and also along Wahoo Creek.

It is important to discuss the impact that constructing levees would have. Increasing the capacity of Wahoo Creek and its tributaries would increase flow velocities and decrease the travel time of the flood flows through the channels and valleys and therefore to the towns downstream. Conveyance structures generally alter the hydrograph by causing a steeper (quicker) rising limb, higher peak, and shorter duration. The flood hydrograph changes discussed above would lead to increased peaks, shorter duration (more severe) flows in the lower reaches of the watershed, reduced time between subwatershed peak flows, and increased flooding downstream of the levees.

Levees would also remove a sizable footprint of land from agricultural production for every landowner along the creek channels, throughout the entire watershed. Levee embankment, seepage mitigation berms, required buffers and internal drainage infrastructure would have a significant footprint throughout the entire watershed.

Design and implementation constraints include the sinuous nature of Wahoo Creek and its tributaries as well as infrastructure proximity to the streams, including rail lines, bridges, and habitable buildings. For example, the Village of Weston and a Union Pacific rail line are at the confluence of Dunlap Creek and Wahoo Creek and would pose significant implementation issues. In addition, the levees would intersect with over 40 road crossings, including Highway 77. To identify if the alternative could potentially be reasonable and if the alternative should be further analyzed, an abbreviated cost analysis was conducted.

Costs for this alternative include land purchase at a cost of \$7,500 per acre, which is carried through the analysis for all alternatives. The land area width to be purchased includes approximately 500-feet of valley and 100-feet of levee to account for the stream sinuosity. Earthen fill cost is based on engineering judgement and similar, recent projects in Nebraska and includes a levee cross-section with 3:1 side slopes and 10-foot top widths.

Over 265,000-feet of stream would require levees to meet this Plan's purpose. This would result in over 3.3 million cubic yards of earthen fill and 3,600-acres of land acquisition. The cost breakdown is shown in Table 4-2. These costs do not include construction costs beyond earthen fill and therefore do not include potential modifications to impacted roads and railroads, structure acquisition, or impacts to other infrastructure.

Table 4-2. Abbreviated Cost Analysis for Levee Alternative¹

Alternative	Earthen Fill (dollars)	Land Acquisition (dollars)	Total (dollars)
Levees	19,200,000	27,000,000	46,200,000

¹Does not include costs to modify or raise bridges/roads, impacts to infrastructure, structure acquisition, construction costs besides earthen fill (mobilization, etc.), or engineering.

This alternative meets the Project's purpose and need and would provide adequate flood damage reduction benefits. However, this alternative removes much of the productive farmland that the Sponsor is looking to protect and after considering the partial costs identified during the abbreviated analysis for this alternative, these alone are unreasonably expensive in comparison to other available alternatives. Therefore, this alternative is not reasonable and will not be carried forward for detailed study.

4.2.2 Wetland/Stream Restoration

This alternative involves creating wetlands within the Upper Wahoo Creek watershed to provide the desired flood risk reduction benefits to the area of benefit identified in the purpose and need and shown in Figure 1-1. This would include constructing wetland storage areas in lands that have characteristics that support wetland creation or enhancement. Potential areas were identified within the Upper Wahoo Creek watershed as having hydric soils and available hydrology. For this geographic area and topography, these areas are generally in and near existing streams and would include constructing a series of structures to impound stream flow to create shallow detention areas. Wetlands have the capability to provide 3.0 acre-feet to 4.6

acre-feet of flood storage per acre of wetland (EPA, 2006). Hydric soils make up 14,300-acres of the 63,000-acres within the Upper Wahoo Creek watershed; however, this entire area could not be used for wetland creation due to existing development and topography. Areas within the headwaters of the area of benefit have steeper slopes and are not conducive to the creation of wetlands to support flood damage reduction. Although areas lower in the Upper Wahoo Creek watershed along Wahoo Creek are less steep with wider floodplains and are more favorable to wetland creation, this would not benefit areas within the Upper Wahoo Creek watershed. This alternative does not meet the purpose and need because it does not provide flood reduction benefits throughout the watershed and removes farmland that the project intends to protect with wetlands and was therefore not carried forward for detailed analysis. Combining this alternative with others to achieve the purpose and need was also considered but no reasonable combination of alternatives was found.

4.2.3 Cropland Conversion

This alternative involves acquiring and converting existing cropland into grassland thereby reducing the flood damage risk to landowners. This is a technically viable alternative; however, the cost is exorbitant compared to other alternatives, it would remove productive farmland, and would be socially unacceptable. To begin calculating the potential cost, the area that floods adjacent to Wahoo Creek during a 2-year event was analyzed below the confluence of Wahoo and Cottonwood Creeks. The Sponsor would purchase existing cropland within this 2-year floodplain and reseed those areas with a native grassland mix. A detailed HEC-RAS hydraulic model (see Appendix D, Section D4.3 for model extents) was used to determine the existing 2-year floodplain. Approximately 7,500-acres of land are flooded by the 2-year storm event with approximately 4,400-acres (60 percent) of that land currently used for farmland. Using the cost per acre carried through the analysis of all alternatives (\$7,500/acre) and seeding costs from recent projects in eastern Nebraska, the total to purchase and seed this area is approximately \$37,700,000. This cost does not include reducing flood damages within the Upper Wahoo Creek watershed and therefore additional costs would be incurred to achieve the Project purpose and need. This cost also does not include the acquisition of land impacted by less frequent, higher precipitation events. The cost for this alternative would exceed \$37.7 million and is therefore unreasonable due to cost and is not carried forward for detailed study. Combining this alternative with others to achieve the purpose and need was also considered but no reasonable combination of alternatives was found.

4.2.4 Smaller Structures

This alternative involves using wet or dry dams to provide flood reduction benefits in locations that differ from the ones selected in the Wet Dams and Dry Dams alternatives in order to potentially reduce impacts to wetlands and streams. Potential site locations were selected for the Wet Dams and Dry Dams alternatives to avoid impacts to existing infrastructure and known environmental resources (wetlands, extensive stream length, etc.) during the planning process and were then included in a hydrologic model to determine which sites would maximize flood reduction and economic benefits. All potential sites were ranked in order of flood damage reduction benefits. See Appendix D for more detailed information on the site selection process for the preferred alternative. Constructing floodwater structures in alternative locations would require more structures to provide the same flood damage reduction as the preferred alternative and will be less economically beneficial. Due to this alternative's reduced economic benefit and increased footprint

and therefore increased impact to streams and potentially other environmental resources, this alternative is considered unreasonable and will not be carried forward for detailed study.

4.2.5 Raising Existing Roads and Bridges

This alternative involves raising the height of roads and bridges to avoid overtopping from rain events and to potentially reduce flooding due to backwater effects of the structures. This alternative would reduce infrastructure damage as well as reduce traffic delays and rerouting. However, raising roads and bridges throughout the watershed will not sufficiently reduce agricultural flood damages. Therefore, this alternative does not meet the Project's purpose and need and will not be carried forward for detailed study.

4.2.6 Increased Channel Capacity

This alternative involves increasing channel conveyance capacity to prevent flood damages up to and including the 50-year flood for the area of benefit identified in the purpose and need and shown in Figure 1-1. To achieve this, the channel cross-section could be increased to increase flow, the channel could be lined in sections to provide more effective conveyance, and road and railroad crossings could be enlarged to accommodate the increased conveyance capacity. Utilities and other infrastructure would also need to be moved to accommodate the wider channel. There are almost 80 stream miles within the area of benefit. If capacity were to only be increased within the Upper Wahoo Creek watershed or only downstream of the confluence of Cottonwood and Wahoo Creek (or any subset of the area of benefit), this alternative would not meet the purpose and need of the project. Channel dimensions for this alternative were determined using 50-year flows from HEC-HMS at key locations within the area of benefit. Existing channel slopes and depths were kept at the current condition, meanders were not removed to avoid channelization, and 3:1 side slopes were assumed for channel slope stability. Future channel widths ranged from 40-feet to 300-feet, with existing (and thus future) depths ranging from 9-feet to 18-feet.

As with the levee alternative, it is important to discuss the impact that increasing channel capacity would have downstream. Increasing the capacity of Wahoo Creek and its tributaries would increase flow velocities and decrease the travel time of the flood flows through the creeks and therefore to the towns downstream. Modifying the channel geometry would alter the hydrograph by causing a steeper (quicker) rising limb, higher peak, and shorter duration. This would lead to increased peak flows in the lower reaches of the watershed and increased flooding downstream.

An abbreviated cost analysis was conducted to determine if this alternative was reasonable. Costs for this alternative include the land cost at \$7,500/acre, which was kept constant for all alternatives. Seeding and excavation costs are also included, with seeding included at \$500/acre and excavation included at \$3.70/cubic yard. These costs alone are shown in Table 4-3. Not included are the costs that would be incurred to modify bridges and culverts and roadway and railroad crossings or any additional construction costs such as mobilization or a spoil site for the millions of cubic yards of excavation. It is important to note, also, that this alternative would meet the purpose and need for the area of benefit but would dramatically increase flows downstream due to the removal of floodplain attenuation.

Table 4-3. Abbreviated Cost Analysis for Increased Channel Capacity Alternative¹

Alternative	Excavation (dollars)	Seeding (dollars)	Land Acquisition (dollars)	Total (dollars)
Increased Channel Capacity	77,239,000	400,000	16,300,000	93,939,000

¹Does not include costs to modify bridges/culverts, impacts to infrastructure, additional construction costs (mobilization, spoil site, etc.), or engineering.

This alternative is unreasonably expensive compared to other alternatives and is therefore not carried forward for detailed analysis.

4.2.7 Large Downstream Dam

This alternative involves constructing a single, large downstream dam on Wahoo Creek within the Upper Wahoo Creek watershed, upstream of its confluence with Cottonwood Creek. The topography along the right bank just upstream of the confluence is flat and does not provide the necessary elevations for the dam embankment to tie into. Locations further upstream are plausible from a topography standpoint, but this alternative would not meet the purpose and need of providing flood reduction within Upper Wahoo Creek watershed. This alternative does not meet the purpose and need and was therefore not carried forward for detailed analysis. Combining this alternative with others to achieve the purpose and need was also considered but no reasonable combination of alternatives was found.

4.3 Alternative Descriptions

The following section describes the alternatives that were carried forward for detailed analysis.

4.3.1 Alternative 1: Future Without Project

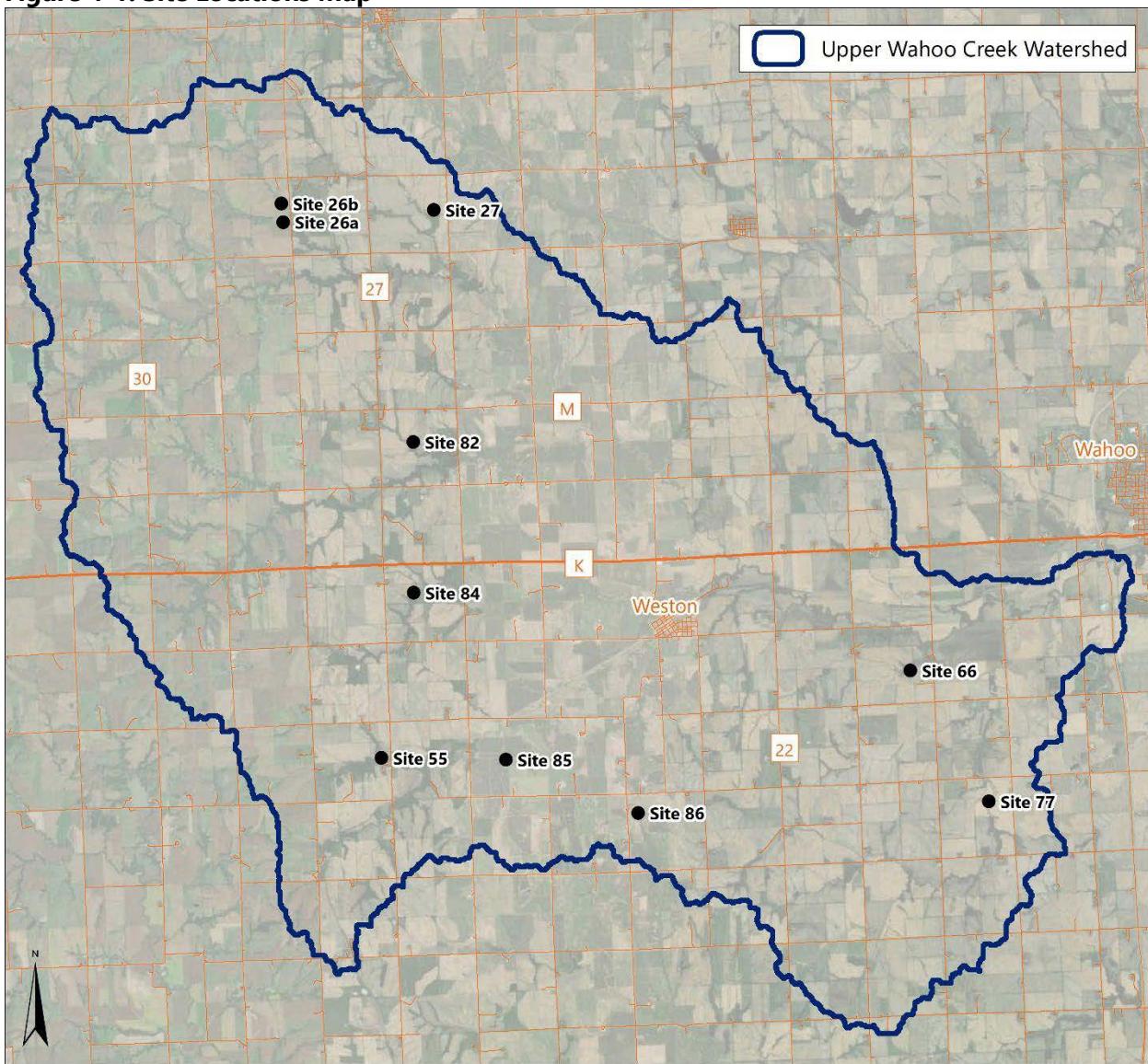
This alternative is the most likely future condition if none of the action alternatives are selected and there is no expenditure of federal funds. This alternative would involve no implementation of any flood risk reduction structures or measures. The flood damages to cropland and infrastructure would continue. This alternative does not meet the purpose and need; however, it is carried forward through the analysis as a benchmark condition.

4.3.2 Alternative 2: Dry Dams

The Dry Dams alternative consists of 10 single-purpose floodwater retarding dams without permanent pools. This alternative would control approximately 26-square miles to provide flood damage reduction to agricultural lands and the communities of Weston, Wahoo, Ithaca, and Memphis. A calibrated hydrologic model using HEC-HMS was developed for the entire Wahoo Creek watershed to analyze peaks within the Wahoo Creek watershed and to determine locations that would provide the most flood risk reduction when analyzed as a system. The model includes the existing Sand Creek and Cottonwood Creek reservoirs as well as Lake Wanahoo. The Swedeburg watershed structures were not included due to the minimal impacts on flood risk reduction. In addition to modeling, existing infrastructure (highways, gas lines, rail lines, homes, etc.) and sensitive environmental resources were identified both at potential structure locations and downstream of these locations in order to optimize the use of low hazard structures. Once potential locations were identified, the model was run and the sites were ranked based on flood reduction benefits. Detailed information is given on this process in Appendix D.

Due to the rural locations and potential breach paths of the proposed structures, nine of the dams would be designed to NRCS low-hazard classification standards and one dam would be designed to NRCS significant-hazard classification standards (Site 77, see Figure 4-1). Each structure would be comprised of an earth embankment dam, a vegetated auxiliary spillway, a reinforced concrete pressure pipe (RCPP) principal spillway, and a multi-port riser to allow base flow through the structure. The absence of a permanent pool through use of a multi-port riser is the main difference between the design in the dry dam alternative and the wet dam alternative. The proposed sites include 24-inch RCPP spillways for eight of the structures, a 54-inch RCPP spillways for one of the structures (Site 82), and a 72-inch RCPP spillway for the largest structure (Site 77). Because there is no reservoir in a dry dam, the volume of storage per vertical foot is smallest at the bottom of the valley and the rate of flood stage increases significantly during a storm event compared to an embankment with a permanent pool. This causes the type of flash flooding characteristic of desert environments. There are no urban developments or homes within the flood pool of any of the dams; however, there is a risk of rapid inundation that can pose a safety risk to the landowners.

The dry dams included with this alternative are each designed for a 50-year lifespan and combined would trap approximately 2,080-acre-feet of total sediment. By trapping the sediment, these structures would protect downstream waterbodies from an influx of sediment and nutrients, and therefore improve overall water quality. This alternative offers grade control within streams, which would protect and stabilize existing eroding streams. Dam heights range from 19.5-feet for the shortest structure (Site 85) to 41-feet for the tallest structure (Site 26b). Embankment fill volumes range from 44,700-cubic yards (Site 82) to 190,000-cubic yards for the largest site (Site 77). Vegetated auxiliary spillway widths vary and range from 50-feet at Sites 26a and 26b to 250-feet at Site 77. Appendix D includes detailed information on hydrology and other methodology used for the design. Easements would be required to the top of dam. The total cost for this alternative is \$19,750,300, which includes construction costs with a 20 percent contingency, easements, final design/engineering, permitting, construction observation, mitigation, and legal and appraisal fees.

Figure 4-1. Site Locations Map

4.3.3 Alternative 3: Wet Dams

The Wet Dams alternative consists of the same 10 single-purpose floodwater retarding dam locations discussed in the dry dams alternative, but would include permanent pools. This alternative would control approximately 26-square miles to provide flood damage reduction to agricultural lands and the communities of Weston, Wahoo, Ithaca, and Memphis. A calibrated hydrologic model using HEC-HMS was developed for the Wahoo Creek watershed to analyze peaks within the Wahoo Creek watershed and to determine locations that would provide the most flood risk reduction when analyzed as a system. The model includes the existing Sand Creek and Cottonwood Creek reservoirs as well as Lake Wanahoo. In addition to modeling, existing infrastructure (highways, gas lines, rail lines, homes, etc.) and sensitive environmental resources were identified both at potential structure locations and downstream of these locations in order to optimize the use of low hazard structures. Once potential locations were identified, the model was run

and the sites were ranked based on flood reduction benefits. Detailed information is given on this process in Appendix D.

Due to the rural locations and potential breach paths of the proposed structures, nine of the dams would be designed to NRCS low-hazard classification standards and one dam would be designed to NRCS significant-hazard classification standards (Site 77, see Figure 4-1). Each structure would be comprised of an earth embankment dam, a vegetated auxiliary spillway, and a RCPP principal spillway. The proposed sites include 24-inch RCPP spillways for eight of the structures, a 54-inch RCPP spillways for one of the structures (Site 82), and a 72-inch RCPP spillway for the largest structure (Site 77). Ported risers would be used when feasible to increase flood reduction benefits of frequent storm events. Specific information for each site can be found in Table 3, provided in Chapter 7.0.

The wet dams included with this alternative are each designed for a 50-year lifespan and combined would trap approximately 2,080-acre-feet of total sediment. By trapping the sediment, these structures would protect downstream waterbodies from an influx of sediment and nutrients, and therefore improve overall water quality. Forty NRCS watershed plans with previously implemented dams in eastern Nebraska have shown that sediment hungry water flowing out of reservoirs does not cause an increase in downstream erosion. Additionally, the permanent pools within each wet dam would provide aquatic habitat and wetlands would form around and within the shallow regions of the permanent pools, which would improve water quality and provide habitat for wildlife. This alternative offers grade control within streams, which would protect and stabilize existing eroding streams. The total cost for this alternative is \$19,667,600. Detailed cost information is provided in Appendix D.

4.3.4 National Economic Development (NED) Alternative

The NED evaluation was based on calculated costs and benefits to reasonably maximize the net economic benefits. The NED Alternative for this project is the Wet Dams Alternative and all information related to the NED Alternative is included in the Wet Dams Alternative sections.

4.3.5 Alternatives Summary and Comparison

Table 4-4 includes relevant concerns that were identified during scoping (see Chapter 2.0 for further information) as well as economic information for the alternatives that were carried forward for detailed study.

Table 4-4. Summary and Comparison of Alternative Plans

	Item or Concern	Alternative 1. No Action/Future Without Project	Alternative 2. Dry Dams	Alternative 3. NED Alternative (Recommended)
Alternative Description		No actions would be undertaken to reduce flooding.	Construct 10 floodwater retarding dry dam structures within the Upper Wahoo Creek watershed.	Construct 10 floodwater retarding wet dam structures within the Upper Wahoo Creek watershed.
Installation Cost	-NRCS Contribution -Sponsor Contribution -Total	\$0 \$0 \$0	\$ 11,743,700 \$ 8,006,600 \$ 19,750,300	\$ 11,661,000 \$ 8,006,600 \$ 19,667,600
NED Account	Average Annual Costs: - Installation - O&M -Total	- - -	\$ 567,400 \$ 61,300 \$ 628,700	\$ 564,800 \$ 60,800 \$ 625,600
	Average Annual Benefits	-	\$ 772,100	\$ 772,100
	Average Annual Costs	-	\$ 628,700	\$ 625,600
	Average Annual Net Benefits	-	\$ 143,400	\$ 146,500
Environmental Quality Account	Soils			
	Erosion and Sedimentation	No change in existing conditions.	Will capture and store 2,080-acre-feet of sediment in the reservoirs over the 50-year design life. Reduction in channel erosion. Sponsor will obtain agreements from owners to carry out farm conservation plans for not less than 50 percent of the land upstream of each structure.	Will capture and store 2,080-acre-feet of sediment in the reservoirs over the 50-year design life. Reduction in channel erosion. Sponsor will obtain agreements from owners to carry out farm conservation plans for not less than 50 percent of the land upstream of each structure.
	Prime and Unique Farmland	Approximately 47,110-acres of prime farmland and farmland of statewide importance are within the Upper Wahoo Creek watershed. There will be a continued risk to prime	Will decrease flooding to prime and unique farmland. Will directly convert 46-acres of prime farmland and farmland of statewide importance. No Farmland Protection Policy Act (FPPA) significant concerns.	Will decrease flooding to prime and unique farmland. Will directly convert 245-acres of prime farmland and farmland of statewide importance. No Farmland Protection Policy Act (FPPA) significant concerns.



	Item or Concern	Alternative 1. No Action/Future Without Project	Alternative 2. Dry Dams	Alternative 3. NED Alternative (Recommended)
		farmland due to flooding.		
Water				
	Surface Water Quality	Decreased surface water quality due to erosion.	Enhanced water quality to streams and downstream waterbodies.	Enhanced water quality to streams and downstream waterbodies.
	Surface Water Quantity	Continued flood damage from excess water.	Decreased peak flows and flood damage reduction. Restoration of natural base flows to receiving streams.	Decreased peak flows and flood damage reduction. Restoration of natural base flows to receiving streams. Creation of 331-acres of surface water within permanent pools.
	Floodplain Management	No impact.	Located within and may alter the regulatory 100-year floodplain by decreasing 100-year flood elevations downstream.	Located within and may alter the regulatory 100-year floodplain by decreasing 100-year flood elevations downstream.
	Streams	Continued stream degradation and widening.	Will improve stream stability and provide protection from stream degradation due to headcut progression and erosion due to flooding. Adequate erosion control is planned below each proposed structure to ensure degradation is not caused by the alternative. Forty NRCS watershed plans with previously implemented dams in	Will improve stream stability and provide protection from stream degradation due to headcut progression and erosion due to flooding. Adequate erosion control is planned below each proposed structure to ensure degradation is not caused by the alternative. Forty NRCS watershed plans with previously implemented dams in



	Item or Concern	Alternative 1. No Action/Future Without Project	Alternative 2. Dry Dams	Alternative 3. NED Alternative (Recommended)
			<p>eastern Nebraska have shown that sediment hungry water flowing out of reservoirs does not cause an increase in downstream erosion.</p> <p>Loss of 2,690-feet of intermittent stream and 350-feet of perennial stream due to fill from the embankments.</p>	<p>eastern Nebraska have shown that sediment hungry water flowing out of reservoirs does not cause an increase in downstream erosion.</p> <p>Loss of 2,690-feet of intermittent stream and 350-feet of perennial stream due to fill from the embankments. The structures will not change stream flow regimes. During normal operations, base flow is passed through the dam to maintain perennial flow.</p> <p>Inundation and conversion to lacustrine system of 45,490-feet of intermittent stream and 8,800-feet of perennial stream from permanent pools.</p>
	Wetlands	Potential for loss of riparian wetlands due to stream erosion.	<p>Loss of 0.2 acres of riverine wetlands.</p> <p>Loss of 0.3 acres of depressional wetlands.</p>	<p>Net gain of 142-acres of lacustrine wetlands.</p> <p>Loss of 1.7 acres of riverine wetlands.</p> <p>Loss of 1.7 acres of depressional wetlands.</p>
Plants				
	Threatened and Endangered Species	No impact	No impact	No impact
Habitats				

	Item or Concern	Alternative 1. No Action/Future Without Project	Alternative 2. Dry Dams	Alternative 3. NED Alternative (Recommended)
	Grasslands	No impact	Loss of 5-acres of grasslands due to embankments. Additional 9-acres of grasslands will be lost due to sediment capture over the 50-year design life of the structures. Creation of 60-acres of grassland.	Net gain of 46-acres of grasslands. Loss of 14-acres of grasslands due to fill from embankments and inundation from permanent pools. Creation of 60-acres of grassland.
	Woodlands	No impact	Loss of 6-acres of woodlands. Additional loss of 78-acres of woodlands due to sediment capture over the 50-year design life of the structures. Improved woodland community through mitigation.	Loss of 84-acres of woodlands due to fill from embankments and permanent pool inundation. Improved woodland community through mitigation.
	Wetlands	Potential for loss of riparian wetlands due to stream erosion.	Loss of 0.5-acres of wetland habitat.	Net increase of 142-acres of wetlands results in increased wildlife habitat.
	Threatened and Endangered Species	No effect	May affect, not likely to adversely affect due to conservation measures.	May affect, not likely to adversely affect due to conservation measures.
	Migratory Birds/Bald and Golden Eagles	No effect	Limited impact due timing of construction.	Limited impact due to timing of construction.
Humans				
	Flood Damages	Agricultural flood damage from frequent precipitation events	Flood damages reduced.	Flood damages reduced.
	Cultural Resources	Potential impacts due to flooding.	Reduced risk of impacts from flooding to historic properties downstream from project area. There are no NRHP eligible cultural resources within the APEs that would be adversely affected by dam construction	Reduced risk of impacts from flooding to historic properties downstream from project area. There are no NRHP eligible cultural resources within the APEs that would be adversely affected by dam construction



	Item or Concern	Alternative 1. No Action/Future Without Project	Alternative 2. Dry Dams	Alternative 3. NED Alternative (Recommended)
			affected by dam construction.	
	Environmental Justice	No impact	No impact	No impact
	Public Health and Safety	Continued flooding and maintenance	Flooding reduced. Maintenance required. Minimal risk of a dam breach. Breach analysis has been performed to ensure correct dam classification and breach paths will be protected from development by local ordinances.	Flooding reduced. Maintenance required. Minimal risk of a dam breach. Breach analysis has been performed to ensure correct dam classification and breach paths will be protected from development by local ordinances.

5.0 ENVIRONMENTAL CONSEQUENCES

An Environmental Evaluation using NRCS form number NE-CPA-52 was completed during the planning process (provided in Appendix E). This evaluation has identified the potential affected resources within the affected resource areas for the alternatives studied in detail (Figures C1.1–C1.9, Appendix C). Chapter three, Affected Environment, describes these resources as they currently exist. This chapter describes the environmental consequences and impacts of the NRCS alternatives described in Section 4.3.

5.1 Erosion

No Action Alternative. This alternative has no impact on erosion in the watershed.

Dry Dams Alternative. This alternative would provide some incidental grade control along streams, providing a minimal decrease in upland and channel erosion. Installation of dams will only have a slight impact on erosion production and the major effects will occur with reductions in sedimentation (discussed in Section 5.2) and associated damages.

Wet Dams (NED Alternative). This alternative would provide some incidental grade control along streams, providing a minimal decrease in upland and channel erosion. Installation of dams will only have a slight impact on erosion production and the major effects will occur with reductions in sedimentation (discussed in Section 5.2) and associated damages. The Sponsor will obtain agreements from owners to carry out farm conservation plans for not less than 50 percent of the land upstream of each structure, reducing erosion within the watershed. Conservation practices will include contour farming, cover crops, and others.

5.2 Sedimentation

No Action Alternative. This alternative would not prevent sediment from entering streams and water bodies and continue to allow the influx of nutrients to enter water and compromise water quality within the watershed.

Dry Dams Alternative. This alternative would result in the capture and storage of 50-years of accumulated sediment at each reservoir. This would reduce the influx of nutrients from sediment to downstream water bodies, which harms water quality. The Dry Dams Alternative eliminates sedimentation from being transported downstream and reduces the annual sedimentation rate for the Wahoo Creek Watershed from 266,900 tons per year to 181,400 tons per year. See Table 5-1 for information about the impacts at each site.

Wet Dams (NED Alternative). This alternative would result in the capture and storage of 50-years of accumulated sediment at each reservoir. This would reduce the influx of nutrients from sediment to downstream water bodies, which harms water quality. The Wet Dams Alternative eliminates sedimentation from being transported downstream and reduces the annual sedimentation rate for the Wahoo Creek Watershed from 266,900 tons per year to 195,000 tons per year. Forty NRCS watershed plans with previously implemented dams in eastern Nebraska have shown that sediment hungry water flowing out of reservoirs does not cause an increase in downstream erosion. See Table 5-1 for information about the impacts at each site.

Table 5-1. Sediment Transported Downstream by Structure Subwatershed

Site	Sediment Transported Downstream by Structure Subwatershed (tons/year)		
	No Action	Dry Dams Alternative	Wet Dams (NED Alternative)
26a	2,500	0	0
26b	6,000	0	0
27	6,500	0	0
55	6,200	0	0
66	5,000	0	0
77	23,800	0	0
82	5,400	0	0
84	11,900	0	0
85	2,200	0	0
86	2,400	0	0
Total	71,900	0	0

Note: Values rounded to the nearest 100 tons/year

Both dam alternatives will have a negligible amount of sediment transported downstream. Negligible amounts of sediment are reported as zero for this analysis.

5.3 Prime and Unique Farmlands

No Action Alternative. This alternative would not convert any prime or unique farmland or farmland of statewide importance. However, continued flooding would threaten existing farmland.

Dry Dams Alternative. Implementation of the proposed alternative will directly convert approximately 60-acres and indirectly convert approximately 910-acres of land. This includes direct and indirect conversion of a total of 561-acres of prime farmland and 148-acres of farmland of statewide importance. See Table 5-2 for information about the impacts at each site. The soil types found for all converted land for each site are shown in Figures C2.1-C2.9 (provided in Appendix C) and the directly converted land extents for this alternative are labeled as 'Alternative B'. Please see Table 3-1 in Section 3.3 for information about the soil types' farm classifications.

Nebraska NRCS state soil scientists completed the land evaluation section of Forms AD-1006 Farmland Conversion Impact Rating for each site for the proposed alternative. Form AD-1006 is based on a point system that has 160 points set as a minimum number of 'total points' that triggers in-depth site reviews. Implementation of this alternative results in each site having a 'total points' score of less than 160 and therefore NRCS determined that the proposed project is clear of Farmland Protection Policy Act significant concerns. Decreased frequent flooding downstream of the structures will improve prime farmland and farmland of statewide importance.

Table 5-2. Prime Farmland and Farmland of Statewide Importance

Site	Area Directly Converted ¹ (Acres)			Area Indirectly Converted ² (Acres)		
	Prime Farmland	Farmland of Statewide Importance	Total	Prime Farmland	Farmland of Statewide Importance	Total
26a	2.0	1.0	3.0	3.7	9.2	12.9
26b	1.9	0.7	2.6	28.2	6.6	34.8
27	2.4	2.3	4.7	50.3	9.4	59.7
55	2.0	1.0	3.0	26.6	1.9	28.5
66	1.2	3.3	4.5	45.4	18.0	63.4
77	7.6	5.0	12.6	260.3	37.5	297.8
82	2.6	3.4	6.0	26.3	6.9	33.2
84	1.8	1.0	2.8	62.3	21.1	83.4
85	1.4	3.7	5.1	19.5	10.7	30.2
86	1.8	0.1	1.9	13.2	4.3	17.5
Total	25	22	46	536	126	661

¹Area within proposed earth fill and auxiliary spillway

²Area between area directly converted and top of dam

Source: USDA. Web Soil Survey. Saunders County, Nebraska (NE155). Last updated: September 2018.

Wet Dams (NED Alternative). Implementation of the proposed alternative will directly convert approximately 390-acres and indirectly convert approximately 580-acres of land. This includes direct and indirect conversion of a total of 561-acres of prime farmland and 143-acres of farmland of statewide importance. See Table 5-3 for information about the impacts at each site. The soil types found for all converted land for each site are shown in Figures C2.1-C2.9, Appendix C and the directly converted land extents for this alternative are labeled as 'Alternative A'. Please see Table 3-1 in Section 3.3 for information about the soil types' farm classifications.

Nebraska NRCS state soil scientists completed the land evaluation section of Forms AD-1006 Farmland Conversion Impact Rating for each site for the proposed alternative. Form AD-1006 is based on a point system that has 160 points set as a minimum number of 'total points' that triggers in-depth site reviews. Implementation of this alternative results in each site having a 'total points' score of less than 160 and therefore NRCS determined that the proposed project is clear of Farmland Protection Policy Act significant concerns. Decreased frequent flooding downstream of the structures will improve prime farmland and farmland of statewide importance.

Table 5-3. Prime Farmland and Farmland of Statewide Importance

Site	Area Directly Converted ¹ (Acres)			Area Indirectly Converted ² (Acres)		
	Prime Farmland	Farmland of Statewide Importance	Total	Prime Farmland	Farmland of Statewide Importance	Total
26a	4.4	1.5	5.9	1.3	8.7	10

Site	Area Directly Converted ¹ (Acres)			Area Indirectly Converted ² (Acres)		
	Prime Farmland	Farmland of Statewide Importance	Total	Prime Farmland	Farmland of Statewide Importance	Total
26b	9.5	1.3	10.8	20.6	6	26.6
27	24.0	3.4	27.4	28.7	8.3	37
55	4.7	1.0	5.7	23.9	1.9	25.8
66	25.8	7.2	33	20.8	14.1	34.9
77	101.0	5.8	106.8	166.9	36.7	203.6
82	7.0	3.4	10.4	21.9	6.9	28.8
84	16.3	2.9	19.2	47.8	19.2	67
85	13.9	6.6	20.5	7.3	4.1	11.4
86	4.6	1	5.6	10.4	3.4	13.8
Total	211	34	245	350	109	459

¹Area within proposed earth fill, auxiliary spillway, and permanent pool

²Area between area directly converted and top of dam

Source: USDA. Web Soil Survey. Saunders County, Nebraska (NE155). Last updated: September 2018.

5.4 Surface Water Quality

No Action Alternative. This alternative would continue to allow the existing level of sediment to enter streams and waterbodies, thus continuing to allow the influx of nutrients to enter the water and compromise water quality within the watershed.

Dry Dams Alternative. This alternative would provide grade control along streams, decreasing upland and channel erosion. Additionally, implementation would result in the capture and storage of 50-years of accumulated sediment at each reservoir. This would reduce the influx of nutrients from sediment to downstream waterbodies, improving water quality.

Wet Dams (NED Alternative). This alternative would provide grade control along streams, decreasing upland and channel erosion. Additionally, implementation would result in the capture and storage of 50-years of accumulated sediment at each reservoir. This would reduce the influx of nutrients from sediment to downstream waterbodies, improving water quality.

5.5 Floodplain Management

No Action Alternative. This alternative would have no effect on the 100- and 500-year flood hazards.

Dry Dams Alternative. This alternative would provide slight reductions of the 100 and 500-year floods within the downstream urban areas, which includes the cities of Ithaca, Memphis, Wahoo, and Weston. Maps depicting the pre- and post-Project 100- and 500-year flooding extents within impacted urban areas are included in Figures C3.1-C3.8 in Appendix C. Breach overlay districts will increase building restrictions within the existing 100-year floodplain immediately below the planned structures. These areas are agricultural and are expected to remain so for the life of the structures. There are approximately 28 properties within these urban areas consisting of homes and commercial buildings subject to continued flooding from these

flood events. It is Nebraska's standard that the flood pool behind all dams that require NeNDR approval be mapped as regulatory floodplain and therefore each site will require a CLOMR and follow up LOMR.

Wet Dams (NED Alternative). This alternative would provide slight reductions of the 100- and 500-year floods within the downstream urban areas, which includes the cities of Ithaca, Memphis, Wahoo, and Weston. Maps depicting the pre- and post-Project 100- and 500-year flooding extents within impacted urban areas are included in Figures C3.1-C3.8 in Appendix C. Breach overlay districts will increase building restrictions within the existing 100-year floodplain immediately below the planned structures. These areas are agricultural and are expected to remain so for the life of the structures. There are approximately 28 properties within these urban areas consisting of homes and commercial buildings subject to continued flooding from these flood events. It is Nebraska's standard that the flood pool behind all dams that require NeNDR approval be mapped as regulatory floodplain and therefore each site will require a CLOMR and follow up LOMR.

5.6 Streams

Detailed information on the existing streams within the affected resource areas can be found in Appendix E and shown in Figures C4.1-C4.10, Appendix C.

No Action Alternative. This alternative would not place fill in or inundate any streams. However, the streams within the affected resource areas are experiencing continual degradation and widening. All streams within the affected resource areas will continue to degrade and widen with this alternative.

Dry Dams Alternative. This alternative would place earth fill within 2,700-feet of intermittent stream and 350-feet of perennial stream from the dam embankments. The structures would act as grade control structures and therefore help to stabilize the eroding streams. However, dry dams would not provide functional or habitat improvements. A summary of the stream impact lengths at each site are shown in Table 5-4. Below is a summary of the channel characteristics of the impacted streams.

Intermittent streams at Sites 55, 84, and 85 impacted by the proposed dam embankments have low functional value and are degrading and widening and experiencing severe erosion. The channel banks are steep and are subject to slope failures which result in mass wasting of soil and woody vegetation into the channel bed. Woody debris from threatened riparian vegetation is present within the channels. The channels are disconnected from the floodplain and minimal in-stream habitat is present besides the woody debris.

Impacted intermittent streams at Sites 26a, 27, and 82 as well as a perennial stream at Site 77 also have low functional value and are degrading and widening and experiencing moderate erosion. The channel banks are mostly vegetated and dominated by *Phalaris arundinacea*. The channels are experiencing sloughing and moderate erosion along the channel banks. The impacted channels at Sites 26b, 66, and 86 have vegetated banks and are experiencing degradation. Channels at Sites 26b and 66 have steep channel banks and are experiencing occasional sloughing. The intermittent stream at Site 86 is in relatively good condition with stable channel banks; however, no in-stream habitat is present below the ordinary high water mark (OHWM).

Overall, this alternative will have an insignificant impact on streams within the watershed. Mitigation would likely be required by the USACE at sites with over 300-feet of stream impacts to offset this minor impact.

Table 5-4. Stream Impacts - Dry Dams Alternative

Site	Fill Impacts (ft)	
	Intermittent	Perennial
26a	310	--
26b	340	--
27	320	--
55	400	--
66	240	--
77	--	350
82	220	--
84	300	--
85	400	--
86	170	--
Total	2,700	350

Wet Dams (NED Alternative). This alternative would place earth fill within 2,700-feet of intermittent stream and 350-feet of perennial stream from the embankments. Approximately 62,900-feet of streams will be inundated by the permanent pools.

This watershed is characterized by predominantly cohesive sediment sources which do not typically aggrade within the stream channels anywhere. Because of the lack of aggradation in this system, degradation occurs during large scale flood events regardless of the sediment load of the incoming flow. Based on this and 40 existing NRCS watershed plans in eastern Nebraska with previously implemented dams, the sediment hungry water concept described in other streams outside of eastern Nebraska is not applicable here.

There are no species in this watershed that migrate through the system where a dam could segment the river and prevent their migration or reduce the quality of their life. Seasonal streamflow variability will not occur due to the construction of this alternative as this watershed is not a seasonal system as is the case with the Platte River. There is no indication of thermal stratification or environmental impacts in this region due to thermal issues and stratification. Water quality is improved in this region by dams as the trapping reduces the suspended cohesive materials thereby increasing water clarity downstream. The flood protection from these structures will provide miles of bankline stability improvements due to decreased flood flow velocity and reduces the sediment load carried by the system, providing improvements in water quality associated with decreased erosion.

A summary of the stream impacts at each site is shown in Table 5-5.

The impacted streams at Site 26a are degrading and widening with moderate channel bank erosion scattered throughout the channel. At Site 26b, an intermittent stream is impacted from the embankment and permanent pool. The stream is degrading and disconnected from the floodplain and its channel banks



are dominated by *Phalaris arundinacea*. Channel banks have sloughed off and formed channel benches which are located throughout the streams in the watershed.

Approximately 5,000-feet of intermittent stream is inundated at Site 27. The intermittent stream impacted by fill has low functional value and is highly incised with nearly vertical channel banks and moderate erosion. The portion of the channel impacted from inundation at Site 27 is degrading and experiencing occasional bank sloughing with vegetated channel banks and benches. At Site 55, the impacted intermittent streams are degrading and widening and experiencing varying degrees of erosion. Streambank mass wasting and bank sloughing is present in some stretches of the channel and only erosion at the base of the streambank is present at others. The channel is experiencing severe erosion at the proposed embankment at Site 55. Three intermittent streams are impacted at Site 66. Two of the impacted streams are highly incised and experiencing minor erosion. One of the impacted streams is disturbed from agricultural land use adjacent to its top of banks and has bank sloughing and near vertical channel banks.

At Site 77 there will be impacts to approximately 9,150-feet of perennial stream and 5,500-feet of ephemeral stream. The perennial stream is widening and degrading and experiencing minor erosion. The ephemeral channels are experiencing varying degrees of erosion and degradation. At Site 82 there will be 4,380-feet of impacts from earth fill and inundation to intermittent streams. These streams are incised at varying widths and dominated by *Phalaris arundinacea*.

Almost 12,700-feet of intermittent stream is impacted at Site 84. The intermittent streams are experiencing severe erosion. High and near vertical channel banks that have experienced streambank mass wasting are present throughout the impacted channel. Site 85 has approximately 2,150-feet of impacted intermittent stream. This channel is degrading and experiencing moderate erosion throughout. There will be impacts to narrow ephemeral and intermittent streams at Site 86. The intermittent stream at Site 86 is in relatively good condition with stable channel banks; however, no in-stream habitat is present below the OHWM.

Table 5-5. Stream Impacts – Wet Dams Alternative

Site	Fill Impacts (ft)		Inundation Impacts (ft)		
	Intermittent	Perennial	Ephemeral	Intermittent	Perennial
26a	310	--	--	2,640	--
26b	340	--	--	4,740	--
27	320	--	--	5,050	--
55	400	--	--	9,500	--
66	240	--	--	4,220	--
77	--	350	5,480	--	8,800
82	220	--	--	4,160	--
84	300	--	--	12,640	--
85	400	--	--	1,750	--
86	170	--	1,020	790	--
Total	2,700	350	6,500	47,600	8,800



5.7 Wetlands

Detailed information on the existing wetlands within the affected resource areas can be found in Appendix E and shown in Figures C4.1-C4.9, Appendix C.

No Action Alternative. No change in existing conditions.

Dry Dams Alternative. A total of 0.48-acres of wetlands are impacted from earth fill for the 10 dam embankments and the berm and driveway grading at Site 82 (Table 5-6). This includes 0.41-acres of palustrine emergent wetlands and 0.07-acres of palustrine forested wetlands will be impacted. Wetland impacts will primarily include impacts to riverine wetlands located adjacent to streams as well as one depressional wetland within a farm field at Site 77.

Table 5-6. Wetland Impact Areas

Site	Cowardin Wetland Classification ¹	Hydrogeomorphic Classification	Fill Impacts (ac)
26a	PEMA/C	Riverine	0.02
26b	PEMA/C	Riverine	0.03
27	PEMC	Riverine	0.01
77	PEMA	Depressional	0.27
82	PEMA	Riverine	0.07
	PFOA	Riverine	0.07
84	PEMA/C	Riverine	0.01
Total			0.48

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

PEMA/C = Palustrine emergent temporarily/seasonally flooded

PFOA = Palustrine forested temporarily flooded

Wet Dams (NED Alternative). A total of 0.48-acres of wetlands will be impacted by fill from the 10 dam embankments and for the berm and driveway grading at Site 82. Permanent pool inundation will impact 2.98-acres of wetlands, resulting in a total of 3.46-acres of wetland impacts. The majority of wetlands impacted are palustrine emergent with some impacts to scrub-shrub and forested wetlands. See Table 5-7 for site specific wetland impact data.

Table 5-7. Wetland Impact Areas

Site	Cowardin Wetland Classification ¹	Hydrogeomorphic Classification	Fill Impacts (ac)	Inundation Impacts (ac)	Total (ac)
26a	PEMA/C	Riverine	0.02	0.27	0.29
26b	PEMA/C	Riverine	0.03	0.12	0.15
27	PEMC	Riverine	0.01	0.44	0.45
55	PEMA/C	Riverine	--	0.25	0.25
66	PEMC	Riverine	--	0.01	0.01
	PEMA	Depressional	--	0.30	0.30
	PEMC	Lacustrine Fringe	--	0.04	0.04



Site	Cowardin Wetland Classification ¹	Hydrogeomorphic Classification	Fill Impacts (ac)	Inundation Impacts (ac)	Total (ac)
77	PEMA	Depressional	0.27	0.04	0.31
	PEMC	Depressional	--	0.20	0.20
	PFOC	Depressional	--	0.28	0.28
	PEMA	Riverine	--	0.01	0.01
82	PEMA	Riverine	0.07	0.16	0.23
	PFOA	Riverine	0.07	--	0.07
84	PEMA/C	Riverine	0.01	0.24	0.25
	PEMA/C	Depressional	--	0.06	0.06
	PSSA	Riverine	--	0.02	0.02
86	PEMA	Depressional	--	0.54	0.54
Total			0.48	2.98	3.46

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

PEMA/C = Palustrine emergent temporarily/seasonally flooded

PSSA = Palustrine scrub-shrub temporarily flooded

PFOA = Palustrine forested temporarily flooded

PFOC = Palustrine forested seasonally flooded

A total of 145.8-acres of lacustrine fringe wetlands will be created around permanent pool elevations to mitigate for the loss of wetlands. Wetland vegetation will be planted and is predicted to establish at 2-feet vertically above and below the permanent pool elevation based on existing topography, proposed grading, and local experience. Lacustrine fringe wetlands established above and below the permanent pool elevation will have Cowardin wetland classifications of PEMC and PEMGh respectively. Please see table 5-8 for the anticipated types and areas of wetlands created at each site.

Table 5-8. Wetland Creation Areas

Site	Created Wetlands (acres)		
	PEMC - Lacustrine Fringe	PEMGh - Lacustrine Fringe	Total
26a	2.0	2.1	4.1
26b	5.3	3.6	8.9
27	6.0	6.2	12.2
55	3.6	2.7	6.3
66	9.8	5.5	15.2
77	24.9	30.2	55.1
82	6.1	4.5	10.6
84	10.1	9.8	19.8
85	3.6	2.7	6.3
86	3.4	3.7	7.1
Total	74.7	71.1	145.8

5.8 Threatened and Endangered Species

NRCS Programmatic Consultation evaluation parameters, species matrix, and conservation conditions were used during this EA's environmental evaluation in conjunction with input from natural resource specialists at NRCS, NGPC, and USFWS. Based on the 2001 field inventory, discussions with specialists, and an assessment of each species' natural history, range, and habitat needs, it has been determined that none of the alternatives are likely to adversely impact any state or federally listed endangered, threatened, proposed, or candidate species. A concurrence letter USFWS is included in Appendix E and a species-specific discussion is provided below.

Northern Long-Eared Bat

No Action Alternative. This alternative would have no effect on the Northern long-eared bat.

Dry Dams Alternative. There are no known hibernacula within the affected resource areas. Northern long-eared bats could conceivably roost underneath bark, in cavities, or in crevices in both live and dead trees that will be cleared. There is currently no Endangered Species Act (ESA) Section 7 programmatic informal consultation agreement between NRCS and USFWS for the Northern long-eared bat. Section 4(d) of the ESA allows the USFWS to endorse special rules for species listed as threatened that provide flexibility in implementing the ESA. This helps to reduce ESA conflicts by allowing some activities that do not harm the species and allows more time for the USFWS to focus efforts on threats to the continued existence of the species. The 4(d) rule for the Northern long-eared bat focuses on areas affected by white-nose syndrome (which includes the affected resource areas) during the bat's most sensitive life stages and relies on the findings of the programmatic biological opinion prepared by the USFWS. Federal agencies can choose to follow standard Section 7 of the ESA procedures or use the 4(d) rule framework to streamline consultation when appropriate. Using the key to the 4(d) rule, made available by the USFWS, it is determined that the proposed action is consistent with those evaluated in the programmatic intra-Service consultation for the final 4(d) rule and does not require separate consultation. No tree clearing will occur from June 1 to July 31 to limit the potential of an incidental take. This alternative is not likely to adversely affect the Northern long-eared bat.

Wet Dams Alternative. There are no known hibernacula within the affected resource areas. Northern long-eared bats could conceivably roost underneath bark, in cavities, or in crevices in both live and dead trees that will be cleared. There is currently no Endangered Species Act (ESA) Section 7 programmatic informal consultation agreement between NRCS and USFWS for the Northern long-eared bat. Section 4(d) of the ESA allows the USFWS to endorse special rules for species listed as threatened that provide flexibility in implementing the ESA. This helps to reduce ESA conflicts by allowing some activities that do not harm the species and allows more time for the USFWS to focus efforts on threats to the continued existence of the species. The 4(d) rule for the Northern long-eared bat focuses on areas affected by white-nose syndrome (which includes the affected resource areas) during the bat's most sensitive life stages and relies on the findings of the programmatic biological opinion prepared by the USFWS. Federal agencies can choose to follow standard Section 7 of the ESA procedures or use the 4(d) rule framework to streamline consultation when appropriate. Using the key to the 4(d) rule, made available by the USFWS, it is determined that the proposed action is consistent with those evaluated in the programmatic intra-Service consultation for the final 4(d) rule and does not require separate consultation. No tree clearing will occur from June 1 to July

31 to limit the potential of an incidental take. This alternative is not likely to adversely affect the Northern long-eared bat.

Pallid Sturgeon

No Action Alternative. This alternative would have no effect on the pallid sturgeon.

Dry Dams Alternative. The pallid sturgeon has a limited range within the Missouri and Platte Rivers in Nebraska and is not found within affected resource area streams. No critical habitat has been designated within Nebraska. The USFWS has found that actions resulting in depletions to flows in the Platte River system are likely to jeopardize the continued existence of certain listed threatened and endangered species, including the pallid sturgeon. This alternative involves structures without permanent pools and all inflow would flow-through the structure to the Platte River. The net depletions (February through July) for each structure are less than the benchmark of 25 acre-feet and therefore there are no concerns about Platte River depletions from NGPC or USFWS. This alternative is not likely to adversely affect the pallid sturgeon.

Wet Dams (NED Alternative). The pallid sturgeon has a limited range within the Missouri and Platte Rivers in Nebraska and is not found within affected resource area streams. No critical habitat has been designated within Nebraska. The USFWS has found that actions resulting in depletions to flows in the Platte River system are likely to jeopardize the continued existence of certain listed threatened and endangered species, including the pallid sturgeon. This alternative involves structures with permanent pools, and all additional inflow would flow-through the structure to the Platte River. The accumulative net depletions (February through July) for each structure is less than the benchmark of 25 acre-feet and therefore, there are no concerns about Platte River depletions from NGPC or USFWS. More detailed information about the consumptive use calculations is included in Appendix D and Appendix E. This alternative is not likely to adversely affect the pallid sturgeon.

Western Prairie Fringed Orchid

All alternatives. All alternatives are outside of the known range of the western prairie fringed orchid and would therefore have no effect.

Interior Least Tern

No Action Alternative. This alternative would have no effect on the interior least tern.

Dry Dams Alternative. The known range of the interior least tern is outside of the affected resource area limits. No critical habitat has been designated within Nebraska. The known range includes areas along Wahoo Creek downstream of Memphis as well as along the Platte River. The USFWS has found that actions resulting in depletions to flows in the Platte River system are likely to jeopardize the continued existence of certain listed threatened and endangered species. This alternative involves structures without permanent pools and all inflow would flow-through the structure and continue downstream to Wahoo Creek and eventually the Platte River. The net depletions (February through July) for each structure are less than the benchmark of 25 acre-feet and therefore there are no concerns about Platte River depletions from NGPC or USFWS. This alternative is not likely to adversely affect the interior least tern.

Wet Dams (NED Alternative). The known range of the interior least tern is outside of the affected resource area limits. No critical habitat has been designated within Nebraska. The known range includes areas along Wahoo Creek downstream of Memphis as well as along the Platte River. The USFWS has found that actions

resulting in depletions to flows in the Platte River system are likely to jeopardize the continued existence of certain listed threatened and endangered species. This alternative involves structures with permanent pools, and all additional inflow would flow-through the structure to Wahoo Creek and the Platte River. The accumulative net depletions (February through July) for each structure is less than the benchmark of 25 acre-feet and therefore, there are no concerns about Platte River depletions from NGPC or USFWS. More detailed information about the consumptive use calculations is included in Appendix D and Appendix E. This alternative is not likely to adversely affect the least tern.

Piping Plover

No Action Alternative. This alternative would have no effect on the piping plover.

Dry Dams Alternative. The known range of the piping plover is outside of the affected resource area limits. No critical habitat has been designated within Nebraska. The known range includes areas along Wahoo Creek downstream of Memphis as well as along the Platte River. The USFWS has found that actions resulting in depletions to flows in the Platte River system are likely to jeopardize the continued existence of certain listed threatened and endangered species. This alternative involves structures without permanent pools and all inflow would flow-through the structure and continue downstream to Wahoo Creek and eventually the Platte River. The net depletions (February through July) for each structure are less than the benchmark of 25 acre-feet and therefore there are no concerns about Platte River depletions from NGPC or USFWS. This alternative is not likely to adversely affect the piping plover.

Wet Dams (NED Alternative). The known range of the piping plover is outside of the affected resource area limits. No critical habitat has been designated within Nebraska. The known range includes areas along Wahoo Creek downstream of Memphis as well as along the Platte River. The USFWS has found that actions resulting in depletions to flows in the Platte River system are likely to jeopardize the continued existence of certain listed threatened and endangered species. This alternative involves structures with permanent pools, and all additional inflow would flow-through the structure to Wahoo Creek and the Platte River. The accumulative net depletions (February through July) for each structure is less than the benchmark of 25 acre-feet and therefore, there are no concerns about Platte River depletions from NGPC or USFWS. More detailed information about the consumptive use calculations is included in Appendix D and Appendix E. This alternative is not likely to adversely affect the piping plover.

Lake Sturgeon

All alternatives. All alternatives are outside of the known range of the lake sturgeon and would therefore have no effect.

Sturgeon Chub

All alternatives. All alternatives are outside of the known range of the sturgeon chub and would therefore have no effect.

Flathead Chub

All alternatives. All alternatives are outside of the known range of the flathead chub and would therefore have no effect.

Plains Minnow

All alternatives. All alternatives are outside of the known range of the plains minnow and would therefore have no effect.

Western Silvery Minnow

All alternatives. All alternatives are outside of the known range of the western silvery minnow and would therefore have no effect.

5.9 Grasslands

No Action Alternative. No change in existing conditions.

Dry Dams Alternative. This alternative would convert approximately 5-acres of disconnected, non-farmed grasslands with predominantly native species, with additional impacts occurring over the life of the structure due to sedimentation behind the embankment. This conversion will cause only minor impacts to the grassland system due to the existing fair and disconnected condition. Implementation of this alternative would also reduce chances of future flooding and sedimentation over additional grasslands within the watershed and stabilize the stream channel, decreasing the chances of future grassland loss. Seeding of the 10 embankments and auxiliary spillways will create 60-acres of grasslands. This alternative would not have a significant impact on grasslands.

Wet Dams (NED Alternative). This alternative would convert or inundate approximately 14-acres of disconnected, non-farmed grasslands with predominantly native species. This conversion will cause only minor impacts to the grassland system due to the existing fair condition. Implementation of this alternative would also reduce chances of future flooding and sedimentation over additional grasslands within the watershed and stabilize the stream channel, decreasing the chances of future grassland loss. Seeding of the ten embankments and auxiliary spillways will create 60-acres of grasslands. This alternative would not have a significant impact on grasslands and no further mitigation is anticipated.

5.10 Woodlands

No Action Alternative. This alternative would not remove or inundate any of the existing woodland community.

Dry Dams Alternative. This alternative would remove approximately 6-acres of discontinuous woodland habitat and would impact trees most closely represented by the Dry-Mesic Bur Oak Forest and Woodland community within the Eastern Dry-Mesic Bur Oak Forest and Woodland ecological system. The trees typical of this community likely to be removed include the *Ulmus americana*, *Celtis occidentalis*, *Fraxinus pennsylvanica*, and *Juniperus virginiana*. Implementation of this alternative would stabilize the stream channel and decrease the chances of future woodland loss. Woodland impacts will cause only minor impacts to the existing woodland system; however, woodland mitigation requirements are common in eastern Nebraska and would likely be required by the USACE as a condition of CWA Section 404 permits. Mitigation amounts will be determined after a detailed tree survey and are discussed further in Section 7.3.3.

Wet Dams (NED Alternative). This alternative would inundate or remove approximately 84-acres of discontinuous woodland habitat and would impact trees most closely represented by the Dry-Mesic Bur



Oak Forest and Woodland community within the Eastern Dry-Mesic Bur Oak Forest and Woodland ecological system. The trees typical of this community likely to be removed include the *Ulmus americana*, *Celtis occidentalis*, *Fraxinus pennsylvanica*, and *Juniperus virginiana*. Woodland impacts will cause only minor impacts to the existing woodland system; however, woodland mitigation requirements are common in eastern Nebraska would likely be required by the USACE as a condition of CWA Section 404 permits. Mitigation amounts will be determined after a detailed tree survey and are discussed further in Section 7.3.3.

5.11 Fish and Wildlife Habitat

No Action Alternative. This alternative would not impact any fish habitat.

Dry Dams Alternative. This alternative would provide grade control along the affected resource area streams, enhance overall stream function, and consequently improve in-stream fish habitat. However, there would be no creation of new fish habitats and would not improve terrestrial habitat. This alternative has no significant impact on fish habitat.

Wet Dams (NED Alternative). This alternative would provide grade control along the affected resource area streams, enhance overall stream function, and consequently improve in-stream fish habitat. Additionally, the permanent pools at each site will provide approximately 375-acres of additional fish habitat. The watershed to lake ratio for each site ranges from 25:1 to 70:1 and the preferred range for fish habitat is 20:1 to 30:1 for watersheds having 85 percent treatment. Most sites are relatively close to the preferred watershed to lake ratio of 30:1 for desirable fish habitat and it is not practical due to increased costs to increase the permanent pools to meet this ratio at the remaining sites. Overall, this alternative improves fish habitat.

5.12 Migratory Birds and Eagles

No Action Alternative. This alternative would have no impact on migratory birds or eagles.

Dry Dams Alternative. This alternative would avoid any habitat destruction from February 1 to July 15 to avoid impacts to nesting migratory birds or raptors. If tree clearing must occur during these times, bird surveys would be conducted to ensure compliance with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. There are no known bald or golden eagle winter roost sites near or within the affected resource areas and a database of bald eagles kept by the NGPC indicates that there are no known bald eagle nests within 0.5-miles of the affected resource areas (as of April 18, 2019). Therefore, tree clearing and construction activities will not impact these eagles. This project would not adversely impact migratory birds, bald eagles, or golden eagles.

Wet Dams (NED Alternative). This alternative would avoid any habitat destruction from February 1 to July 15 to avoid impacts to nesting migratory birds or raptors. If tree clearing must occur during these times, bird surveys would be conducted to ensure compliance with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. There are no known bald or golden eagle winter roost sites near or within the affected resource areas and a database of bald eagles kept by the NGPC indicates that there are no known bald eagle nests within 0.5-miles of the affected resource areas (as of April 18, 2019). Therefore, tree clearing

and construction activities will not impact these eagles. This project would not adversely impact migratory birds, bald eagles, or golden eagles.

5.13 Flood Damages

No Action Alternative. No change to existing conditions.

Dry Dams Alternative. Estimated average annual flood damage without the project is approximately \$4,232,200. Construction of the dry dam alternative would reduce damages to an average annual of \$3,272,900, producing \$959,300 of flood reduction benefits.

Wet Dams (NED Alternative). Estimated average annual flood damage without the project is approximately \$4,232,200. An economic analysis using the current federal discount rate of 2.50 percent and a design life of 50-years was conducted with construction expected to occur in 8 years. Construction of the wet dam alternative would reduce damages to an average annual of \$3,272,900, producing \$959,300 of flood reduction benefits.

5.14 Cultural and Historic Properties

Section 106 of the National Historic Preservation Act (NHPA [54 U.S.C. § 306108]) and its implementing regulations (36 CFR Part 800) requires Federal agencies to take into account the effect of their undertakings on historic properties and to afford the Advisory Council on Historic Preservation a reasonable opportunity to provide comment on the undertaking. Other consulting parties in the Section 106 process include the State Historic Preservation Officer (SHPO), Indian tribes that attach religious and cultural significance to historic properties that may be affected by an undertaking, local governments, applicants, and the public.

In compliance with Section 106 of the NHPA, the Nebraska SHPO and Indian Tribes with ancestral ties to the project area were contacted early in the planning process to identify the presence of properties of historic, religious, and cultural significance within the study area and to participate in agency scoping meetings. For a list of Tribes contacted see Table 6-1. The public and local government agencies were afforded an opportunity to provide input on cultural resources during the December 7, 2017, June 12, 2018, and March 20, 2019 scoping meetings.

After the alternatives were identified, the area of potential effect (APE) for each proposed dam site was surveyed for the presence of historic properties by professional archeologists who meet the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (36 CFR Part 61). Cultural resource investigations were completed in May 2018 (Mackling 2018) and November 2018-January 2019 (Bevitt and Bevitt 2019).

Twenty cultural resource sites were identified within the APE during the cultural resource inventories. In accordance with 36 CFR 800.4 and 36 CFR 60.4, all sites within the project APE were evaluated to determine eligibility for inclusion in the National Register of Historic Places (NRHP). Eighteen of the sites were determined to not meet any of the criteria for NRHP eligibility. Two of the sites (25SD216 and 25SD219) were determined to be eligible for the NRHP under Criteria A and C (Criterion A: association with Czech immigrant settlement of Nebraska; Criterion C: association with early Czech-American settlement construction patterns). Both NRHP eligible sites are 19th century farmsteads with multiple standing structures as described in Chapter 3.14. The Nebraska State Historic Preservation Office concurred with

these determinations of eligibility in letters received January 16, 2019, December 13, 2019, and August 9, 2021 (Appendix A).

No Action Alternative. Under this alternative there would be no federal action with the potential to affect historic properties. No further NHPA compliance would be required.

Dry Dams Alternative. Two historic properties are located within the APE of two dams proposed under the Dry Dams Alternative. A barn at site 25SD216 is within the top of dam elevation for one of the proposed structures and will be included within the easement acquired for that dam. However, the barn and other structures at site 25SD216 are above the maximum reservoir pool elevation of the dam, and the site will not be affected directly or indirectly by dam construction. Site 25SD219 would not be directly affected by ground disturbance from dam construction, but the barn, house, and chicken coop are within the proposed maximum pool elevation of a dam. During heavy rain events that fill the dam to the auxiliary spillway (>9 inches of rain in a 24-hour period), water could fill the buildings to depths ranging from 0.5 feet to 4.8 feet depending on the rainfall amount.

In accordance with 36 CFR 800.5(b), NRCS determined that the proposed action will have no adverse effect on historic properties. The proposed action will not cause any direct effects from ground disturbance at either property, but portions of site 25SD219 may be inundated during heavy rain events that fill the reservoir pool above the auxiliary spillway. Water in the flood pool is expected to rise slowly during the inundation period, and the water should drain slowly over several days. The low energy nature of this type of flooding is unlikely to cause significant erosion. There may be minor movement of surface artifacts and wetting of wooden structural elements during inundation. Rain events causing flooding of this resource are expected to be rare (less than 3% chance in a given year), and the temporary inundation is unlikely to cause significant direct or cumulative effects that would alter subsurface cultural deposits or damage the standing structures in such a manner as to change the characteristics that contribute to the historical significance of site 25SD219. NRCS consulted on its determination of effect with the Nebraska SHPO, the Pawnee Nation of Oklahoma, the Otoe-Missouria Tribe of Oklahoma, and the Omaha Tribe of Nebraska in letters sent July 21, 2021 (Appendix A), emails sent August 5, 2021, and phone calls on August 26, 2021 and September 10, 2021. Nebraska SHPO concurred with the determination of effect in a letter received August 9, 2021; the Pawnee Nation of Oklahoma concurred with the determination of effect in an email received September 2, 2021 (Appendix A). No other responses were received.

Wet Dams (NED Alternative). Two historic properties are located within the APE of two dams proposed under the Wet Dams Alternative. A barn at site 25SD216 is within the top of dam elevation for one of the proposed structures and will be included within the easement acquired for that dam. However, the barn and other structures at site 25SD216 are above the maximum reservoir pool elevation of the dam, and the site will not be affected directly or indirectly by dam construction. Site 25SD219 would not be directly affected by ground disturbance from dam construction, but the barn, house, and chicken coop are within the proposed maximum pool elevation of a dam. During heavy rain events that fill the dam to the auxiliary spillway (>9 inches of rain in a 24-hour period), water could fill the buildings to depths ranging from 0.5 feet to 4.8 feet depending on the rainfall amount.

In accordance with 36 CFR 800.5(b), NRCS determined that the proposed action will have no adverse effect on historic properties. The proposed action will not cause any direct effects from ground disturbance at either property, but portions of site 25SD219 may be inundated during heavy rain events that fill the reservoir pool above the auxiliary spillway. Water in the flood pool is expected to rise slowly during the inundation period, and the water should drain slowly over several days. The low energy nature of this type of flooding is unlikely to cause significant erosion. There may be minor movement of surface artifacts and wetting of wooden structural elements during inundation. Rain events causing flooding of this resource are expected to be rare (less than 3% chance in a given year), and the temporary inundation is unlikely to cause significant direct or cumulative effects that would alter subsurface cultural deposits or damage the standing structures in such a manner as to change the characteristics that contribute to the historical significance of site 25SD219. NRCS consulted on its determination of effect with the Nebraska SHPO, the Pawnee Nation of Oklahoma, the Otoe-Missouria Tribe of Oklahoma, and the Omaha Tribe of Nebraska in letters sent July 21, 2021 (Appendix A), emails sent August 5, 2021, and phone calls on August 26, 2021 and September 10, 2021. Nebraska SHPO concurred with the determination of effect in a letter received August 9, 2021; the Pawnee Nation of Oklahoma concurred with the determination of effect in an email received September 2, 2021 (Appendix A). No other responses were received.

5.15 Environmental Justice

No Action Alternative. This alternative would not adversely impact minority groups.

Dry Dams Alternative. This alternative will not adversely impact any known minority groups or individuals living in poverty. No private property will be taken without just compensation and no relocations are anticipated for this alternative. The community and landowners will benefit from flood damage reduction and stream stabilization.

Wet Dams (NED Alternative). This alternative will not adversely impact any known minority groups or individuals living in poverty. No private property will be taken without just compensation and no relocations are expected for this alternative. Landowners at each site will benefit from having access to the permanent pools for fishing and other passive recreation. Care will be taken during final design to meet landowner goals and water quality concerns, including the watershed to reservoir surface area ratio and permanent pool depth. When feasible, at least 25 percent of the reservoir will be at least 15 feet deep when the landowner indicates that a sustainable fishery is desirable. Additionally, the permanent pools are anticipated to increase the surrounding land values for potential home development areas. The community and landowners will benefit from flood damage reduction and stream stabilization.

5.16 Public Health and Safety

Implementation of the wet or dry dam alternative would decrease flood damages and reduce risks to public health and safety. A breach analysis was performed at each site and showed that in the case of a dam failure, there would be no probable loss of human life with any structure and low economic loss for 9 of the 10 sites. Saunders County Planning Commission as well as the City of Wahoo and the Village of Weston have approved zoning language for areas within the breach paths at all sites to ensure that no future homes will be constructed to protect the designed hazard class of the dams. The breach path zoning restrictions were discussed in depth at public and agency meetings with no controversy. The overlay district was voted

on and unanimously approved at the Saunders County Board of Supervisors meeting and open Public Hearing.

5.17 Riparian Areas

No Action Alternative. This alternative would have no impact on riparian areas.

Dry Dams Alternative. This alternative will not adversely impact existing riparian areas. Riparian areas exist only sporadically throughout the watershed and the minimal footprint of the dam embankments would not cause any significant impact. The floodplain is generally agricultural land and the structures will improve the adjacent cropland.

Wet Dams (NED Alternative). This alternative will not adversely impact existing riparian areas. Riparian areas exist only sporadically throughout the watershed and the minimal impact due to the dam embankments and inundation would not be significant. The floodplain is generally agricultural land and the structures will improve the adjacent cropland.

5.18 Indirect Effects

Indirect effects are those that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). These can be positive or negative and can include effects to the human socioeconomic environment and/or the natural environment. An indirect effect of the no action alternative would be continued stream degradation, resulting in increased bank instability and channel widening. An indirect effect of the wet dams alternative could potentially be increased residential properties due to the improved aesthetic of the permanent pool and recreation benefits of the permanent pool and open space around the reservoirs.

5.19 Cumulative Impacts

Cumulative impacts are defined by the Council on Environmental Quality (CEQ) as:

the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7).

These impacts include both the direct and indirect impacts of the proposed project with any other projects that have happened in the past or could reasonably happen in the future. Reasonably foreseeable actions must have progressed far enough through planning or design so that they are likely to be carried out. The framework provided in CEQ's "Considering Cumulative Effects under the National Environmental Policy Act" was consulted for this analysis. As is discussed in the aforementioned framework, a method to discern cumulative impacts is to assess potential resources affected by the proposed action, to look at other past or future projects that could also impact those resources, and to analyze the locations and timeframes of those actions to determine if cumulative impacts are present.

Actions occurring within the Upper Wahoo Creek watershed were considered for this analysis. Flood damage reduction and impacts to erosion, sedimentation, wetlands, and streams were identified as the

primary resources to consider. This Plan-EA is the only NRCS watershed work plan for the area and therefore no other new NRCS structures are planned in the foreseeable future within the entire Wahoo Creek watershed. Foreseeable actions within the watershed impacting erosion and sedimentation are continued and increased land conservation techniques. A change in land use is not expected. Therefore, any cumulative impacts would be beneficial to the watershed and the receiving waters downstream.

Upper Wahoo Creek Watershed in conjunction with the structures built from the 1950s - 2008 in the Swedeburg Watershed (1950s), Cottonwood Creek Watershed (1960s-1990s), and Sand and Duck Creek Watersheds including Lake Wanahoo (2000s) could present cumulative impacts to flooding, wetlands, and other waters of the U.S when combined with the proposed action. The cumulative impact on flood damages is beneficial, as is shown in Appendix D. Due to the low quality and small quantity of wetlands being impacted by the wet and dry dam alternatives and the potential for wetlands to form around the permanent pool in the wet dam alternative, there are no negative cumulative impacts expected. Fill and inundation of streams caused by the dry and wet dam alternatives do decrease stream length within the watershed and present a cumulative negative impact on stream length when considered with the other, nearby reservoirs. However, this reduction in low-functioning stream does not represent an overall decrease in aquatic or terrestrial habitat or biological diversity due to the improved aquatic habitat provided by the permanent pool of the wet dam alternative and protected buffer to the top of dam limits for both the wet and dry alternatives.

5.20 Compliance with Federal, State, and Local Laws

The following permit and compliance requirements must be met for construction of the Project to occur.

- **Clean Water Act Section 404.** CWA Section 404 permits must be obtained from the USACE to account for fills within jurisdictional waters of the United States prior to construction. The Sponsor will obtain a 404 permit for each dam site prior to construction.
- **Migratory Bird Treaty Act and Endangered Species Act Section 7.** To avoid migratory bird nesting and Northern long-eared bat roosting impacts, clearing activities will be conducted between August 1 and March 31. If tree clearing must occur between April 1 and May 31, a field survey will be conducted to ensure compliance with the Migratory Bird Treaty Act.
- **NDEQ.** A National Pollutant Discharge Elimination System (NPDES) construction storm water permit from the Nebraska Department of Environmental Quality (NDEQ) will be required at each site if more than 1-acre of land is disturbed for construction.
- **Dust Regulations.** Nebraska Title 129, Chapter 32 fugitive dust regulations shall apply to all excavation and construction activities.
- **Excavation.** All applicable regulations in Nebraska Title 128 and Title 132 must be followed. Any solid or hazardous wastes generated or discovered during project operations must be properly handled, contained, disposed, and (if necessary) characterized. No waste permit required.
- **National Historic Preservation Act.** Section 106 of the NHPA [54 U.S.C. § 306108] and its implementing regulations, "Protection of Historic Properties" [36 CFR part 800] requires Federal agencies to determine whether their undertakings will have an adverse impact on historic properties that are listed on or are eligible for listing on the National Register of Historic Places and to afford the Advisory Council on Historic Preservation a reasonable opportunity to provide comment. In compliance with Section 106 of the NHPA, the Nebraska SHPO and Indian Tribes with ancestral ties to the project area were contacted early in the planning process to identify the presence of properties of historic, religious, and cultural significance within the study area and to participate in agency scoping meetings. For a list of Tribes contacted see Table 6-1. The public was afforded an opportunity to provide input on cultural resources during the open houses held in Wahoo, Nebraska on December 7, 2017, June 12, 2018, and March 20, 2019. The APE for each alternative that was carried forward for detailed study was identified and reviewed for the presence of historic properties by professional archeologists who meet the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (36 CFR 61). The APE included top of dam extents as well as potential borrow, waste, access, and staging areas (see Figures C1.1-C1.9, Appendix C). Cultural resources investigations were completed in May 22-25, 2018 and from November 2018 - January 2019. Two historic properties were identified within the APE of two proposed structures. However, NRCS determined that construction of the dams would have no adverse effect on either resource. NRCS consulted on its determination of effect with the Nebraska SHPO, the Pawnee Nation of Oklahoma, the Otoe-Missouria Tribe of Oklahoma, and the Omaha Tribe of Nebraska in letters sent July 21, 2021, emails sent August 5, 2021, and phone calls on August 26, 2021 and September 10, 2021. Nebraska SHPO concurred that the proposed action



would have no adverse effect on historic properties in a letter received August 9, 2021; the Pawnee Nation of Oklahoma concurred with the determination of effect in an email received September 2, 2021 (Appendix A). No other responses were received.

- **Storage Permit.** A water storage permit will be obtained from NeDNR prior to construction.
- **Dam Safety.** The final engineering plans will be reviewed and approved by the NeDNR Dam Safety Section prior to construction. Before approval of a dam, NeDNR will have to verify the dam has the proper hazard classification.
- **Water wells.** Coordination with NeDNR will occur prior to construction to locate any registered water wells. **Operation and Maintenance.** An O&M Plan will be prepared using the NRCS National Operation and Maintenance Manual.
- **Floodplain Management.** Prior to construction, the Sponsor will participate in and comply with applicable Federal, State, and Local floodplain management rules and regulations.
 - Any and all development in the regulatory floodplain or floodway will require a local Floodplain Development Permit (Neb. Rev. Stat. § 31-1021 & Title 455 Nebraska Administrative Code, Chapter 1). This includes all Special Flood Hazard Areas identified on FEMA's Flood Insurance Rate Maps, and any other area adopted by the local jurisdiction. Development is defined as "Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations or storage of equipment or materials."
 - Any development that causes more than a foot of rise in a regulatory floodplain without floodway or any rise in a regulatory floodplain with floodway is required to obtain a Conditional Letter of Map Revision (CLOMR) from FEMA. (44 CFR 65.12/60.3c10/60.3d3/60.3d4). The floodplain development permit application must contain engineering that shows the project meets these requirements.
 - Any development that causes a change to the regulatory floodplain or floodway boundary must submit a Letter of Map Revision (LOMR) within six months of project completion. (44 CFR 65.3)
- **Water Administration.** Any new reservoirs or new surface water diversions may be subject to frequent water administration during the summer months due to unmet target flows for the Nebraska Game & Parks instream flow appropriations to protect fish and wildlife. Water diversions may be restricted for local shortages or for protection of senior water rights. The NeDNR may monitor water levels in reservoirs and may require passing of inflows for livestock or other downstream use. The accumulative net depletions (February through July) for each structure is less than the bench mark of 25 acre-feet as shown in Appendix D.
- **National Environmental Policy Act.** This document was prepared to comply with the National Environmental Policy Act and the Principles and Guidelines for Water and Related Land Resources Implementation Studies.

5.21 Possible Conflicts with Plans and Policies

No potential conflicts between land use plans, regional water resource management plans, policies, or controls for the area were identified.

5.22 Risk and Uncertainty

Each alternative contains risk factors and uncertainty values that could involve changes in costs and benefits. Costs, structural data, and benefits were based on an evaluated life of 50 years. Sedimentation rates were calculated using existing land use and conditions. Land use could change upstream and therefore increase or decrease these rates. Urbanization can cause a rapid influx of sediment into the basin although that is not anticipated. Costs were determined by engineer estimates for project implementation and were based on local experience and engineering judgement. All estimated costs and benefits are subject to change due to local, regional, or world economics. These uncertainties were not considered for this analysis.

5.23 Precedent for Future Actions with Significant Impacts

Implementation of the proposed action does not set a precedent for future actions with significant impacts. Future projects for flood damage reduction would be analyzed by their own circumstances and evaluated for effects based on resources of concern identified during the scoping process.

5.24 Controversy

The existing landowners and agencies largely support the implementation of the Project. Landowner communication was extensive throughout the planning process and concerns voiced during public meetings and throughout the planning process were taken into consideration during the selection of alternatives and were addressed to the satisfaction of the public. No areas of controversy remain.

6.0 CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION

The following chapter details agency and public participation efforts throughout the planning process. Additional internal consultation and coordination took place between the Sponsor and NRCS throughout the planning process.

6.1 Internal Scoping Meeting

The Sponsor and NRCS held a scoping meeting on March 27, 2018 at 10:00am at the Lincoln, Nebraska NRCS office to discuss the scope of the Watershed Plan and EA. Attendees included representatives from the LPNNRD, NRCS, USACE, and FYRA Engineering. An overview of this meeting is included below.

- Planning and construction schedules were discussed in relation to funding.
- Site selection, cultural resources, threatened and endangered species, and wetland delineation analysis and timelines were discussed.
- The Plan-EA environmental analysis for wetlands should meet both NRCS and USACE requirements and the analysis should include an alternatives analysis that considers 404(b)(1) requirements.
- Public and Agency Meetings will be held on the same days for the combined project sites.

6.2 Public Meetings

The Sponsor held three public meetings to provide opportunities for public participation throughout the planning process. The public meetings were held after business hours and considered planting and harvest timelines to accommodate potential public scheduling conflicts. Letters were mailed to the potentially impacted landowners and notices about the meeting were posted on the Sponsor website and in the Wahoo Newspaper. An overview of each meeting is included below. An online website with the primary project contact information, project meeting information, and relevant project information was made available to keep the public informed and address any concerns they may have throughout the planning process.

6.2.1 Sites 26a, 26b, and 27 Public Scoping Meeting (December 7, 2017)

A public scoping meeting was held on December 7, 2017 from 5:00pm – 7:00pm at the Union Bank and Trust in Wahoo, NE to provide an overview of Sites 26a, 26b, and 27, hear and discuss any concerns from the public, and to begin an open line of communication with the public. An overview of the project was presented and included information about the project history, NEPA planning process, and potential alternatives at Sites 26a, 26b, and 27. Time was allotted for the public to ask formal questions and an open house setting provided an informal time for discussion between the planning team and those that attended the meeting. An information sheet, a resources of concern questionnaire, and comment cards were available to provide information and receive feedback from the public on resources they value within the watershed.

6.2.2 Upper Wahoo Creek Watershed Plan-EA Public Scoping Meeting

A public scoping meeting was held on June 12, 2018 from 5:00pm – 7:00pm at the Union Bank and Trust in Wahoo, NE to provide an overview of the Plan-EA and hear and discuss any concerns with the public. An overview of the project was presented and included information about the project history, NEPA planning process, the site selection process, and potential alternatives at the sites. Time was allotted for the public

to ask formal questions in a group setting and an open house afterward provided an informal time for discussion between the planning team and members of the community. An information sheet, a resources of concern questionnaire, and comment cards were available to provide information and receive feedback from the public. Additionally, posters of each site were available to provide close-up views of each project site.

6.2.3 Upper Wahoo Creek Watershed Plan-EA Public Meeting

A public meeting was held on March 20, 2019 from 5:00pm – 7:00pm at the Union Bank and Trust in Wahoo, NE to provide an update on the progress of the Plan-EA and hear and discuss any concerns with the public. An overview of the project was presented and included information about the project history, NEPA planning process, the site selection process, and preliminary design of the preferred alternative at each site. Time was allotted for the public to ask questions and to have in-depth discussions with the planning team. An information sheet and comment cards were available to provide information and receive feedback from the public. Additionally, posters of the preferred alternative at each site were provided to provide close-up views of potential impacts from the Project.

6.3 Agency Meetings

The Sponsor held three separate agency meetings at the Union Bank and Trust in Wahoo, NE to provide opportunities for agency participation throughout the planning process. The agency meetings were held during business hours to accommodate the agencies prior to each public meeting detailed in Section 6.2. Letters were mailed to related agencies to invite them to attend. The agency mailing list is shown in Table 6-1 and an overview of each agency meeting is described below.

Table 6-1. Agency Mailing List

Agency / Tribe	Position	Name	Address
U.S. Fish and Wildlife Service	Fish & Wildlife Biologist / Assistant Field Supervisor	Eliza Hines	9325 South Alda Road Wood River, NE 68883
Nebraska Game and Parks Commission	Saunders County Conservation Officer	Mike Luben	2200 N. 33 rd Street P.O. Box 30370 Lincoln, NE 68503
Nebraska Game and Parks Commission	District #1 Commissioner	Dan Kreitman	1689 County Road E Wahoo, NE 68066
Nebraska Game and Parks Commission		Carey Grell	2200 N. 33 rd Street Lincoln, NE 68503
United States Army Corps of Engineers		Catherine Blackwell / Matt Wray	Nebraska Regulatory Office 8901 South 154 th Street Omaha, NE 68138
United States Army Corps of Engineers		Sarah Pedrick	Nebraska Regulatory Office 8901 South 154 th Street Omaha, NE 68138
U.S. Environmental Protection Agency Region 7	Region 7 NEPA Reviewer	Larry Shepard	National Environmental Policy Act 11201 Renner Blvd. Lenexa, KS 66219

Agency / Tribe	Position	Name	Address
Nebraska Department of Environmental Quality		Elbert Traylor	1200 N. Street The Atrium, Suite 400 Lincoln, NE 68509
Office of the Governor	Governor	Pete Rickets	P.O. Box 94848 Lincoln, NE 68509
City of Wahoo	Secretary	Loren Lindahl	605 North Broadway Wahoo, NE 68066
Saunders County Public Works	Highway Superintendent	Steve Mika	426 North Broadway Wahoo, NE 68066
Saunders County Planning and Zoning	Zoning Administrator	George Borreson	433 North Chestnut Wahoo, NE 68066
Saunders County	District #5 Supervisor	Larry Mach	2744 County Road N. Weston, NE 68070
Nebraska State Historical Society	Deputy State Historic Preservation Officer	Jill Dolberg	1500 R. Street Lincoln, NE 68508
Otoe-Missouria Tribe of Indians	Chairman	John R. Shotton	8151 Highway 177 Red Rock, OK 74651
Omaha Tribe of Nebraska	Chairman	Michael Wolfe / Isaac Sherman / Everett Baxter, Jr.	PO Box 368 Macy, NE 68039
Pawnee Nation of Oklahoma	President	W. Bruce Pratt / Jimmy Whiteshirt / Walter Echo Hawk	881 Little Dee Drive Pawnee, OK 74058

6.3.1 Sites 26a, 26b, and 27 Agency Scoping Meeting

An agency scoping meeting for Sites 26a, 26b, and 27 was held on December 7, 2017 from 2:00pm – 4:00pm at the Union Bank and Trust in Wahoo, NE. The Sponsor, NRCS, FYRA Engineering, and agency members from the USACE, NGPC, NDEQ, and Saunders County were in attendance. An overview and history of the Project, alternatives analysis information, and predicted schedules were presented. An informational sheet, resources of concern questionnaire, and comment cards were available to provide information and receive feedback about the Project.

6.3.2 Upper Wahoo Creek Watershed Plan-EA Agency Scoping Meeting

An agency scoping meeting for the Plan-EA was held on June 12, 2018 from 2:00pm – 4:00pm at the Union Bank and Trust in Wahoo, NE. A letter was sent to the agency members in Table 6-1; however, no agency members attended besides NRCS staff. The planned presentation, information sheet, and resources of concern questionnaire were emailed to all agency members on the distribution list to provide project information to those unable to attend. No comments were received.

6.3.3 Upper Wahoo Creek Watershed Plan-EA Agency Meeting

An agency meeting for the Plan-EA was held on March 20, 2019 from 2:00pm – 4:00pm at the Union Bank and Trust in Wahoo, NE. A letter was sent to the agency members in Table 6-1 with an attached location figure; however, no agency members attended besides NRCS staff. USACE staff notified the planning team that they would be unable to attend due to commitments related to the recent flooding in Nebraska. The planned presentation, information sheet, and project website address were provided via email. No comments were received.

6.4 Zoning Meetings

The Sponsor has met with Saunders County staff throughout the planning process to approve zoning requirements for areas within the breach paths at all Project sites. These meetings were held to establish zoning restrictions to ensure that no future homes or infrastructure will be constructed within the downstream breach paths that could invalidate the designed hazard class of the dams. Please see Table 6-2 for a timeline of meetings between the Sponsor and Saunders County regarding breach path protection.

Table 6-2. Saunders County Meeting Timeline

Date	Meeting
December 5, 2017	Saunders County Project Committee
December 19, 2017	Saunders County Supervisors' Meeting
January 11, 2018	Saunders County Zoning Office Staff
April 10, 2018	Saunders County Zoning Staff
May 22, 2018	Saunders County Supervisors
June 4, 2018	Saunders County Zoning Board
June 28, 2018	Saunders County Road Superintendent
July 17, 2018	Saunders County Supervisors
September 11, 2018	Saunders County Supervisors
March 12, 2019	Saunders County Supervisor, Frank Albrecht
April 10, 2019	Saunders County Zoning Staff
June 27, 2019	Saunders County Zoning Staff
July 1, 2019	Saunders County Zoning Board
July 9, 2019	Saunders County Supervisors
August 5, 2019	Saunders County Zoning Board
August 13, 2019	Saunders County Supervisors
September 3, 2019	Saunders County/Hearing on Dam Breach Overlay District, unanimously approved.

6.5 Threatened and Endangered Species and Bald and Golden Eagles

In compliance with the ESA, Section 7, Nebraska NRCS has a programmatic informal consultation process with the USFWS and NGPC to assist NRCS in making the proper effects determination. Table 6-3 provides a discussion for each species. Informal consultation with USFWS has indicated that all listed federal species have a no effect determination with the exception of the Northern long-eared bat, pallid sturgeon, Interior least tern, and piping plover - which have a determination of not likely to adversely affect. A concurrence letter from USFWS is included in Appendix E.

The affected resource areas are outside of the known range for all state listed and proposed species. Coordination with NGPC has indicated that there are no known bald eagle nests within 0.5-miles of the any of the affected resource areas and that no known northern long-eared bat hibernaculum or maternity roost trees documented near the affected resource areas.

Table 6-3. Threatened and Endangered Species

Common Name	Scientific Name	State/ Federal	Threatened or Endangered	Discussion & Determination
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Federal	T	4(d) Rule, no tree clearing from June 1-July 31 consistent with programmatic intra-Service consultation. Not likely to adversely affect.
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Federal	E	Net depletions in the Platte River for each structure are less than 25 acre-feet. Not likely to adversely affect.
Western Prairie Fringed Orchid	<i>Platanthera praecox</i>	Federal	T	Outside of known range. No effect.
Interior Least Tern	<i>Sternula antillarum athalassos</i>	Federal	T	Net depletions in the Platte River for each structure are less than 25 acre-feet. Not likely to adversely affect.
Piping Plover	<i>Charadrius melanotos</i>	Federal	E	Net depletions in the Platte River for each structure are less than 25 acre-feet. Not likely to adversely affect.
Lake Sturgeon	<i>Acipenser fulvescens</i>	State	T	Outside of known range. No effect.
Sturgeon Chub	<i>Macrhybopsis gelida</i>	State	E	Outside of known range. No effect.
Flathead Chub	<i>Platygobio gracilis</i>	State (Proposed)	T	Outside of known range. No effect.
Plains Minnow	<i>Hybognathus placitus</i>	State (Proposed)	T	Outside of known range. No effect.
Western Silvery Minnow	<i>Hybognathus argyritis</i>	State (Proposed)	E	Outside of known range. No effect.

7.0 THE PREFERRED ALTERNATIVE

7.1 Rationale for the Preferred Alternative

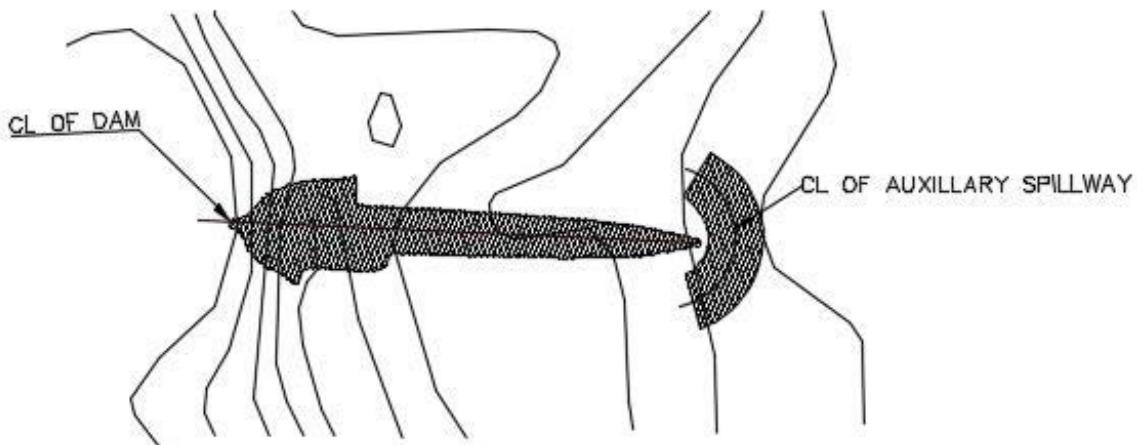
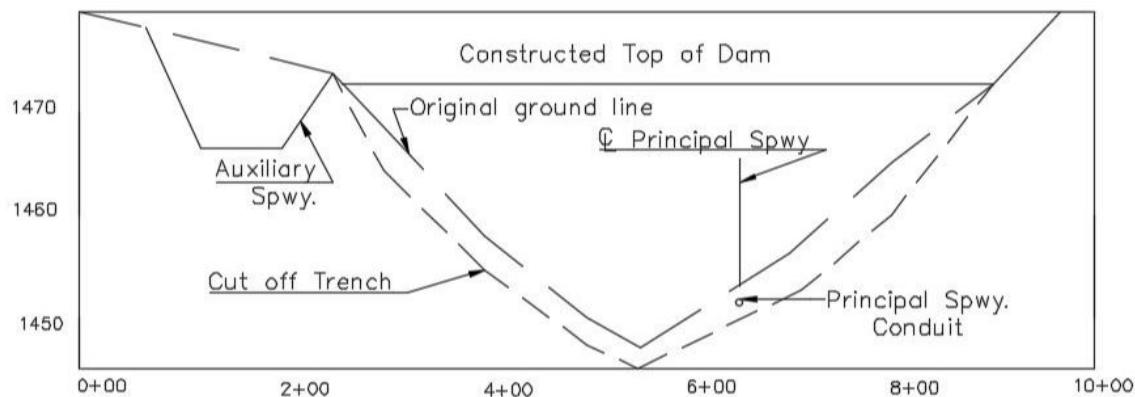
Three alternatives were analyzed in detail during project formulation and the Wet Dams alternative of 10 flood control structures provides the maximum net economic benefit and greatest environmental benefits while meeting the purpose and need of the Project. Therefore, the Wet Dams alternative is the NED alternative. Economic tables are provided at the end of this chapter and additional information on the alternatives analysis can be found in Chapter 4.0. Please see Appendix D for information about the investigation and analysis of the preferred alternative.

7.2 Measures to be Installed

Ten floodwater retarding dams will be installed to reduce flood damages (Figures 7.1-7.2, Figures C5.1-C5.9 in Appendix C). These earth embankment dams will include reinforced concrete pressure pipe principal spillways with vegetated auxiliary spillways to discharge runoff safely when floodwater capacity and principal spillway capacities are exceeded. In any given year the chance of operation of the emergency spillway at any site is four percent or less. The top two inches of topsoil will be stripped from the embankment and auxiliary spillway extents before construction. Rock riprap will be used on the face of the dam above and below the permanent pool elevation per the recommended in Part 5 of NRCS Technical Release 210-60, Earth Dams and Reservoirs (March 2019) (Figure C6, Appendix C). The main purpose of this riprap is to protect the embankment surface against erosion from reservoir wave action. The rock riprap was selected to provide a quality of protection consistent with the anticipated life of the dam and provide a structurally stable design.

The 10 dams were planned to NRCS TR-60 criteria with the associated auxiliary spillway hydrograph rainfall values of 6.93 to 9.07-inches and freeboard hydrograph rainfall values of 8.93 to 13.60-inches over a 24-hour duration. The 10 dams will provide detention storage to control 26-square miles (26 percent of the Upper Wahoo Creek watershed). The combined volume of floodwater retarding storage will be 5,070 acre-feet with a combined temporary surface area of 700 acres. All dams are planned for a 50-year accumulation of sediment, yielding a combined sediment storage volume for all dams of 2,075 acre-feet and the combined surface area of the sediment pools totaling approximately 330 acres. Table 3, provided at the end of this chapter, contains structural data for all proposed floodwater retarding dams. It is anticipated that all main borrow areas will be confined to sediment pools and emergency spillway excavations.

The floodwater pool of Site 77 will inundate County Road G, an east-west road on the south side of Section 30, Township 14 North, Range 7, by over 3-feet during a 2-year storm event. County Road P, a minimum maintenance road located on the north side of Section 15, Township 15 North, Range 5 East, will be inundated by the floodwater pool of Site 26b by almost 3-feet during a 2-year event. The Sponsor, in coordination with the local governing officials, met to resolve the problem and decided to recommend that both roads be closed in conjunction with construction of the two sites. No other roads will be impacted by floodwater pools during the 10-year or more frequent events.

Figure 7-1. General Plan View**Figure 7-2. Profile of Dam on Centerline**

Each dam in this Plan-EA was assigned a hazard class based on the criteria contained in the Classification of Dams by the NeDNR. There is one class (b), significant hazard potential dam (Site 77) due to potential impacts to downstream homes and roads and the remaining sites are all class (a), low hazard potential structures. The breach inundation map, Figure C7 in Appendix C, shows sudden dam breach flow and additional information on the breach analysis is included in Appendix D.

7.3 Mitigation

There will be minor adverse impacts to some wildlife habitat and other sensitive resources during installation of the Project. Impacts to wildlife habitats include woodlands, grasslands, streams, and wetlands expected to be permanently lost to construction within the embankment and auxiliary spillway extents as well as from inundation by the permanent pools. Field surveys were conducted to determine the quantities of wetlands and streams to be impacted by the implementation of the Plan. Aerial images, ArcMap toolsets, and field investigations were used to determine the areas of woodlands and grasslands expected to be lost.

Mitigation requirements were determined in conjunction with NRCS specialists and based on USACE Regulatory requirements of similar, recent projects within eastern Nebraska. Land needed for mitigation measures will be located at or near the structure sites and will be acquired by the Sponsor by use of easements for the life of the project. The designated mitigation areas will be fenced as need to manage or prevent livestock grazing.

7.3.1 Wetland Mitigation

Construction of the proposed action will result in minimal wetland impacts. Wetlands with the Cowardin classifications of palustrine emergent (PEM), palustrine forested (PFO), and palustrine scrub-shrub (PSS) will be impacted from implementation of the preferred alternative. Mitigation ratios established by the USACE in recent and similar projects will be used to account for the loss in resource type and function of impacted wetlands. Wetland mitigation will include the creation of PEM lacustrine fringe wetlands within and surrounding the project sites' permanent pools to mitigate for the loss of PEM wetlands. A 1:1 mitigation ratio will be used for in-kind (lacustrine fringe) impacts and a 4:1 mitigation ratio will be used for out-of-kind (riverine and depressional) impacts. It is predicted that wetland vegetation can be established and self-maintained at 2-feet vertically below and 2-feet vertically above the permanent pool elevation based on existing topography, hydrology, and proposed grading. Areas 2-feet above and below the proposed permanent pools will be graded to support wetland development and will be seeded with wetland vegetation. There will be a minimum of approximately 12.3-acres of lacustrine fringe wetlands created surrounding the permanent pools to mitigate for the loss of approximately 3.1-acres of PEM wetlands.

Forested wetlands will be created on-site to mitigate for impacts to PFO wetlands and scrub-shrub wetlands will be created to mitigate for impacts to PSS wetlands. A 4:1 mitigation ratio will be used to adequately account for the loss in resource type. The locations of mitigation sites will be determined during final design and will likely be located near the project sites. There will be a minimum of approximately 1.4-acres of forested wetland created to mitigate for approximately 0.35-acres of impacted PFO wetlands and approximately 0.1-acres of scrub-shrub wetland mitigation areas to mitigate for 0.02-acres of impacts to PSS wetlands. A 12-point Mitigation Plan will be developed in cooperation with the USACE prior to construction to account for all compensatory mitigation.

7.3.2 Stream Mitigation

Approximately 2,690-feet of fill impacts to intermittent streams and 350-feet of fill impacts to perennial streams will occur from dam embankment construction. Additional intermittent and perennial streams will be impacted due to inundation from the pond's permanent pools. Streams within the affected resource area are largely incised and have low functional value. A desktop and on-site stream assessment will occur at each Site prior to construction to analyze and record existing stream conditions according to the procedures outlined in the Nebraska Stream Condition Assessment Procedure (NeSCAP) developed by the USACE. This procedure uses a scoring system of six factors that can strongly influence streams and the adjacent riparian system. Each factor is given a score and these are used to calculate a final Stream Condition Index (SCI) for each reach of stream being analyzed. The SCI is multiplied by the stream length (or area) and the resulting weighted value is then used as the basis of comparison of stream functional units for each Site.

Mitigation requirements are determined by comparing the pre- and post-project stream functional units. Required mitigation would be calculated by the loss of functional units attributable to project implementation. For projects that convert streams to an impoundment (as is recommended in the preferred alternative), the USACE has required mitigation for functional units lost due to embankment limits at a minimum. Similar project types in Nebraska that also exhibit degraded stream characteristics often result in an increase in overall functional units and therefore only require mitigation for the stream length/units lost due to fill. Stream mitigation measures can include a variety of methods such as increased continuity and width of stream buffers, vegetation management, and improvements to hydraulic conveyance and sediment dynamics. A 12-point Mitigation Plan will be developed in cooperation with the USACE prior to construction to account for all compensatory mitigation.

7.3.3 Woodland Mitigation

There will be approximately 84-acres of permanently impacted woodlands from the embankments and permanent pools of each Site as determined by aerial images and field visits. General tree species were recorded during the wetland and stream field investigations; however, a thorough tree inventory will be completed for each Site to determine the quantity, type, and size of trees that will be impacted. Mitigating for the loss of trees due to removal or inundation will involve replacing trees at specified ratios. The ratios listed herein are those that have been required by the USACE in conjunction with CWA Section 404 permit issuance and agreed upon by NRCS specialists in projects of a similar nature, have occurred recently, and have been located relatively near the affected resource areas.

It is anticipated that desired trees will be replaced at a ratio of 3:1 for those having a diameter at breast height (DBH) greater than 12-inches and 2:1 for those less than 12-inches DBH. Undesirable trees will be replaced at a ratio of 1:1 for all DBH sizes and invasive trees will not be replaced because removal will improve the overall quality of the woodland community. Recommended native trees will be determined based on species that have shown resiliency and success in the area. A species composition of desired plants at 75 percent or more (by strata – herbaceous, shrub, tree, etc.) will be necessary for meeting the objectives of the developed Mitigation Plan. Potential woodland mitigation locations will be acquired by the Sponsor using easements. The locations for woodland mitigation will be determined based on the required woodland mitigation areas. Woodland mitigation locations near the project sites are preferred.

7.4 Permits and Compliance

The following permit and compliance requirements must be met for construction of the Project to occur. All permits will be acquired by the Sponsor with technical assistance from NRCS.

- **Clean Water Act Section 404.** CWA Section 404 permits must be obtained from the USACE to account for fills within jurisdictional waters of the United States prior to construction. The Sponsor will obtain a 404 permit for each dam site prior to construction.
- **Migratory Bird Treaty Act and Endangered Species Act Section 7.** To avoid migratory bird nesting and Northern long-eared bat roosting impacts, clearing activities will be conducted between August 1 and March 31. If tree clearing must occur between April 1 and May 31, a field survey will be conducted to ensure compliance with the Migratory Bird Treaty Act.

- **NDEQ.** A National Pollutant Discharge Elimination System (NPDES) construction storm water permit from the Nebraska Department of Environmental Quality (NDEQ) will be required at each site if more than 1-acre of land is disturbed for construction.
- **Dust Regulations.** Nebraska Title 129, Chapter 32 fugitive dust regulations shall apply to all excavation and construction activities.
- **Excavation.** All applicable regulations in Nebraska Title 128 and Title 132 must be followed. Any solid or hazardous wastes generated or discovered during project operations must be properly handled, contained, disposed, and (if necessary) characterized. No waste permit required.
- **National Historic Preservation Act.** Section 106 of the NHPA [54 U.S.C. § 306108] and its implementing regulations, "Protection of Historic Properties" [36 CFR part 800] requires Federal agencies to determine whether their undertakings will have an adverse impact on historic properties that are listed on or are eligible for listing on the National Register of Historic Places and to afford the Advisory Council on Historic Preservation a reasonable opportunity to provide comment. In compliance with Section 106 of the NHPA, the Nebraska SHPO and Indian Tribes with ancestral ties to the project area were contacted early in the planning process to identify the presence of properties of historic, religious, and cultural significance within the study area and to participate in agency scoping meetings. For a list of Tribes contacted see Table 6-1. The public was afforded an opportunity to provide input on cultural resources during the open houses held in Wahoo, Nebraska on December 7, 2017, June 12, 2018, and March 20, 2019. The APE for each alternative that was carried forward for detailed study was identified and reviewed for the presence of historic properties by professional archeologists who meet the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (36 CFR 61). The APE included top of dam extents as well as potential borrow, waste, access, and staging areas (see Figures C1.1-C1.9, Appendix C). Cultural resources investigations were completed in May 22-25, 2018 and from November 2018 - January 2019. Two historic properties were identified within the APE of two proposed structures. However, NRCS determined that construction of the dams would have no adverse effect on either resource. NRCS consulted on its determination of effect with the Nebraska SHPO, the Pawnee Nation of Oklahoma, the Otoe-Missouria Tribe of Oklahoma, and the Omaha Tribe of Nebraska in letters sent July 21, 2021, emails sent August 5, 2021, and phone calls on August 26, 2021 and September 10, 2021. Nebraska SHPO concurred that the proposed action would have no adverse effect on historic properties in a letter received August 9, 2021; the Pawnee Nation of Oklahoma concurred with the determination of effect in an email received September 2, 2021 (Appendix A). No other responses were received.
- **Storage Permit.** A water storage permit will be obtained from NeDNR prior to construction.
- **Dam Safety.** The final engineering plans will be reviewed and approved by the NeDNR Dam Safety Section prior to construction. Before approval of a dam, NeDNR will have to verify the dam has the proper hazard classification.
- **Water wells.** Coordination with NeDNR will occur prior to construction to locate any registered water wells.

- **Operation and Maintenance.** An O&M Plan will be prepared using the NRCS National Operation and Maintenance Manual.
- **Floodplain Management.** Prior to construction, the Sponsor will participate in and comply with applicable Federal, State, and Local floodplain management rules and regulations.
 - Any and all development in the regulatory floodplain or floodway will require a local Floodplain Development Permit (Neb. Rev. Stat. § 31-1021 & Title 455 Nebraska Administrative Code, Chapter 1). This includes all Special Flood Hazard Areas identified on FEMA's Flood Insurance Rate Maps, and any other area adopted by the local jurisdiction. Development is defined as "Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations or storage of equipment or materials."
 - Any development that causes more than a foot of rise in a regulatory floodplain without floodway or any rise in a regulatory floodplain with floodway is required to obtain a Conditional Letter of Map Revision (CLOMR) from FEMA. (44 CFR 65.12/60.3c10/60.3d3/60.3d4). The floodplain development permit application must contain engineering that shows the project meets these requirements.
 - Any development that causes a change to the regulatory floodplain or floodway boundary must submit a Letter of Map Revision (LOMR) within six months of project completion. (44 CFR 65.3)
- **Water Administration.** Any new reservoirs or new surface water diversions may be subject to frequent water administration during the summer months due to unmet target flows for the Nebraska Game & Parks instream flow appropriations to protect fish and wildlife. Water diversions may be restricted for local shortages or for protection of senior water rights. The NeDNR may monitor water levels in reservoirs and may require passing of inflows for livestock or other downstream use. The accumulative net depletions (February through July) for each structure is less than the bench mark of 25 acre-feet as shown in Appendix D.
- **National Environmental Policy Act.** This document was prepared to comply with the National Environmental Policy Act and the Principles and Guidelines for Water and Related Land Resources Implementation Studies.

7.5 Costs and Cost Sharing

This Project received funding through two NRCS P.L. 83-566 programs, the Regional Conservation Partnership Program (RCPP) and the Watershed and Flood Prevention Operations program (WFPO). RCPP has a program wide goal of a minimum of a 1:1 ratio of Sponsor to NRCS contributions. RCPP allocated funds include a portion of the construction of Sites 26a, 26b, and 27 (up to \$1.35 million) and \$150,000 in NRCS technical assistance, including \$37,500 for planning. Additional construction costs as well as engineering/design costs for these sites will be funded by the Sponsor. WFPO allocated funds include 100 percent funding for planning (\$575,000) and design (\$1,325,630) of the seven additional sites identified in the preferred alternative. It is anticipated that that 100 percent of construction costs for the seven sites

(excluding mitigation) will also be funded by the WFPO program. The availability of Federal funds is contingent upon appropriations available for this purpose.

A description of the costs and cost sharing for the preferred alternative are included below. Economic Tables 1, 2, 2A, and 4 are included at the end of this chapter and further cost and assumption details are included in Appendix D. Cost and cost sharing details are also presented in the Watershed Agreement between the Sponsor and NRCS.

7.5.1 Construction

Construction costs include all costs to build the proposed project, including mitigation. Major components include mobilization, clearing and grubbing, excavation, fill, reinforced concrete, reinforced concrete pressure pipe, seeding, and fencing. A detailed engineer's estimate is included in Appendix D for each dam site and economic Tables 1 and 2 provided at the end of this chapter summarize construction costs and cost share. NRCS P.L. 83-566 funds would pay 86 percent of the total construction costs (see Section 7.5 for explanation). The Sponsor is responsible for 100 percent of the mitigation costs, which are estimated at 5 percent of the construction cost.

7.5.2 Engineering

Engineering costs include final design of the preferred alternative, surveys, geotechnical investigations, construction observation, and permit acquisition. The Sponsor is responsible for 100 percent of the permit acquisition costs. Engineering costs are based on acquired P.L. 83-566 funding and contracts in-place between the Sponsor and a private engineering consultant. Construction observation costs are not included in the aforementioned contract for seven of the sites and are therefore estimated at 10 percent of the construction cost (not including mitigation). NRCS would provide 76 percent of funding for costs of engineering (see Section 7.5 for explanation). See economic Tables 1 and 2 at the end of this chapter and Appendix D for a summary of engineering costs and cost share.

7.5.3 Real Property Acquisition and Easements

The Sponsor is responsible for 100 percent of real property acquisition and easements. Easements will be required for approximately 974-acres for project implementation, up to the top of dam at each site. Payment to the landowner for easements are estimated at 100 percent of land value (\$7,500/acre) for areas under the embankment and permanent pool, within the limits of the auxiliary spillway, and a 50-foot conservation buffer around the permanent pool (536 acres). Payment for easements are estimated at 50 percent of land value (\$3,750/acre) for temporary storage of water between the conservation buffer and the top of dam (586 acres). Costs of legal fees and land appraisals are included and estimated at \$15,000/site. A breach analysis using NRCS methodology was conducted to determine the effects downstream of each dam site. Saunders County Planning Commission as well as the City of Wahoo and the Village of Weston have approved zoning language for areas within the breach paths at all sites in order to protect the planned hazard class of the dams. See economic Tables 1 and 2 at the end of this chapter and Appendix D for a summary of real property rights costs and cost share.

7.5.4 Operation and Maintenance

Costs of operation and maintenance of the measures is based on experience from similar structures and is included at 0.75 percent of the construction cost, not including mitigation. No replacement costs are

included because the expected life equals or exceeds the length of the evaluation period. The Sponsor is responsible for 100 percent of the operation and maintenance costs for the planned life of the structure. See economic Tables 1 and 2 at the end of this chapter and Appendix D for a summary of operations and maintenance costs and cost share.

7.5.5 Project Administration

Project administration is estimated based on local experience. Project administration includes project oversight and review, contract administration and supervision, and checking installation measures to ensure the proposed and installed works meet NRCS criteria. The Sponsor would be required to provide 100 percent of funding for its own administrative costs. See economic Tables 1 and 2 at the end of this chapter for a summary of operations and maintenance costs and cost share.

7.6 Installation and Financing

7.6.1 Framework for Carrying out the Plan

Final design for all 10 sites would occur in the first two years. Construction would occur over an 8-year period. Table 7-1 shows the distribution of estimated total project costs.

Table 7-1. Distribution of Total Project Costs, Installation of Preferred Alternative

Project Costs	P.L. 83-566 Funds	Other Funds	Total
Construction¹	\$ 9,167,400	\$ 1,491,600	\$ 10,659,000
	86%	14%	100%
Engineering^{2,3}	\$ 2,163,600	\$ 674,100	\$ 2,837,700
	76%	24%	100%
Real Property Rights⁴	\$ -	\$ 5,518,400	\$ 5,518,400
	0%	100%	100%
Project Administration	\$ 330,000	\$ 322,500	\$ 652,500
	51%	49%	100%
Total Project	\$ 11,661,000	\$ 8,006,600	\$ 19,667,600
	59%	41%	100%

¹Includes mitigation

²Includes construction observation

³Includes permit acquisition

⁴Includes cost of legal fees and land appraisals

7.6.2 Planned Sequence of Installation

Table 7-2 depicts the timeline for the preferred alternative. The Sponsor has taxing authority for project funding and the power of imminent domain if needed.

Table 7-2. Preferred Alternative Timeline

Action	Timeframe
Site 26a & 26b final design plans and specifications complete	2022
Sponsor obtains USACE Section 404 permit for Site 26a & 26b	2022
Secure easements for Site 26a & 26b	2022
Site 27 final design plans and specifications complete	2022
Sponsor obtains USACE Section 404 permit for Site 27	2022
Secure easements for Site 27	2022
Complete construction of Site 26a & 26b	2023
Site 55, 66, 77, 82, 84, 85, & 86 final design plans and specifications	2023
Complete construction at Site 27	2023
Sponsor obtains USACE Section 404 permit for Site 55	2023
Complete construction of Site 55	2024
Sponsor obtains USACE Section 404 permit for Site 66	2024
Complete construction of Site 66	2025
Sponsor obtains USACE Section 404 permit for Site 77	2025
Complete construction of Site 77	2026
Sponsor obtains USACE Section 404 permit for Site 82	2026
Complete construction of Site 82	2027
Sponsor obtains USACE Section 404 permit for Site 84	2027
Complete construction of Site 84	2028
Sponsor obtains USACE Section 404 permit for Site 85 & 86	2028
Complete construction of Site 85 & 86	2029

7.6.3 Responsibilities

The Sponsor is responsible for obtaining all permits and ensuring compliance as identified in Section 7.4, Permits and Compliance. In addition, the Sponsor is responsible for obtaining all land rights and easements required for project implementation. The Sponsor has analyzed their financial needs and is able to make funds available when needed. Federal funds are to be provided by NRCS for a portion of the construction of Sites 26a, 26b, and 27 through the Regional Conservation Partnership Program and final design and construction of the seven additional sites through the Watershed and Flood Prevention Operations program. Federal funds are to be provided for project administration, technical assistance, and construction observation as well. The availability of Federal funds is contingent upon appropriations available for this purpose. Prior to entering into agreements that obligate funds of NRCS, the Sponsor will have a financial management system for control, accountability, and disclosure of P.L. 83-566 funds received and for control and accountability for property and other assets purchased with P.L. 83-566 funds.

7.6.4 Contracting

Each dam will be constructed through project agreements between the NRCS and the Sponsor by means of Federal contract procedures and resultant contracts.

7.6.5 Real Property and Relocations

Easements on approximately 974-acres will be acquired by the Sponsor for project implementation. No relocations are anticipated. The breach inundation area is protected from development through previously agreed-upon zoning restrictions (see Section 7.5.3).

7.6.6 Financing

The Sponsor has the power and authority to levy taxes, issue revenue bonds for the purpose of financing authorized construction facilities, and exercise the power of eminent domain. Costs for easements, permits, and mitigation are the responsibility of the Sponsor.

7.6.7 Conditions for Providing Assistance

The estimated cost of installing the project is \$19,667,600. The NRCS, under authority of the Watershed Protection and Flood Prevention Act, Public Law 566, as amended, will provide \$11,661,000. The Sponsor, using other authorities and private funds, will provide approximately \$8,006,600. Federal financial assistance for construction is contingent upon appropriations for this purpose.

7.7 Operation and Maintenance

Operation and maintenance (O&M) includes responsibilities for operating, inspecting, and maintaining the 10 floodwater retarding structures and includes practices involved with mitigation such as tree and shrub planting, weed control, and replanting. The Sponsor is responsible for financing and implementing all O&M activities and is liable throughout the lifetime of the structure.

Operation includes the administration, management, and performance of non-maintenance actions needed to keep the structure safe and functioning as planned. Maintenance includes performance of work, preventing deterioration, and repairing damage. Damages caused by normal deterioration, drought, flooding caused by rainfall in excess of design rainfall, or vandalism are all considered maintenance.

A separate O&M agreement will be developed in conjunction with structure design. The agreement will include details for inspections, reports, and procedures for performing maintenance items. The structures will be inspected annually by a qualified engineer and formal inspections will be conducted at least once every five years. Special inspections will be conducted immediately following severe storms, earthquakes, initial filling of the reservoir, vandalism, and other significant events. The Sponsor will maintain records in a permanent file at the LPNNRD office and copies of all inspection reports shall be provided to NRCS.

The estimated average annual operation and maintenance costs are \$60,800 (Table 4).

7.8 Emergency Action Plan

An Emergency Action Plan (EAP) is a formal document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize loss of life and property damage (FEMA, 2013). An EAP commensurate with the potential impact of a dam failure or operational incident will be developed by the Sponsor prior to construction of each dam site. The Sponsor will update the EAP annually with input from local emergency response officials, as needed. NRCS will provide technical assistance throughout the development and update of each EAP.



TABLE 1

Estimated Installation Costs

Upper Wahoo Creek Watershed, NE

(Dollars) 1/

Works of Improvement	Unit	Non-Federal land 2/	Estimated cost (dollars) 1/		
			Public Law 83-566 Funds	Other Funds	Total
Floodwater Retarding Structures	No.	10	11,661,000	8,006,600	19,667,600

1/ Price base: 2020

Prepared: 07/2021

2/ Only nonfederal land is involved in this project

TABLE 2

Estimated Cost Distribution

Structural Measures

Upper Wahoo Creek Watershed, NE

(Dollars) 1/

Works of Improvement	Structure No.	Installation Cost-Public Law 83-566					Installation Cost - Other funds					Total
		Construction	Engineering 2/	Real Property Rights	Project Admin	Total Public Law 566	Construction 3/	Engineering 2/4/	Real Property Rights 5/	Project Admin	Total other	
10 Floodwater Retarding Structures	26a	407,000	17,000	--	17,000	441,000	322,500	176,000	188,700	14,700	701,900	1,142,900
	26b	477,100	19,900	--	19,800	516,800	378,100	206,300	379,500	17,300	981,200	1,498,000
	27	465,900	19,400	--	19,400	504,700	369,200	201,500	451,500	16,800	1,039,000	1,543,700
	55	840,600	273,400	--	29,600	1,143,600	42,900	12,900	397,500	29,500	482,800	1,626,400
	66	869,500	276,300	--	30,400	1,176,200	43,500	12,900	577,500	30,400	664,300	1,840,500
	77	2,553,000	444,700	--	89,400	3,087,100	127,700	12,900	2,021,300	89,400	2,251,300	5,338,400
	82	1,089,400	298,300	--	38,100	1,425,800	58,600	12,900	306,000	38,100	415,600	1,841,400
	84	1,001,500	289,500	--	35,100	1,326,100	73,300	12,900	731,300	35,100	852,600	2,178,700
	85	837,500	273,100	--	29,300	1,139,900	44,500	12,900	228,800	29,300	315,500	1,455,400
	86	625,900	252,000	--	21,900	899,800	31,300	12,900	236,300	21,900	302,400	1,202,200
Total		9,167,400	2,163,600	0	330,000	11,661,000	1,491,600	674,100	5,518,400	322,500	8,006,600	19,667,600

1/ Price base: 2020

Prepared: 07/2021

2/ Includes construction observation

3/ Includes mitigation

4/ Includes permit acquisition

5/ Includes cost of legal fees and land appraisals



TABLE 3

Structural Data

Upper Wahoo Creek Watershed, NE

Item	Unit	26a	26b	27	55	66	77
Class of structure		Low	Low	Low	Low	Low	Significant
Seismic zone		2	2	2	2	2	2
Uncontrolled drainage area	mi ²	0.79	1.75	2.12	2.25	1.87	10.22
Controlled drainage area	mi ²	0	0	0	0	0	0
Total drainage area	mi ²	0.79	1.75	2.12	2.25	1.87	10.22
Runoff curve No. (1-day) (AMC II)		81	80	80	82	77	81
Time of concentration (Tc)	hrs	0.7	1.6	2.0	1	1.5	7.0
Elevation top of dam	ft	1380	1387	1345	1374.5	1252.5	1259.5
Elevation crest auxiliary spillway	ft	1376	1383	1341.5	1371.5	1249.5	1253.5
Elevation crest high stage inlet	ft	1374.5	1380.5	1339.5	1369.5	1245	1244
Elevation crest low stage inlet	ft	1367	1373	1333	1360	1239.5	—
Auxiliary spillway type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Auxiliary spillway bottom width	ft	50	50	150	125	100	250
Auxiliary spillway exit slope	percent	4	4	4	4	4	4
Maximum height of dam	ft	38.0	41.0	34.0	40.5	34.5	35.5
Volume of fill	yd ³	50,800	68,000	62,800	75,800	88,000	190,000
Total capacity 1/	acre-ft	207	496	542	573	653	2,480
Sediment submerged	acre-ft	61	135	154	157	154	573
Sediment aerated	acre-ft	11	24	27	28	25	101
Floodwater retarding	acre-ft	135	337	361	388	474	1806
Between high and low stage	acre-ft	107	228	256	101	209	—
Surface area							
Sediment pool	acres	10	21	29	20	27	129
Floodwater retarding pool 1/	acres	20	47	56	54	71	258
Principal spillway design							
Rainfall volume (1-day)	in	5.20	5.20	5.20	5.36	5.30	5.90
Rainfall volume (10-day)	in	8.60	8.60	8.60	8.49	8.53	9.20
Runoff volume (10-day) (1-day)	in	4.50	4.38	4.38	4.65	3.85	5.01
Capacity of low stage (max.)	ft ³ /s	14.5	24.8	35.7	22.4	78.5	—
Capacity of high stage (max.)	ft ³ /s	62.6	71.3	75.6	84.22	93	787.2
Dimensions of conduit	in	24	24	24	24	24	72
Type of conduit		RCPP	RCPP	RCPP	RCPP	RCPP	RCPP
Frequency operation-auxiliary spillway	% chance	4	4	4	4	4	2
Auxiliary spillway hydrograph							
Rainfall volume	in	7.07	7.07	7.07	7.09	6.93	8.93
Runoff volume	in	4.81	4.80	4.67	5	4.34	6.65
Storm duration	hrs	24	24	24	24	24	24
Velocity of flow (Ve)	ft/s	5.1	4.2	4.0	6.8	0	6.7
Max. reservoir water surface elev.	ft	1377.9	1384.5	1343.2	1372.99	1245.06	1256.9
Freeboard hydrograph							
Rainfall volume	in	9.05	9.05	9.05	9.07	8.93	13.60
Runoff volume	in	6.68	6.64	6.52	6.88	6.22	11.13
Storm duration	hrs	24	24	24	24	24	24
Max. reservoir water surface elev.	ft	1379.2	1386.5	1344.7	1374.2	1248.1	1259.0
Capacity equivalents							
Sediment volume	in	1.7	1.7	1.6	1.5	1.8	1.2
Floodwater retarding volume	in	3.2	3.6	3.2	3.2	4.8	3.3

1/ Crest of auxiliary spillway



TABLE 3 - continued

Structural Data

Upper Wahoo Creek Watershed, NE

Item	Unit	82	84	85	86	
Class of structure		Low	Low	Low	Low	
Seismic zone		2	2	2	2	
Uncontrolled drainage area	mi ²	1.95	3.62	0.75	0.71	
Controlled drainage area	mi ²	0	0	0	0	
Total drainage area	mi ²	1.95	3.62	0.75	0.71	
Runoff curve No. (1-day) (AMC II)		80	83	77	77	
Time of concentration (Tc)	hrs	1.5	1.02	0.9	0.6	
Elevation top of dam	ft	1339	1362	1345.5	1354	
Elevation crest auxiliary spillway	ft	1336	1357.5	1342.5	1351	
Elevation crest high stage inlet	ft	1329.5	1355	1340	1348	
Elevation crest low stage inlet	ft	—	1347	1335	1343	
Auxiliary spillway type		Veg.	Veg.	Veg.	Veg.	
Auxiliary spillway bottom width	ft	200	200	100	100	
Auxiliary spillway exit slope	percent	4	4	4	4	
Maximum height of dam	ft	33.0	42.5	19.5	26.5	
Volume of fill	yd ³	44,700	101,900	86,000	60,000	
Total capacity 1/	acre-ft	386	1374	220	218	
Sediment submerged	acre-ft	71	277	68	50	
Sediment aerated	acre-ft	91	49	10	10	
Floodwater retarding	acre-ft	224	1048	142	158	
Between high and low stage	acre-ft	—	466	85	87	
Surface area						
Sediment pool	acres	26	42	14	13	
Floodwater retarding pool 1/	acres	43	99	25	26	
Principal spillway design						
Rainfall volume (1-day)	in	5.20	5.78	5.30	5.30	
Rainfall volume (10-day)	in	8.60	8.99	8.53	8.53	
Runoff volume (10-day) (1-day)	in	4.37	5.20	3.85	3.85	
Capacity of low stage (max.)	ft ³ /s	—	39.34	71.4	29.7	
Capacity of high stage (max.)	ft ³ /s	404.2	99.14	84.3	76.8	
Dimensions of conduit	in	54	24	24	24	
Type of conduit		RCPP	RCPP	RCPP	RCPP	
Frequency operation-auxiliary spillway	% chance	4	3	4	4	
Auxiliary spillway hydrograph						
Rainfall volume	in	7.07	9.07	6.93	6.93	
Runoff volume	in	4.86	7	4.42	4.40	
Storm duration	hrs	24	24	24	24	
Velocity of flow (Ve)	ft/s	4.2	9.3	4.5	1.6	
Max. reservoir water surface elev.	ft	1337.7	1360.2	1344.05	1351.88	
Freeboard hydrograph						
Rainfall volume	in	9.05	11.38	8.93	8.93	
Runoff volume	in	6.73	9.24	6.23	6.23	
Storm duration	hrs	24	24	24	24	
Max. reservoir water surface elev.	ft	1338.8	1361.4	1344.6	1352.7	
Capacity equivalents						
Sediment volume	in	1.6	1.7	1.9	1.6	
Floodwater retarding volume	in	2.2	5.4	3.5	4.2	

1/ Crest of auxiliary spillway



TABLE 4

Estimated Average Annual NED Costs

Upper Wahoo Creek Watershed, NE

(Dollars) 1/

Works of Improvement	Amortization of Installation Cost	Operation and Maintenance Cost	Total
10 Floodwater Retarding Structures	\$ 564,800	\$ 60,800	\$ 625,600

Prepared: 07/2021

1/ Price base: 2020, amortized over 58 years at a discount rate of 2.50 percent



Table 5

Estimated Average Annual Flood Damage Reduction Benefits

Upper Wahoo Creek Watershed, NE

(Dollars) 1/

Item	Estimated average annual damage 2/		
	Without Project	With Project	Damage reduction benefit
Floodwater			
Crop and Pasture	1,205,000	964,400	240,600
Other Agriculture	120,500	96,400	24,100
Road and Bridge	2,264,500	1,859,200	405,300
Urban	293,000	212,600	80,400
Subtotal	3,883,000	3,132,600	750,400
Sediment and Erosion			
Overbank Deposition & Scour	108,500	86,800	21,700
Subtotal	108,500	86,800	21,700
Total	3,991,500	3,219,400	772,100

Prepared: 07/2021

1/ Price base: 2020, amortized over 58 years at a discount rate of 2.50 percent

2/ All agriculture and rural-related



TABLE 6
Comparison of NED Benefits and Costs

Upper Wahoo Creek Watershed, NE

(Dollars) 1/

Works of Improvement	Average Annual Benefits	Average Annual Cost 2/	Benefit : Cost Ratio
10 Floodwater Retarding Structures	772,100	625,600	1.23

1/ Price base: 2020

Prepared: 07/2021

2/ From Table 4

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9.0 LIST OF PREPARERS

The document was prepared by those listed in Table 9-1 with review and guidance throughout the development of this document from those listed in Table 9-2.

Table 9-1. List of Preparers

Name	Present Title	Experience	Years of Experience	Other
Mike Sotak	Civil Engineer	BS Civil Engineering, 1992 MS Business Administration, 2001	31	PE registration (NE, IA, KS, MO, AZ, SD)
Janel Kaufman	Environmental Engineer	BS Civil Engineering, 2005 MS Civil & Environmental Engineering, 2006	14	PE registration (SC)
Bob Gregalunas	Water Resources Engineer	BS Civil Engineering, 2005	16	PE registration (NE)
Anna Petrow	Environmental Engineer	BS Biological Systems Engineering, 2017	5	EI registration
Connor Kelley	Civil Engineer	BS Civil Engineering, 2017	5	EI registration
Timothy Haakenstad	Civil Engineer	BS Civil Engineering, 1983	33	PE registration (NE)
Robert Lutz	Civil Engineer	BS Civil Engineering, 2004	16	PE registration (NE, KS)
John Petersen	Water Resources Engineer	BS Civil Engineering, 2006	16	PE registration (NE, MO, IA)

Table 9-2. List of Reviewers

Name	Title	Organization
Arlis Plummer	Hydraulic Engineer	USDA NRCS Contract Employee
Elisha Mackling	Cultural Resources Specialist	USDA NRCS
Ted Huscher	Geologist	USDA NRCS
Richard Vaughn	Environmental Specialist - Nebraska	USDA NRCS
Ritch Nelson	State Wildlife Biologist, Forester	USDA NRCS
Allen Gehring	State Conservation Engineer	USDA NRCS
Melissa Baier	Archaeologist	USDA NRCS

10.0 DISTRIBUTION LIST

The Draft Supplemental Plan-EA will be submitted to the NWMC for review. After comments from the NWMC are addressed, the Draft Plan-EA will be distributed to the list of agencies listed in Table 10-1. A public notice will also be issued stating that the Draft EA is available for public comment and a 30-day comment period will be provided. Agency comments will be evaluated, and a letter will be sent to each agency in response. All documentation will be available in Appendix A.

Table 10-1. Distribution List

Agency	Position	Name	Address
City of Wahoo	Mayor	Gerald Johnson	605 North Broadway Wahoo, NE 68066
Federal Emergency Management Agency Region VII	Director, Flood Insurance and Mitigation Division	Michael Scott	9221 Ward Parkway Kansas City, MO 64114
Federal Emergency Management Agency Region VII	Regional Administrator	Paul Taylor	9221 Ward Parkway Kansas City, MO 64114
Nebraska Department of Environmental Quality	Agency Administrator Director	Jim Macy	1200 N. Street, Suite 400 Lincoln, NE 68509
Nebraska Department of Natural Resources	Director	Jeff Fassett, P.E.	301 Centennial Mall South P.O. Box 94676 Lincoln, NE 68509-4676
Nebraska Game and Parks Commission		Carey Grell	2200 N. 33 rd Street Lincoln, NE 68503
Nebraska Game and Parks Commission	District #1 Commissioner	Dan Kreitman	1689 County Road E Wahoo, NE 68066
Nebraska Game and Parks Commission	Saunders County Conservation Officer	Mike Luben	2200 N. 33 rd Street P.O. Box 30370 Lincoln, NE 68503
Nebraska State Historical Society	Deputy State Historic Preservation Officer	Jill Dolberg	1500 R. Street Lincoln, NE 68508
Office of the Governor	Governor	Pete Rickets	P.O. Box 94848 Lincoln, NE 68509
Omaha Tribe of Nebraska	Chairman	Everett Baxter Jr.	PO Box 368 Macy, NE 68039
Otoe-Missouria Tribe of Indians	Chairman	John R. Shotton	8151 Highway 177 Red Rock, OK 74651
Pawnee Nation of Oklahoma	President	Walter Echo-Hawk	881 Little Dee Drive Pawnee, OK 74058
Saunders County Public Works	Highway Superintendent	Steve Mika	426 N. Broadway Wahoo, NE 68066
	Zoning Administrator	George Borreson	433 N. Chestnut



Agency	Position	Name	Address
Saunders County Planning and Zoning			Wahoo, NE 68066
Saunders County	District #5 Supervisor	Larry Mach	2744 County Road N Weston, NE 68070
U.S. Environmental Protection Agency Region 7	Region 7 NEPA Reviewer	Larry Shepard	11201 Renner Blvd. Lenexa, KS 66219
U.S. Fish and Wildlife Service	Biologist/Assistant Field Supervisor	Eliza Hines	9325 South Alda Road Wood River, NE 68883
United States Army Corps of Engineers	Environmental Resources Specialist	Matt Wray	8901 South 154 th Street Omaha, NE 68138
Village of Weston		Ivy Bloom	340 N Elm Street Weston, NE 68070

11.0 INDEX

Topic	Page Numbers
Archeological Resources	28,46,62-64,67,70,79
Installation Costs	i,iv,3,4,34-43,69,80-86,89,91
Nebraska Game and Parks Commission and U.S. Fish and Wildlife Service	22,25,57-61,72-74
U.S. Army Corps of Engineers	4,8,11,12,33,53,60,61,67,70,72,73,77,78,83

11.1 List of Acronyms

APE	Area of Potential Effect
ARA	Affected Resource Area
BGEPA	Bald and Golden Eagle Protection Act
CWA	Clean Water Act
DBH	Diameter at Breast Height
EA	Environmental Assessment
EAP	Emergency Action Plan
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
LPNNRD	Lower Platte North Natural Resources District
MBTA	Migratory Bird Treaty Act
NDEQ	Nebraska Department of Environmental Quality
NED	National Economic Development
NEPA	National Environmental Policy Act
NeSCAP	Nebraska Stream Condition Assessment Procedure
NeSHPO	Nebraska State Historical Preservation Office
NGPC	Nebraska Game and Parks Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
NWMC	National Water Management Center
OHWM	Ordinary High Water Mark
PEMA	Palustrine emergent temporarily flooded wetland
PEMC/A	Palustrine emergent seasonally flooded wetland
PFOA	Palustrine forested temporarily flooded wetland
PFOC	Palustrine forested seasonally flooded wetland
PSSA	Palustrine scrub-shrub temporarily flooded wetland
PSSC	Palustrine scrub-shrub seasonally flooded wetland
RCPP	Reinforced concrete pressure pipe
RCPP	Regional Conservation Partnership Program
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture

Appendix D: Investigation and Analysis

USFWS United States Fish and Wildlife Service
WFPO Watershed and Flood Prevention Operations

APPENDIX A – COMMENTS AND RESPONSES

Pawnee Nation

Monday, December 06, 2021

Melissa Baier
Archaeologist
USDA Natural Resources Conservation Service

RE: Section 106 Consultation and Review on:
*Upper Wahoo Creek Watershed Plan Environmental Assessment
Saunders County, Nebraska*

The Pawnee Nation Office of Historic Preservation has received the information and materials requested for our Section 106 Review and Consultation. Consultation with the Pawnee nation is required by Section 106 of the National Historic Preservation Act of 1966 (NHPA), and 36 CFR Part 800.

Given the information provided, you are hereby notified that the following proposed project/s should not affect the cultural landscape of the Pawnee Nation.

However, be advised that additional undiscovered properties could be encountered, and they must be immediately reported to us under both the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act regulations.

This information is provided to assist you in complying with 36 CFR Part 800 for Section 106 Consultation procedures. Should you have questions, please do not hesitate to contact me at jreed@pawneenation.org or by phone at 918-762-2180 ext 220. Thank you for your time and consideration.

Sincerely,
Matt Reed
Historic Preservation Officer
Pawnee Nation of Oklahoma

Historic Preservation Office
Matt Reed
Phone: 918.762.2180
E-mail: jreed@pawneenation.org
P.O. Box 470
Pawnee, Oklahoma 74058

From: [Tapp, Jessica](#)
To: [Gehring, Allen - NRCS, Lincoln, NE](#); [Vaughn, Richard - NRCS, Lincoln, NE](#)
Cc: [Marinovich, Melissa](#); [Huenemann, Thad](#); [Barada, Tony](#); [Roberg, Brett](#); [Koch, Michelle](#); [Nebraskaes, FW6](#); [Nelson, Ritch - NRCS, Lincoln, NE](#); [Janel Kaufman](#)
Subject: Upper Wahoo Creek Draft Watershed Plan-EA
Date: Wednesday, January 5, 2022 3:50:41 PM

Hi Allen and Richard,

We have reviewed the draft plan-EA mentioned above and have the following comments:

1. Section 5.15 on page 62 indicates that “Landowners at each site will benefit from having access to the permanent pools for fishing and other passive recreation.” NGPC takes into consideration factors such as the potential quality, design, and location of a project when determining the potential for fisheries development in any reservoir. For example, when a reservoir is too small for a watershed it will be subject to water quality issues, harmful algae blooms, and will not support a desired, sustainable fishery. Additional factors that impact water quality includes the land practices within the watershed and soil characteristics (soil erodibility and potential for sediment suspension in the water).

We suggest the project consider the following if recreational fishing access is intended as a benefit of the proposed reservoirs:

- Reservoirs should be designed so the watershed to reservoir surface area ratio is low.
- At least 25% of the reservoir must be at least 15 feet deep.
- Control of sedimentation and nutrients via Agricultural Best Management Practices in the sub-watersheds.
- Smaller sediment retention basins upstream to slow the reservoir aging process. These latter two items would come at additional costs, but are necessary for a successful and sustainable fishery.

2. Regarding Section 5.18 “Indirect Effects” - Has the project considered how the implementation of alternatives (i.e. dams) might impact groundwater? Increase in groundwater levels may impact adjacent land use.

Please let us know if there are any questions.

Thanks,

Jessica L. Tapp

Environmental Specialist III
Planning & Programming Division
Nebraska Game & Parks Commission
2200 N. 33rd Street | Lincoln, NE 68503
Office: (402) 471-5554
Email: jessica.tapp@nebraska.gov
Certified Wildlife Biologist®

Please use our new email for all T&E review requests – ngpc.envreview@nebraska.gov



Natural Resources Conservation Service
Nebraska State Office
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866
(402) 437-5300

<http://www.ne.nrcs.usda.gov>

February 25, 2022

Jessica L. Tapp
Nebraska Game & Parks Commission Planning & Program Division
2200 N. 33rd Street
Lincoln, NE 68503
**Sent via electronic mail only: jessica.tapp@nebraska.gov

**RE: Draft Watershed Plan-EA for the Upper Wahoo Creek Watershed,
in Saunders County, Nebraska**

Dear Ms. Tapp and NGPC Staff:

Thank you for taking the time to provide comments on the Draft Watershed Plan-EA for the Upper Wahoo Creek Watershed. We appreciate your valuable insight and thoughtful review. This letter contains responses to your comments provided via electronic mail on January 5, 2022 and is organized by numbered paragraphs that correlate with your comments.

1. Additional language regarding water quality and sustainable fisheries was added to Section 5.15. Watershed to reservoir surface area was considered during this planning effort and Section 5.11 discusses the range in watershed ratios and limitations. Additional steps will be taken during final design to optimize water quality and fisheries when feasible. Sedimentation and nutrients will be minimized upstream of the sites with best management practices. The Sponsor will obtain agreements from owners to carry out farm conservation plans for not less than 50 percent of the land upstream of each structure, reducing erosion within the watershed. Conservation practices will include contour farming, cover crops, and others.
2. Consideration has been given to impacts to groundwater and experience in dam design and implementation in Nebraska has shown that changes in groundwater levels would unlikely affect adjacent land users.

When a reservoir is constructed, a “water mound” is formed beneath where the shape is a function of the depth of the reservoir and the soil properties around it. In an area largely made up of silty clays, the distance from the reservoir formed by the water mound is reduced due to the soil particle size and the associated hydraulic conductivity of the soil. Changes in groundwater levels caused by the proposed reservoirs would likely be concentrated on the upstream side of the reservoir and would be contained within the top of dam easements. Immediately after construction of the reservoir, “wet toes” are commonly seen on earthen dams as localized groundwater surfaces are modified; however, these often dissipate over time. Any remaining wet toes would likely be contained within the downstream easements that are obtained for the auxiliary spillway return flow.



Therefore, it is unlikely that any change in groundwater levels that would affect adjacent land uses. If any did occur, they could be mitigated with the construction of a french drain or improved surface drainage.

Your time spent and assistance provided in the development of this Watershed Plan-EA is appreciated.

Sincerely,

ALLEN GEHRING, PE
State Conservation Engineer



Good Life. Great Water.

DEPT. OF NATURAL RESOURCES

December 22, 2021

Richard Vaughn, Nebraska Watershed Planning Coordinator
Natural Resources Conservation Service
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508
richard.vaughn@usda.gov



Pete Ricketts, Governor

Sent via electronic mail only

RE: Draft Watershed Plan-EA for the Upper Wahoo Creek Watershed, in Saunders County, Nebraska

Dear Mr. Vaughn:

This letter contains comments from the Nebraska Department of Natural Resources (NeDNR) regarding the draft Watershed Plan-Environmental Assessment (Plan-EA) referenced above, in response to the request for comments dated December 7, 2021. The project proposes the installation of 10 single-purpose floodwater retarding dams with permanent pools throughout the watershed, including both low and significant-hazard dams.

NeDNR's comments pertain to the following program areas. For inquiries or other follow-up related to each program area, please contact the person listed below.

Water Planning

Ryan Kelly
(402) 471-1080
ryan.kelly@nebraska.gov

Permits and Registrations

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FAX 402-471-2900

dnr.nebraska.gov

Floodplain Management	Katie Ringland, PE, CFM (402) 471-2094 katie.ringland@nebraska.gov
Water Administration	Jeremy Gehle (402) 471-3933 jeremy.gehle@nebraska.gov

General

- General comment as it relates to land acquisition: it is essential any review of water projects evaluate appropriate alternatives that minimize impact to stakeholders including producers, residents, businesses, and political subdivisions that may not receive direct benefit from those projects. Projects must include the input of the stakeholders and strive for transactions that are willing seller and willing buyer based.

Water Planning

- Please be aware of both the *Lower Platte River Basin Coalition Basin Water Management Plan* (Basin-Wide Plan) and the *Lower Plate North Natural Resources District Voluntary Integrated Management Plan* (Voluntary IMP). Both documents are available on the NeDNR website. These documents detail how surface water and groundwater are budgeted for within the Lower Platte River Basin and within the Lower Platte North Natural Resources District.
- The Voluntary IMP's surface water control states that "The Department [of Natural Resources] will limit new surface water uses to 50% of the annually available stream depletions over the Basin Plan's first five-year increment which concludes on December 31, 2021" and that "Depletions that are not utilized by the District or the Department will be redistributed annually and shared equally between the District and the Department." This is the requirement as laid out in the Voluntary IMP. Ensure that this project remains in compliance with this requirement as it is expected that a similar requirement will be included in the second increment of the Basin-Wide Plan when it is adopted.
- Ensure that all data required by the Basin-Wide Plan and Voluntary IMP to be reported are collected and passed to the NRD for their annual report, or to the Nebraska Department of Natural Resources.

Permits and Registrations

- New on-channel reservoirs that will store 15 acre-feet or more will require applications for storage appropriations to be approved before construction begins. Any off-channel storage reservoir will also need an approved storage appropriation regardless of storage capacity.
- Care should be taken to locate any registered water wells that may be within proposed construction zones. Public water supply wells are not displayed on our public data

retrieval or interactive map resources. Please coordinate with NeDNR when planning the construction.

Dam Safety

- The construction of new dams or the alteration of existing dams will require NeDNR approval if the dam is 25 feet or more in height or has a maximum storage capacity of 50 acre-feet or more.
- Before approval of a dam, NeDNR will have to verify the dam has the proper hazard classification.

Floodplain Management

- Any and all development in the regulatory floodplain or floodway will require a local Floodplain Development Permit (*Neb. Rev. Stat. § 31-1021 & Title 455 Nebraska Administrative Code, Chapter 1*). This includes all Special Flood Hazard Areas identified on FEMA's Flood Insurance Rate Maps, and any other area adopted by the local jurisdiction. Development is defined as "Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations or storage of equipment or materials." Please clarify this on page 11, and within the Floodplain Management section that starts on page 17.
- Any development that causes more than a foot of rise in a regulatory floodplain without floodway or *any* rise in a regulatory floodplain with floodway is required to obtain a Conditional Letter of Map Revision (CLOMR) from FEMA. (44 CFR 65.12/60.3c10/60.3d3/60.3d4). The floodplain development permit application must contain engineering that shows the project meets these requirements.
 - Floodplains with floodways are located in and near the Village of Prague, City of Wahoo and City of Ashland for this study area.
- Any development that causes a change to the regulatory floodplain or floodway boundary must submit a Letter of Map Revision (LOMR) within six months of project completion. (44 CFR 65.3)
- Alternative 2 & 3: Comments
 - These options will require a CLOMR and follow up LOMR for each of the 10 sites.
 - It is Nebraska's standard that the flood pool behind all dams that require NeDNR approval be mapped as regulatory floodplain. For all other dams the flood pool is mapped at the top of dam.
 - Dams only show flood protection downstream in if the dam is able to contain 70% of the Probable Maximum Precipitation (PMP) and in a detailed study area (Zone AE or Zone AE with floodway).

- Timely submission of LOMR applications to FEMA will help ensure that development does not occur in the easement areas behind the dams.
- 5.20 & 7.4 Compliance with Federal, State and Local Laws
 - NFIP Requirements: Floodplain Development Permits will need to be obtained from the local jurisdictions. FEMA does not issue these permits. These projects will have to meet Federal, State, and Local Floodplain Management rules and regulations.
- Regulatory floodplains and floodways can be looked at on NeDNR's Floodplain Management Interactive Map <http://ne.gov/go/floodriskmap> or at the Federal Emergency Management Agency's (FEMA's) Flood Map Service Center <https://msc.fema.gov/portal/home> .
- Contact information for local Floodplain Administrators can be found here: <https://nednr.nebraska.gov/Dynamic/Floodplain/Floodplain/CommunityStatusListSearchIndex>

Water Administration

- Any new reservoirs or new surface water diversions in the project area may be subject to frequent water administration during the summer months due to unmet target flows for the Nebraska Game & Parks instream flow appropriations to protect fish and wildlife. Water diversions may be restricted for local shortages or for protection of senior water rights. The Department may monitor water levels in reservoirs and may require passing of inflows for livestock or other downstream use.

Conclusion

Thank you for the opportunity to comment. This concludes NeDNR's comments at this time.

Sincerely,



Thomas E. Riley, PE



Natural Resources Conservation Service
 Nebraska State Office
 Federal Building, Room 152
 100 Centennial Mall North
 Lincoln, NE 68508-3866
 (402) 437-5300

<http://www.ne.nrcs.usda.gov>

February 25, 2022

Thomas E. Riley, PE, Director
 Department of Natural Resources
 301 Centennial Mall South
 PO Box 94676
 Lincoln, NE 68509

**Sent via electronic mail only: tom.riley@nebraska.gov

**RE: Draft Watershed Plan-EA for the Upper Wahoo Creek Watershed,
 in Saunders County, Nebraska**

Dear Mr. Riley and NeDNR Staff:

Thank you for taking the time to provide comments on the Draft Watershed Plan-EA for the Upper Wahoo Creek Watershed. We appreciate your valuable insight and thoughtful review. This letter contains responses to your comments provided in a letter dated December 22, 2021, sent via electronic mail, and is organized by program area to correlate with your comments.

General

- We agree that alternatives that minimize impacts to stakeholders must be evaluated and that projects must include the input of stakeholders. Many alternatives, including non-structural options, were considered during the development of this Watershed Plan-EA (please see Chapter 4 for details on these alternatives). Three public and agency meetings were held during the planning phase of this project and comments and concerns from landowners and other stakeholders were considered during the preliminary design included in Appendix C and discussed throughout the document. Additional meetings will also be held by the Sponsor (Lower Platte North NRD, LPNNRD) during the final design phase of this project to ensure input from landowners and other stakeholders are considered.

Water Planning

- The LPNNRD is the local sponsor of the Watershed Plan-EA and is therefore aware of the BWP and IMP. We understand there is a concern for the potential for new consumptive uses with the development of reservoirs. If the identified potential projects result in new consumptive uses, those will be tracked/monitored but the estimated net depletions are less than 25 acre-ft/year for each potential site. Estimates can be found within the document and appendices. The potential dams could be used for conjunctive management activities as they can store excess stream flows and facilitate groundwater recharge, which helps meet goals and objectives of the BWP and IMP. Any permits issued or data collected would be included in the annual IMP/BWP reporting by the NRD as required by those plans.

Permits and Registrations, Dam Safety

- Additional verbiage has been added to Sections 5.20 and 7.4 of the document to outline these criteria more explicitly.



Floodplain Management

- Clarification regarding local Floodplain Development Permits has been included in Table 2-1 Section 3.5. Clarification about CLOMRs, LOMRs, and Federal, State, and local floodplain management rules has been added to Section 3.5, 5.20, and 7.4.

Water Administration

- Clarification was added to Sections 5.20 and 7.4.

Your time spent and assistance provided in the development of this Watershed Plan-EA is appreciated.

Sincerely,

ALLEN GEHRING, PE
State Conservation Engineer



Preserving the past. Building the future.

8/9/2021

S. Corey Brubaker
USDA-NRCS
VIA EMAIL

RE: HP# 2107-118-01; Continued NHPA Section 106 Consultation, Revised Upper Wahoo Creek Watershed Plan-EA, Saunders County, Nebraska

Mr. Brubaker,

Thank you for submitting the proposal for the above referenced project for Nebraska State Historic Preservation Office (NeSHPO) review and comment. Our comment on this project and its potential to affect historic properties is required by Section 106 of the National Historic Preservation Act of 1966, as amended, and implementing regulations 36 CFR Part 800.

Based on the information provided, the proposed undertaking is unlikely to affect any cultural resources listed on the National Register of Historic Places or eligible for such a listing. Therefore, the NeSHPO concurs with the determination that **no adverse effect** is appropriate for this undertaking and the project should proceed as planned. Should any changes in this project be made, please notify this office of the changes before further project planning continues.

Please retain this correspondence and your documented finding in order to show compliance with Section 106 of the National Historic Preservation Act, as amended. If you have any questions, please contact me at john.swigart@nebraska.gov or 402-560-0574.

Sincerely,

A handwritten signature in black ink, appearing to read "John Swigart".

John Swigart
Preservation Archeologist



Natural Resources Conservation Service
Nebraska State Office
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866
(402) 437-5300

United States Department of Agriculture

HP# 2107-118-01

received
07/23/2021

<http://www.ne.nrcc.usda.gov>

SENT VIA USPS ELECTRONIC SIGNATURE CONFIRMATION

July 21, 2021

Jill Dolberg
Deputy State Historic Preservation Officer
History Nebraska
1500 R St.
Lincoln, NE 68508-1651

Subject: Continued NHPA Section 106 Consultation, Upper Wahoo Creek Watershed Plan-EA, Saunders County, Nebraska

Ms. Dolberg:

In compliance with Section 106 of the National Historic Preservation Act (NHPA), as amended, and its implementing regulation 36 CFR Part 800, NRCS is consulting with you regarding the subject undertaking. NRCS has previously contacted you regarding this undertaking in letters dated May 25, 2018; October 24, 2019; February 11, 2020; and February 25, 2021.

As noted in the February 11, 2020 letter, a possible adverse effect was identified during the Section 106 consultation process for the Upper Wahoo Creek Watershed Plan-EA in Saunders County. One of the proposed dams is located within the boundaries of archeological site 25SD5, which was recorded in 1936 as a Central Plains Tradition – Nebraska phase village. The site had never been tested or been formally evaluated for the National Register of Historic Places. The geographical location of the site was tentatively confirmed during site visits conducted in 2019 and 2020. During the December 2019 site visit, a circular depression similar to those reported on the 1936 site form was identified within the probable site boundaries. During a second site visit conducted in November 2020, two flakes were observed in a cultivated field near the depression. In February 2021, NRCS proposed limited archeological testing at the site to determine whether the depression was man-made or natural.

Limited archeological testing at 25SD5 took place March 30-31, 2021. The results of the excavations are provided in the enclosed report and summarized briefly below. One test excavation unit was placed within the depression and eight shovel tests were excavated across the landform. Pottery, charcoal, daub, chipped stone debris, and wood were recovered from the test excavation unit. Chipped stone debris and pottery were recovered from three of the shovel tests. Based on the materials recovered from the test excavation unit and the soil profile observed in the wall of the test unit, the depression at site 25SD5 was confirmed to be the remains of an earthlodge. Radiocarbon dating of a charcoal sample from near the bottom of the test unit dates the occupation of the earthlodge to 660 ± 30 BP.



Site 25SD5 is recommended eligible for inclusion in the National Register of Historic Places under Criterion D. The site retains intact, buried cultural deposits in the form of an earthlodge depression and could provide important information regarding life in Nebraska in the 13th – 14th centuries. In accordance with 36 CFR 800.5(a), NRCS has determined that construction of Structure 83 would have an adverse effect on site 25SD5.

During the investigations at site 25SD5, the NRCS archeologists were informed of a location within the APE of Structure 83 where a landowner believed a burial may have been present. The landowner stated that he had removed a pile of stones that measured approximately 6-feet long from one of his fields in the 1960s. NRCS archeologists visited this location with the landowner and observed one flake on the ground surface. This location has been recorded as site 25SD223. Please see the enclosed report for additional information regarding this site.

NRCS presented the results of the excavations to the Lower Platte North Natural Resources District Projects Committee and Board of Directors at meetings held April 29th and May 10th, 2021 and explained what an adverse effect determination would mean for this undertaking. As a result of this presentation, the Board of Directors voted to remove Structure 83 from the Upper Wahoo Creek Watershed Plan-EA on June 14, 2021. The Upper Wahoo Creek Watershed Plan-EA will be revised to exclude Structure 83. A draft of the Plan-EA is anticipated to be available for public and agency review in late 2021 or early 2022.

Since the Area of Potential Effect (APE) no longer includes Structure 83, NRCS is revising its determination of effect to reflect the current APE. Ten flood retention structures are included in the current Plan-EA: Structures 26a, 26b, 27, 55, 66, 77, 82, 84, 85, and 86. The legal descriptions of the APE are provided in Table 1 (enclosed). The APE totals 1,972.5 acres and includes all direct and indirect effects including, but not limited to, ground disturbance, staging areas, access routes, borrow areas, and visual effects. Maps depicting the APE are enclosed.

Structures 26a, 26b, 27, 55, 66, and 77 were surveyed for cultural resources in May-June 1992 during the original planning efforts for flood control in the Wahoo Creek watershed. Structures 26a, 26b, and 27 were surveyed for cultural resources again in May 2018 after funding was received to design and build those structures. Structures 55, 66, 77, 82, 84, 85, and 86 were surveyed for cultural resources in November 2018-January 2019 after funding was received to develop a plan to address flooding issues in the watershed. These three surveys identified a total of 20 cultural resources sites within the APE of the ten structures included in the current watershed Plan-EA. These resources are described further in Table 2 (enclosed) and in the cultural resource inventory reports that were submitted to your office in 2018 and 2019.

NRCS previously consulted with your office on our recommendations of eligibility for all 20 cultural resource sites within the APE (Table 2). Your office concurred with our recommendations of eligibility in letters received in 2019 (H.P. #1901-110-01 and H.P. #1910-154-01). Only sites 25SD216 and 25SD219 are considered to be potentially eligible for inclusion in the National Register of Historic Places. Both resources (25SD216 and 25SD219) are late 19th century farmsteads with multiple buildings.

Site 25SD216 is located within the APE of Structure 66. One of the outbuildings (a barn) is located within the top of dam flood pool of the structure. In the event of a rainfall event sufficient to fill the reservoir above the auxiliary spillway to the top of the dam (>9.0 inches of

rain in a 24-hour period), the lower levels of the barn would be filled with approximately 1.2 to 2.2 feet of water. There is <1% chance of this type of rain event in any given year (100 year flood). Water would drain from the structure within less than a week. Infrequent, temporary inundation is unlikely to significantly damage the barn or require it to be demolished. The barn is still in use by the landowner, and this area will be avoided during construction.

Site 25SD219 is located within the APE of Structure 84. A collapsed barn is within the auxiliary spillway flood pool of the structures, and a house and chicken coop (both standing structures) are within the top of dam flood pool. The area will be avoided during construction, and Structure 84 will not have any direct effects on this site. Temporary, infrequent inundation during periods of heavy rainfall is unlikely to alter any subsurface cultural deposits that may remain at the site. The standing structures are also unlikely to be adversely affected by infrequent, temporary inundation.

In accordance with 36 CFR 800.5(b), NRCS has determined that construction of Structures 26a, 26b, 27, 55, 66, 77, 82, 84, 85, and 86 under the Upper Wahoo Creek Watershed Plan-EA will have no adverse effect on historic properties. Although there are historic properties within the APE of Structures 66 and 84, dam construction and operation will not alter any of the characteristics that make sites 25SD216 and 25SD219 potentially eligible for the NRHP. No ground disturbance will occur near the historic properties, and the properties will not be inundated by the permanent reservoir pools. No historic properties have been identified within the APE of structures 26a, 26b, 27, 55, 77, 82, 85, or 86. Structure 83 is no longer included in this undertaking, so there will be no effects to sites 25SD5 or 25SD223.

NRCS is requesting your comments on this undertaking. If you have questions or need additional information, please contact Melissa Baier at 402.437.4065 or by e-mail at melissa.baier@usda.gov.

Sincerely,

STUART
BRUBAKER

Digitally signed by
STUART BRUBAKER
Date: 2021.07.21
10:57:11 -05'00'

S. COREY BRUBAKER
Acting State Resource Conservationist

BRITT WEISER
Acting State Conservationist

Enclosures:

- A. Report: Limited Archeological Testing at 25SD5, Saunders County, Nebraska
- B. Site forms: 25SD5 and 25SD223
- C. Table 1
- D. Table 2
- E. Maps

Cc: Allen Gehring, State Conservation Engineer, Nebraska State Office
Rich Vaughn, Watershed Program Coordinator, Nebraska State Office
Melissa Baier, Archaeologist, Nebraska State Office



Preserving the past. Building the future.

Melissa Baier
Archeologist
USDA--NRCS
100 Centennial Mall North
Lincoln, NE 68508-386

December 13, 2019

RE: HP# 1910-154-01; Survey# 19-0209; Cultural Resources Survey of Eight Flood Control Structures in the Wahoo Creek Watershed, Saunders County, Nebraska.

Dear Ms. Baier:

Thank you for submitting the cultural resource survey report for the above referenced project for Nebraska State Historic Preservation Office (NeSHPO) review and comment under Section 106 of the National Historic Preservation Act of 1966, as amended in 2014 (Title 54 U.S.C. § 306108 [formerly 16 U.S.C. § 470f]), and its implementing regulations at 36 CFR§800.

This report, submitted by Buried Past Consulting, LLC on behalf of the Lower Platte North Natural Resources District, documents the results of an intensive cultural resources survey of eight proposed flood control structures in the upper Wahoo Creek watershed of southwest Saunders County, Nebraska.

The report thoroughly documents that a total of 26 historic properties were identified during either previous archeological surveys ($n=19$) of the proposed area of potential effect or during the survey currently under review ($n=7$). This report describes the evaluation and reevaluation of all 26 identified resources. Based on the consultant's recommendation, which is concurred with by the Natural Resources Conservation Service (NRCS), 22 archeological sites are considered not eligible for listing on the National Register of Historic Places (NRHP) and four are considered potentially or immediately eligible for listing on the NRHP (25SD89; 25SD216; 25SD219; 25SD124).

Based on the information provided and language included in the draft Operations and Maintenance Plan for "Floodwater Retarding Structure 83", the Nebraska State Historic Preservation Office concurs with the determination that the undertaking will have "**No Adverse Effect**" on identified historic properties listed on or eligible for listing on the National Register of Historic Places.

However, if methodological procedures to avoid the known archeological sites/historic properties present in or adjacent to the undertaking's APE change or become modified, please consult immediately with the NeSHPO. In addition, if currently buried or otherwise obscured cultural or human remains are discovered during the undertaking or the project area expands in any way, please contact the NeSHPO.

Be advised that this opinion does not necessarily reflect that of any Native American Tribes that might have an interest in the area, nor does it pertain to Traditional Cultural Properties, if they exist in the area.

If required, please submit this letter to the project's lead federal agency to fulfill the statutory obligation of Section 106 consultation with the Nebraska State Historic Preservation Office. Should you have any questions regarding this determination, please contact this office by phone at 402-471-2609 or by email at John.Rissetto@Nebraska.Gov.

Sincerely,

A handwritten signature in black ink, appearing to read "John Rissetto".

John Rissetto, Ph.D., Preservation Archeologist

From: [Joseph Reed](#)
To: [Baier, Melissa - NRCS, Lincoln, NE](#)
Subject: FW: re: Pawnee nation and Wahoo Creek Watershed project
Date: Wednesday, December 11, 2019 9:31:26 AM

From: Joseph Reed
Sent: Tuesday, December 10, 2019 5:03 PM
To: Baier, Melissa <mbaier@usbr.gov>
Subject: re: Pawnee nation and Wahoo Creek Watershed project

Melissa,

I had responded to an email concerning this project earlier this month, but had not heard anything back. We have a very long connection to this area, so much so that we have a name for Wahoo Creek. As well there are several Sacred Sites within the vicinity. In short, please keep us informed on this project and how we could help in identifying cultural resources.

Nawa iri,

Matt Reed

Matt Reed
Historic Preservation Officer
Pawnee Nation
PO Box 470
657 Harrison Street
Pawnee, Oklahoma 74058
(918) 762-2180 ext 220
(918) 762-3662 fax
jreed@pawneenation.org

From: [Joseph Reed](#)
To: [Baier, Melissa - NRCS, Lincoln, NE](#)
Subject: FW: Pawnee Nation and Wahoo Creek Watershed Plan and EIS
Date: Wednesday, December 11, 2019 10:40:51 AM

Nawa,

Below is the reply I emailed on 11-16. I'm currently looking for the original letter of November 10. The main reason I emailed you was that I started wondering if I had sent my reply to the wrong person. My filing hasn't been done since June, so as soon as I come across the letter and if I have any further questions I will let you know.

Nawa iri,

Matt Reed

From: Joseph Reed
Sent: Thursday, November 16, 2017 11:59 AM
To: lpnnrd@lpnnrd.org
Subject: re: Pawnee Nation and Wahoo Creek Watershed Plan and EIS

Mr. Tom Mountford,

I received your letter of November 10 which reference the Wahoo Creek project and the plans to update the 1998 Environmental Assessment. I will not be able to attend your upcoming December 7 meeting, but I hope that you will keep our Tribal Historic Preservation Office up to date with copies of any pertinent information regarding this project.

Thank you,

Matt Reed
Tribal Historic Preservation Officer
Cultural Resource Division
Pawnee Nation of Oklahoma
PO Box 470
657 Harrison Street
Pawnee, OK 74058
918-762-2180 office
918-762-3662 fax

Baier, Melissa - NRCS, Lincoln, NE

From: Joseph Reed <jreed@pawneenation.org>
Sent: Thursday, September 2, 2021 11:53 AM
To: Baier, Melissa - NRCS, Lincoln, NE
Subject: RE: Upper Wahoo Creek Watershed Plan-EA

None at all. I'm very happy to hear that they've changed the plan and will be moving the dam. If you need something more than this, I'll be out the rest of the day with GPR but I can send you something tomorrow.

Nawa iri,
Matt

From: Baier, Melissa - NRCS, Lincoln, NE <Melissa.Baier@usda.gov>
Sent: Thursday, September 2, 2021 10:12 AM
To: Joseph Reed <jreed@pawneenation.org>
Subject: RE: Upper Wahoo Creek Watershed Plan-EA

Good morning Matt,

I'm in the process of drafting the cultural resources section of the Wahoo Creek Watershed Plan-EA, and I just wanted to follow up with you on the project once more. Will you be submitting a formal response to our determination of effect? I just want to make sure that there are no objections to the current determination of effect before we send the draft plan to our water management center for review.

Thank you, and have a wonderful day,

Missy

From: Joseph Reed <jreed@pawneenation.org>
Sent: Monday, August 9, 2021 9:19 AM
To: Baier, Melissa - NRCS, Lincoln, NE <Melissa.Baier@usda.gov>
Subject: RE: Upper Wahoo Creek Watershed Plan-EA

Nawa,
I got the report and have read through it. We've had no internet access or email and sometimes no phones all of last week. I'm just now reading emails and working from home. I was super excited to see that we saved the site. I have the intent of making sure that I've added all the updated site information to our database.

Nawa iri,
Matt

From: Baier, Melissa - NRCS, Lincoln, NE <Melissa.Baier@usda.gov>
Sent: Thursday, August 5, 2021 11:14 AM
To: Joseph Reed <jreed@pawneenation.org>
Subject: Upper Wahoo Creek Watershed Plan-EA

Good morning Matt,

I hope all is going well for you these days.

I'm sure you're crazy busy, but I just wanted to check in and make sure that you had seen the consultation packet that I sent regarding the Upper Wahoo Creek Watershed Plan-EA and excavation report on 25SD5. It was only just delivered on July 26th, so you likely haven't had time to read it yet. I'm just paranoid, and wanted to make sure that all of the attachments made it to you. I've also attached all of the documents that were in the envelope just in case. Let me know if you have any questions or want to talk about the project further.

Thanks!

Missy

Missy (Melissa) Baier

Archeologist

USDA--NRCS

100 Centennial Mall North

Lincoln, NE 68508-3866

402-437-4065 (office)

402-317-1005 (cell)

Melissa.Baier@usda.gov

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Preserving the past. Building the future.

Elisha Mackling
Cultural Resources Specialist
Natural Resources Conservation Service (NRCS)
Nebraska State Office
100 Centennial Mall North, Room 152
Lincoln, Nebraska 68508-3866

January 16, 2019

RE: Wahoo Creek Watershed Structures 26 and 27: Saunders County, Nebraska - HP# 1901-110-01

Dear Ms. Mackling:

Thank you for submitting the cultural resource survey report for the above referenced project for Nebraska State Historic Preservation Office (NeSHPO) review and comment under Section 106 of the National Historic Preservation Act of 1966, as amended in 2014 (Title 54 U.S.C. § 306108 [formerly 16 U.S.C. § 470f]), and its implementing regulations at 36 CFR§800.

The report thoroughly documents that no prehistoric or historic properties were identified in any of the areas of potential effect. Based on the information provided, the proposed undertakings are unlikely to impact any cultural resources listed on the National Register of Historic Places or eligible for such a listing. Thus, the Nebraska State Historic Preservation Office concurs with the determination that "**No Historic Properties Affected**" is appropriate for these undertakings and the projects should proceed as planned.

However, there is the possibility that currently buried or otherwise obscured cultural or human remains may be discovered during these undertakings. If any such discovery is made or if the project area becomes expanded in any way, please contact this office immediately for further instruction.

Be advised that this opinion does not necessarily reflect that of any Native American Tribes that might have an interest in the area, nor does it pertain to Traditional Cultural Properties, if they exist in the area.

If required, please submit this letter to the project's lead federal agency to fulfill the statutory obligation of Section 106 consultation with the Nebraska State Historic Preservation Office. Should you have any questions regarding this determination, please contact this office by phone at 402-471-2609 or by email at John.Rissetto@Nebraska.Gov.

Sincerely,

A handwritten signature in black ink, appearing to read "John Rissetto".

John Rissetto, Ph.D.
Preservation Archeologist

APPENDIX B – PROJECT MAP

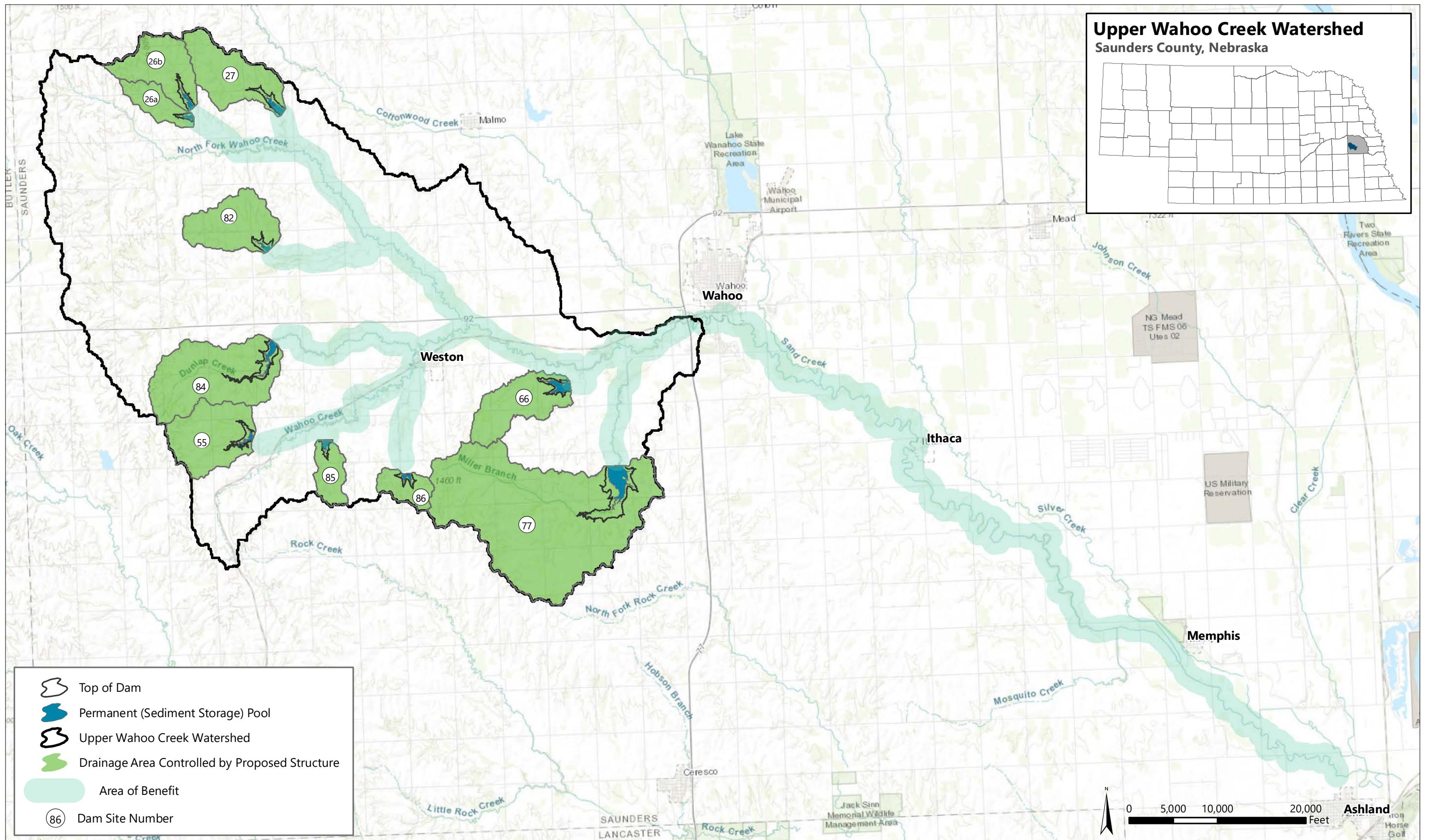


Figure B-1. Project Map

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



FYRA
ENGINEERING



EA
EA Engineering, Science,
and Technology, Inc.

APPENDIX C – SUPPORT MAPS

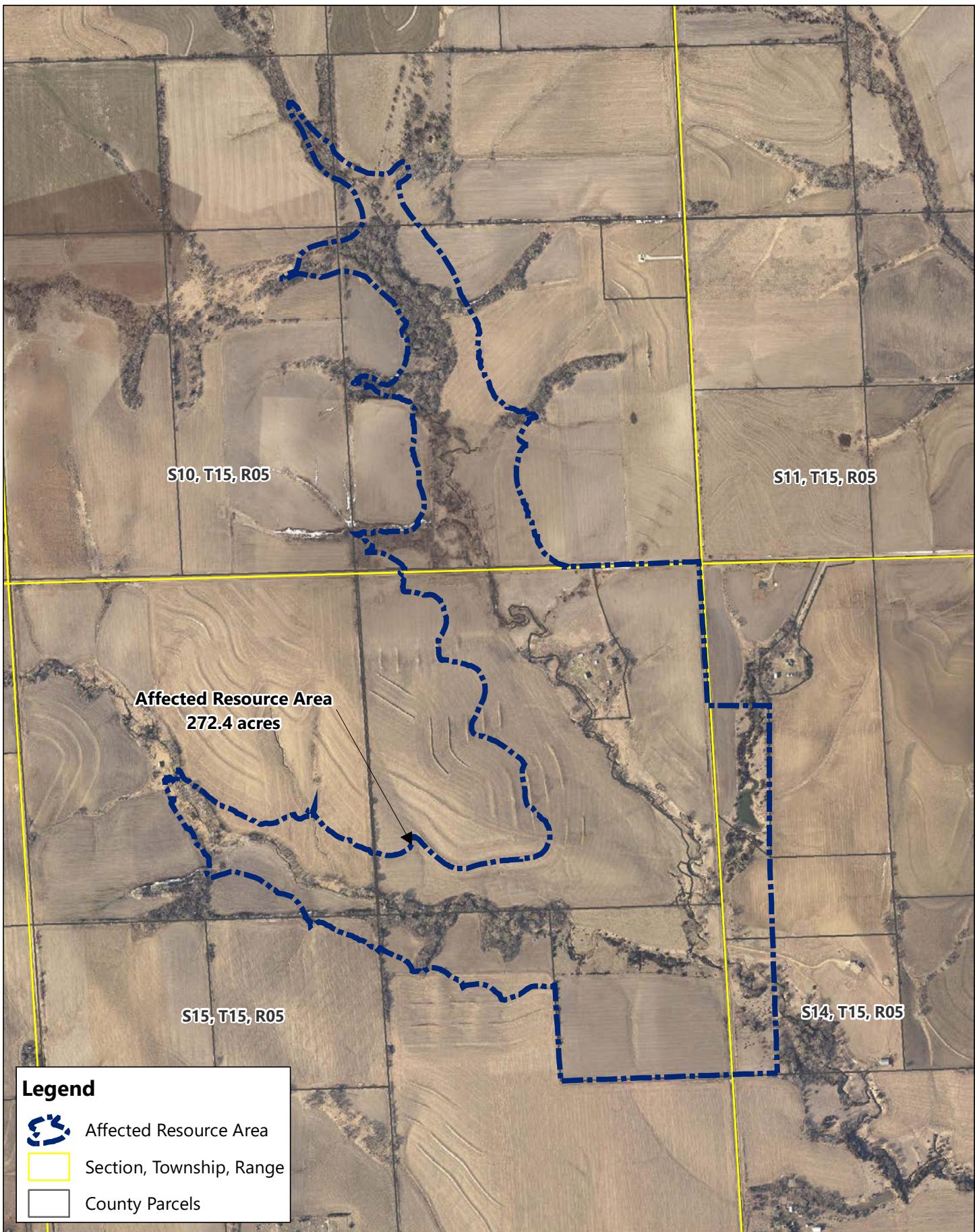


Figure C1.1. Site 26 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



FYRA
ENGINEERING

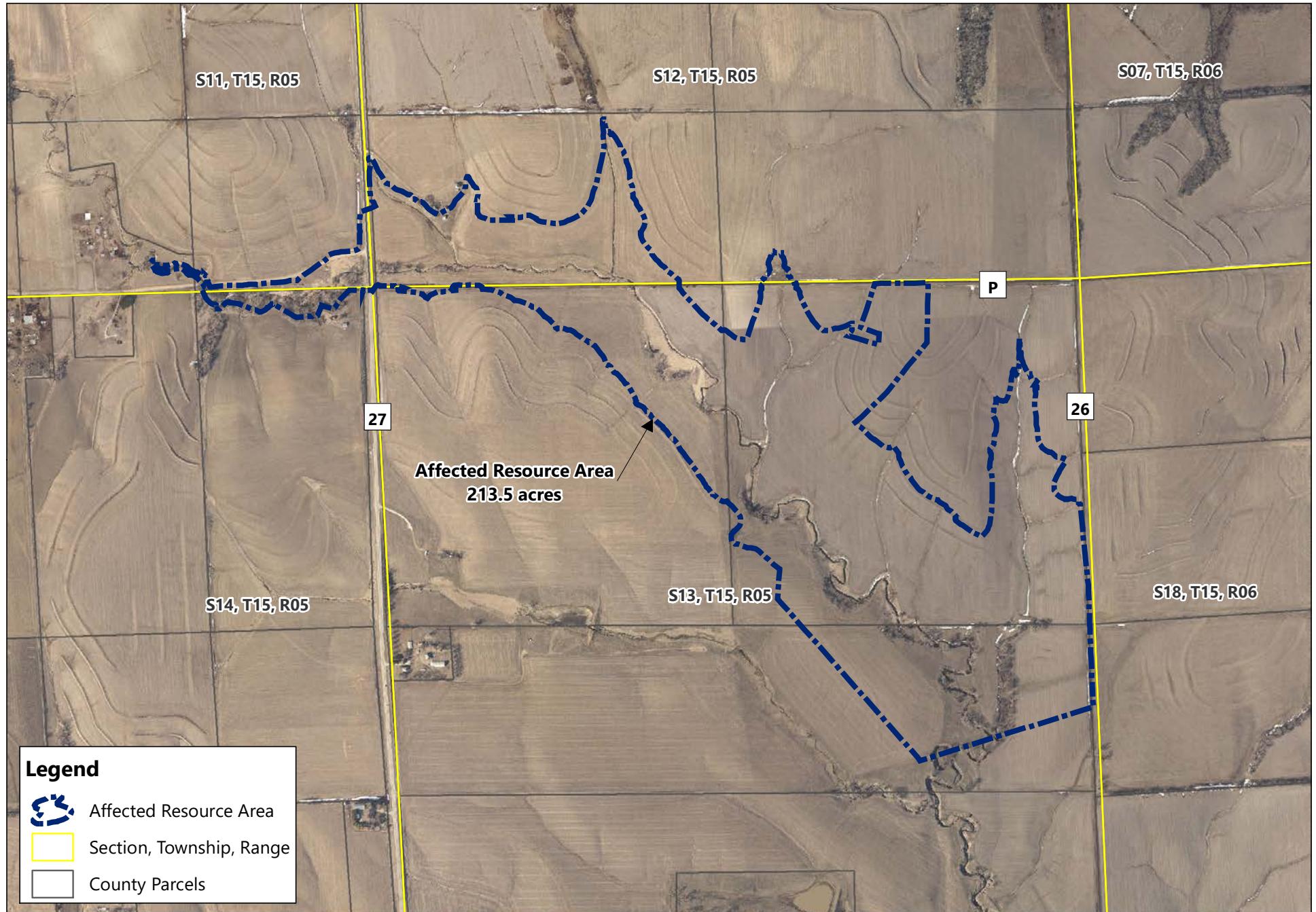


Figure C1.2. Site 27 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 500 1,000 2,000 Feet



FYRA
ENGINEERING

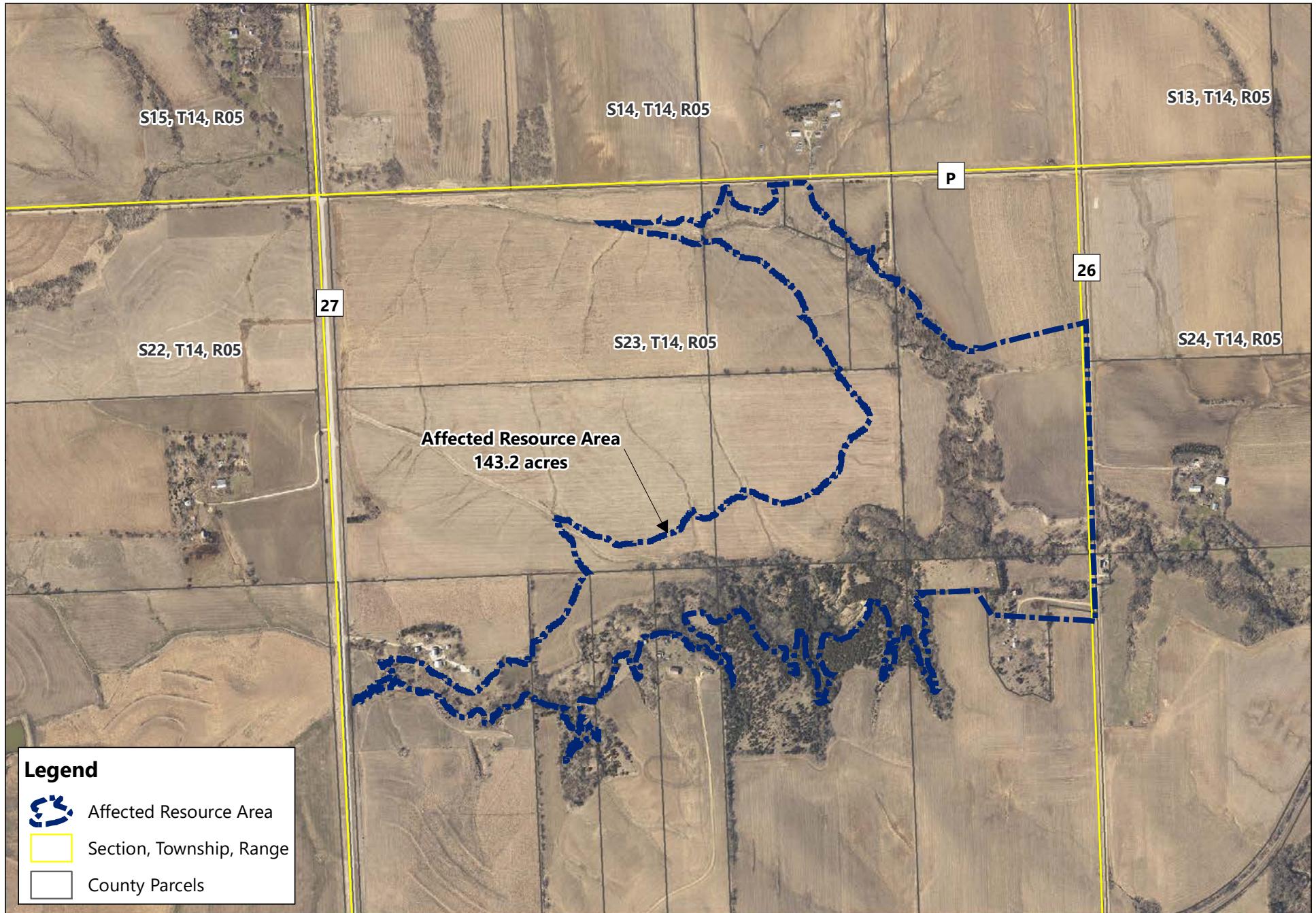


Figure C1.3. Site 55 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 450 900 1,800 Feet



FYRA
ENGINEERING



Figure C1.4. Site 66 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 350 700 1,400 Feet



FYRA
ENGINEERING

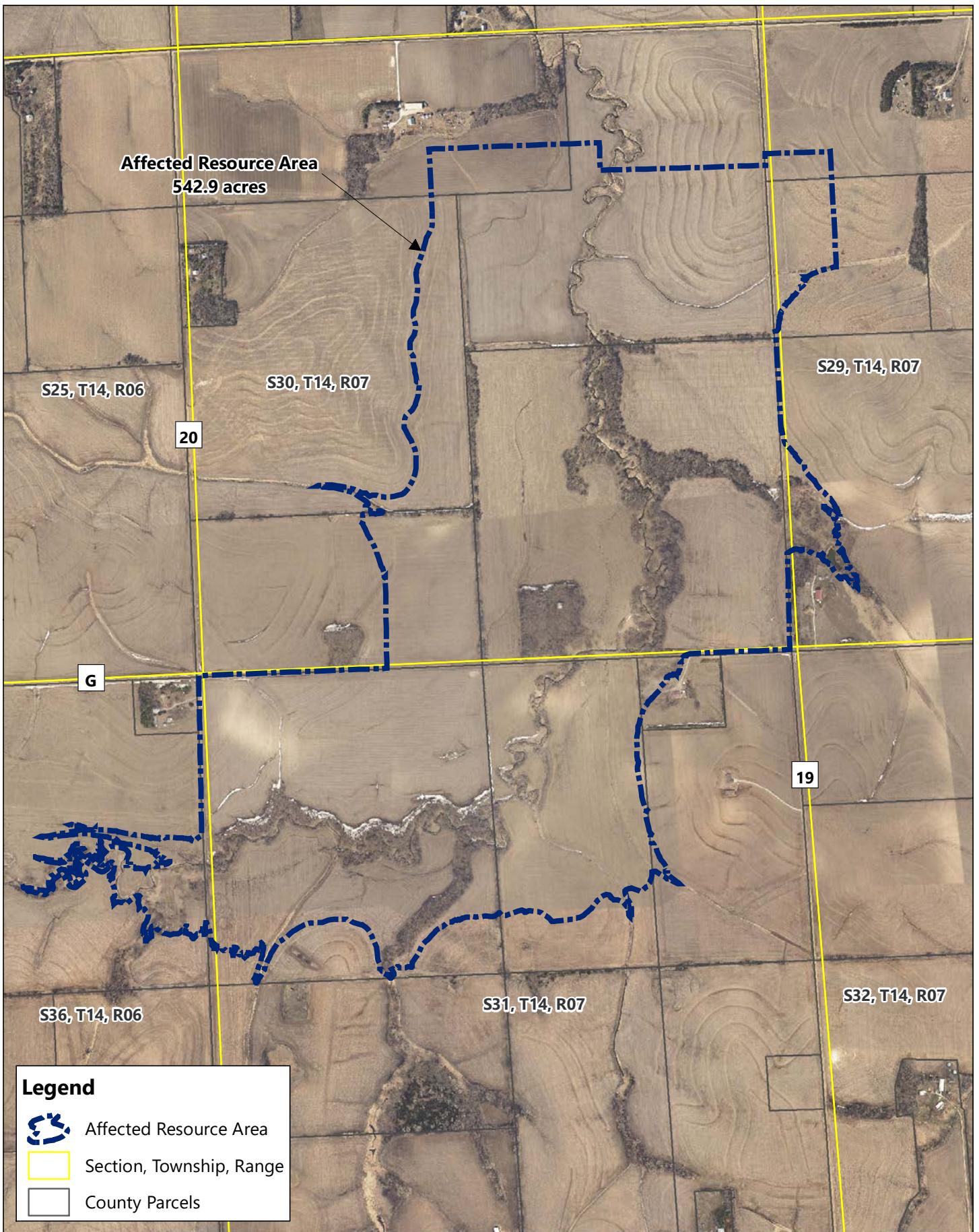
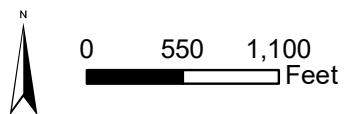


Figure C1.5. Site 77 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



FYRA
ENGINEERING

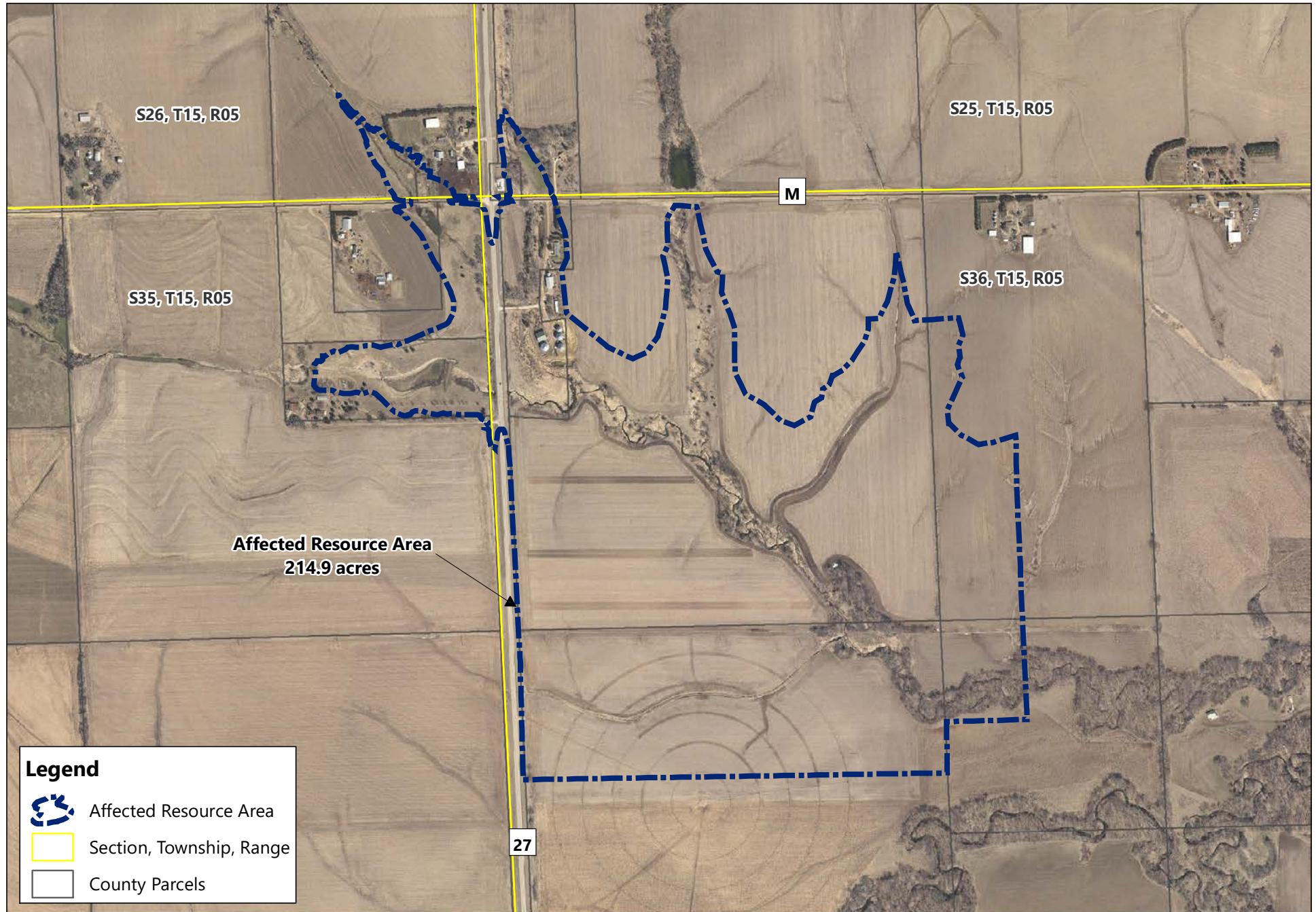


Figure C1.6. Site 82 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 400 800 1,600 Feet



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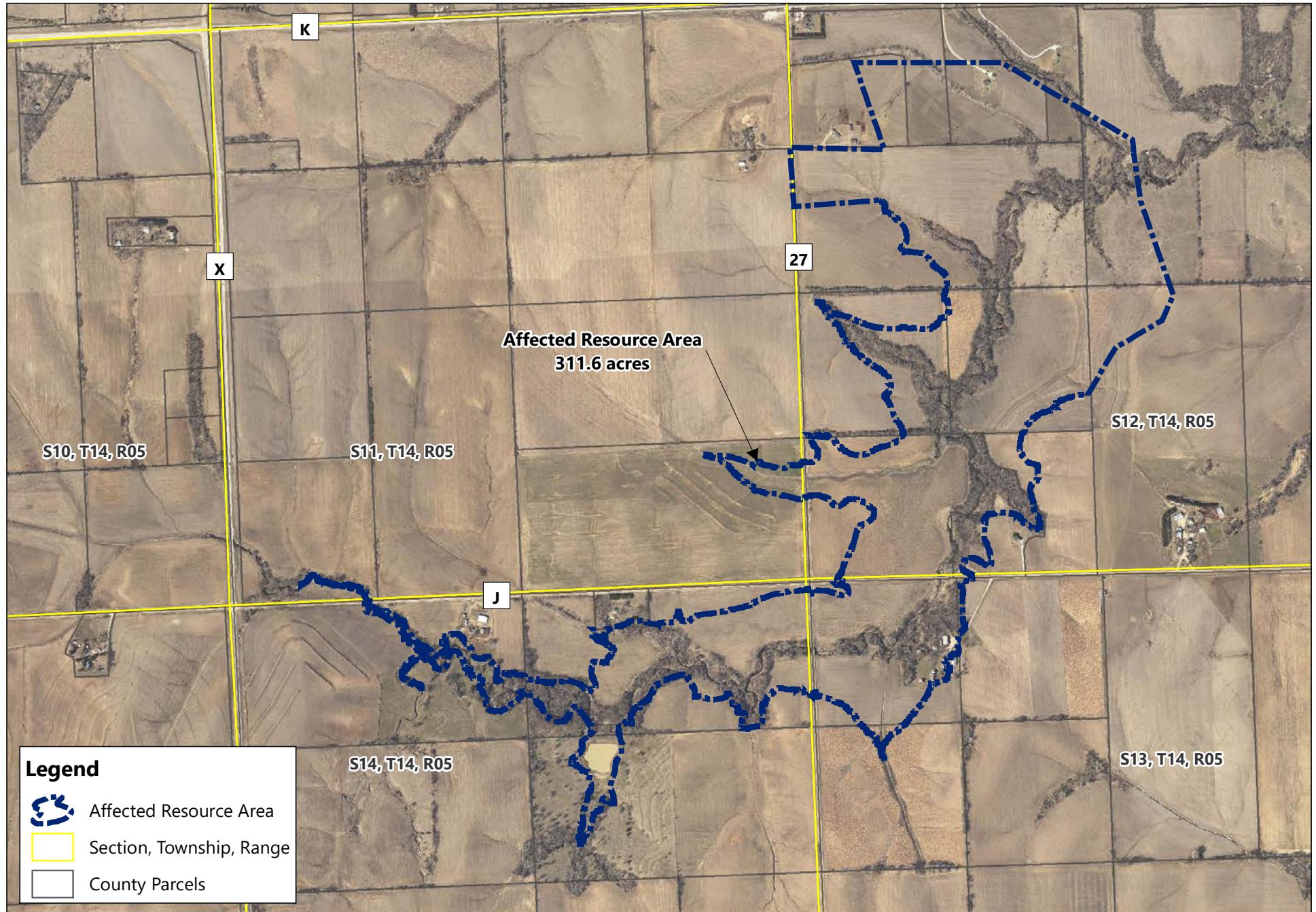


Figure C1.7. Site 84 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 600 1,200 2,400 Feet



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ENGINEERING



Figure C1.8. Site 85 Affected Resource Area

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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Figure C1.9. Site 86 Affected Resource Area

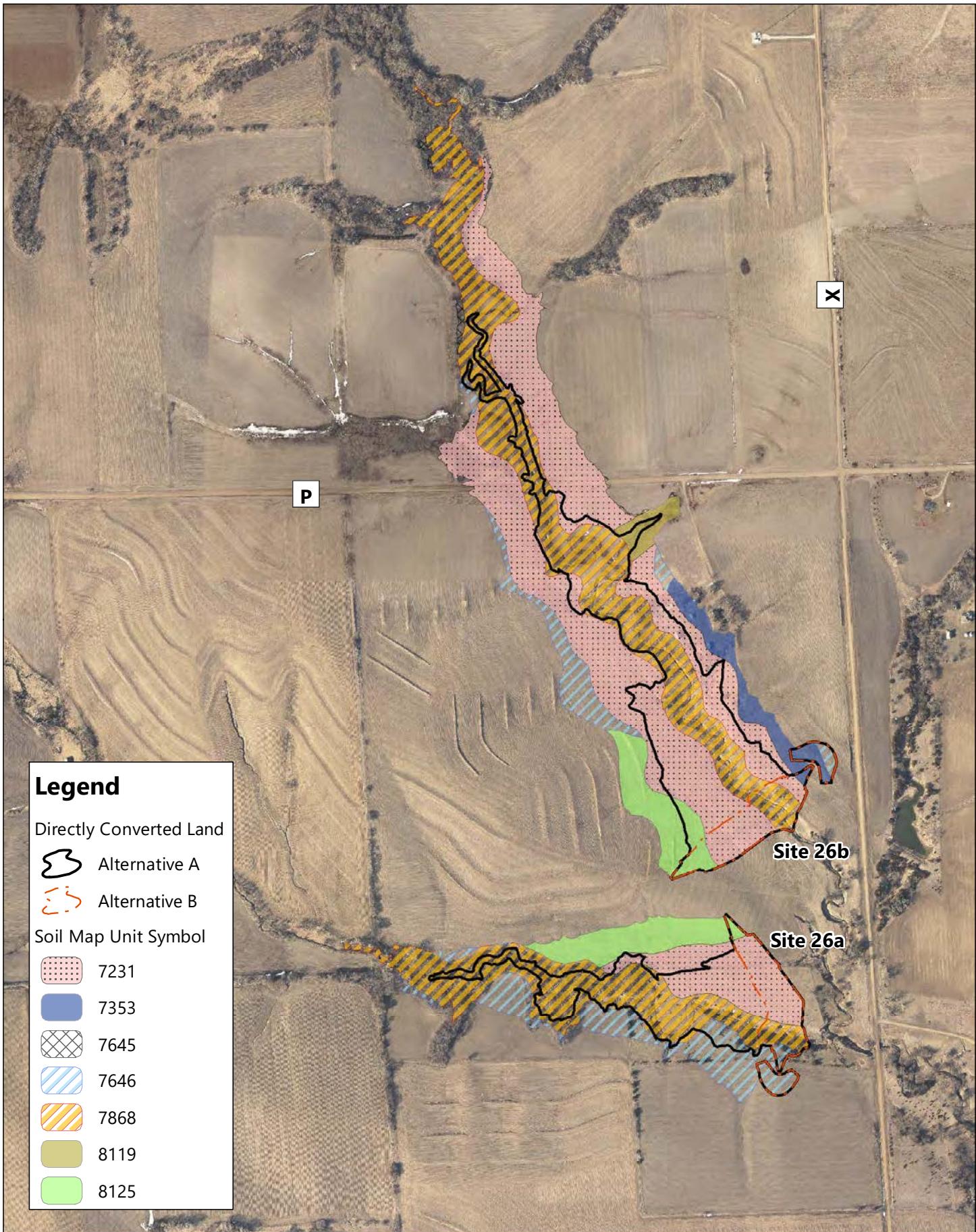
Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 200 400 Feet



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FYRA
ENGINEERING

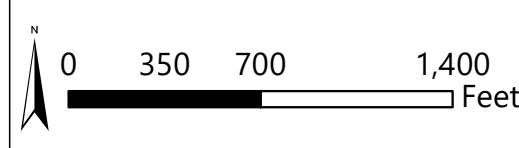
27

Legend

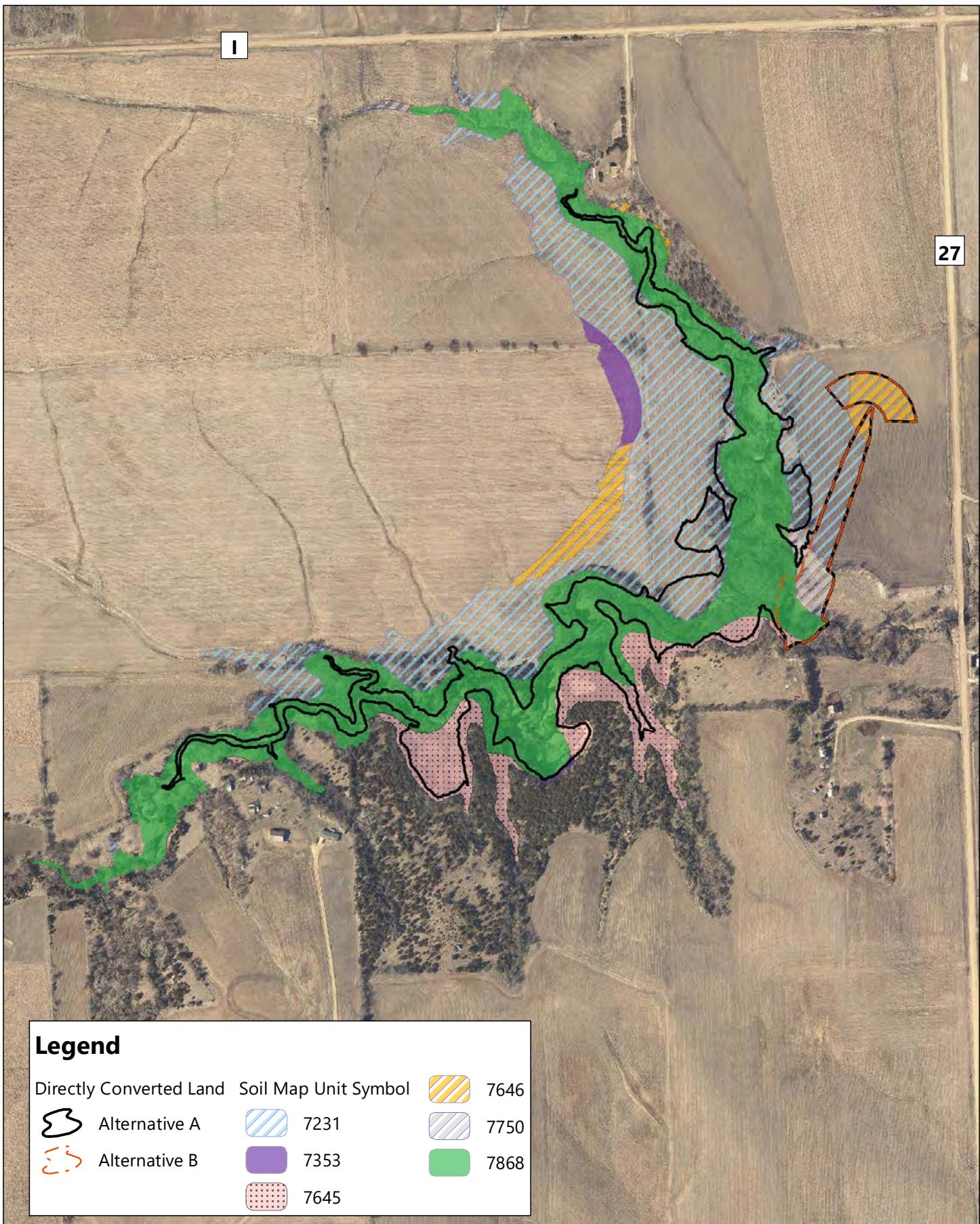
Directly Converted Land	Soil Map Unit Symbol	
		7647
 Alternative A	 7230	7750
 Alternative B	 7231	7868
	 7646	8125

**Figure C2.2. Prime and Unique Farmland
Site 27**

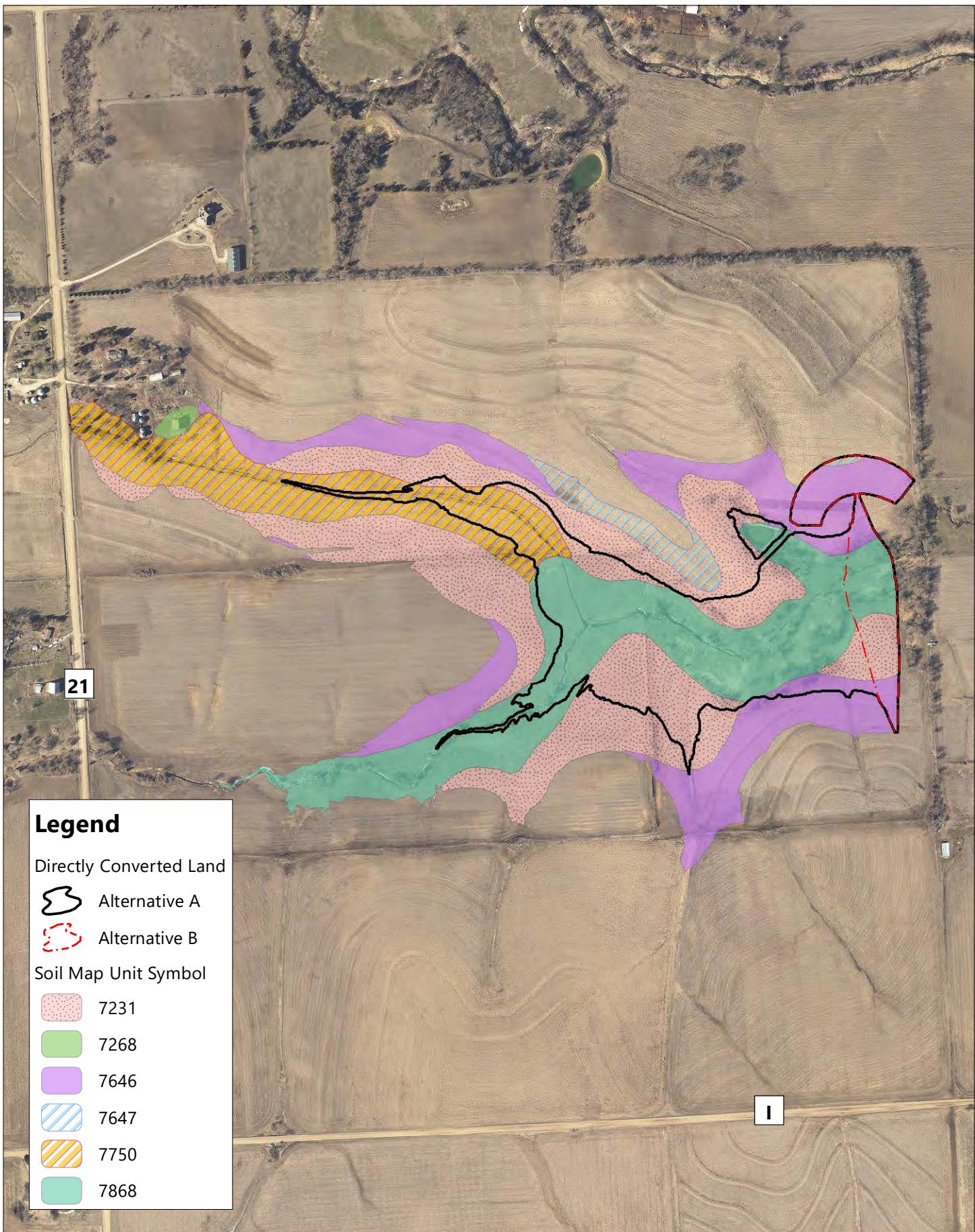
Upper Wahoo Creek Watershed Plan-EA
Natural Resource Conservation Service
Lower Platte North NRD



FYRA
ENGINEERING

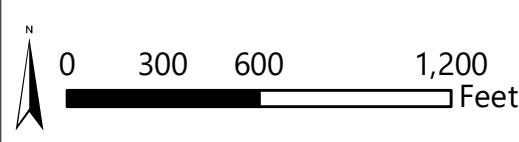


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**Figure C2.4. Prime and Unique Farmland
Site 66**

Upper Wahoo Creek Watershed Plan-EA
Natural Resource Conservation Service
Lower Platte North NRD



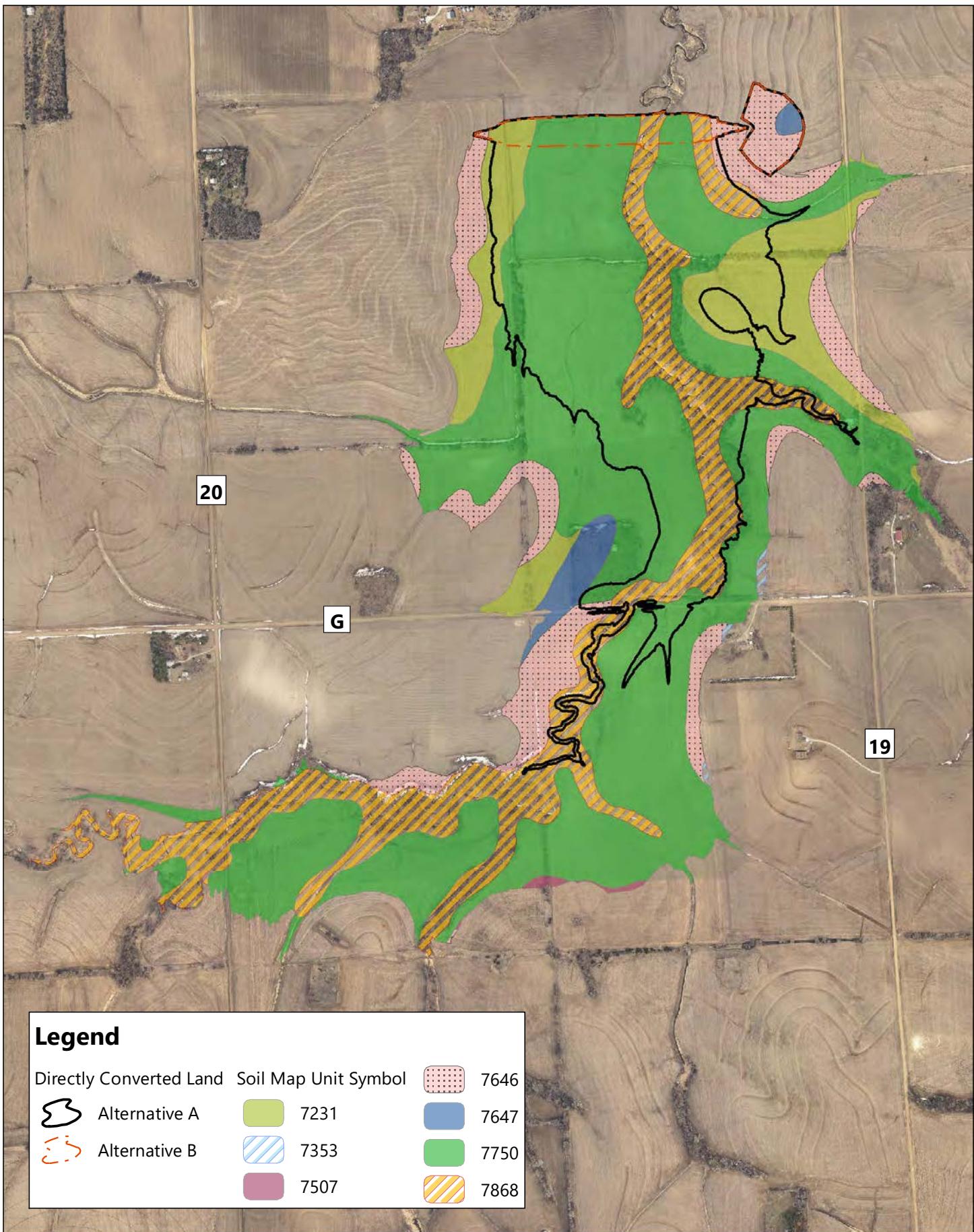


Figure C2.5. Prime and Unique Farmland
Site 77

Upper Wahoo Creek Watershed Plan-EA
Natural Resource Conservation Service
Lower Platte North NRD



0 500 1,000 2,000 Feet



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ENGINEERING

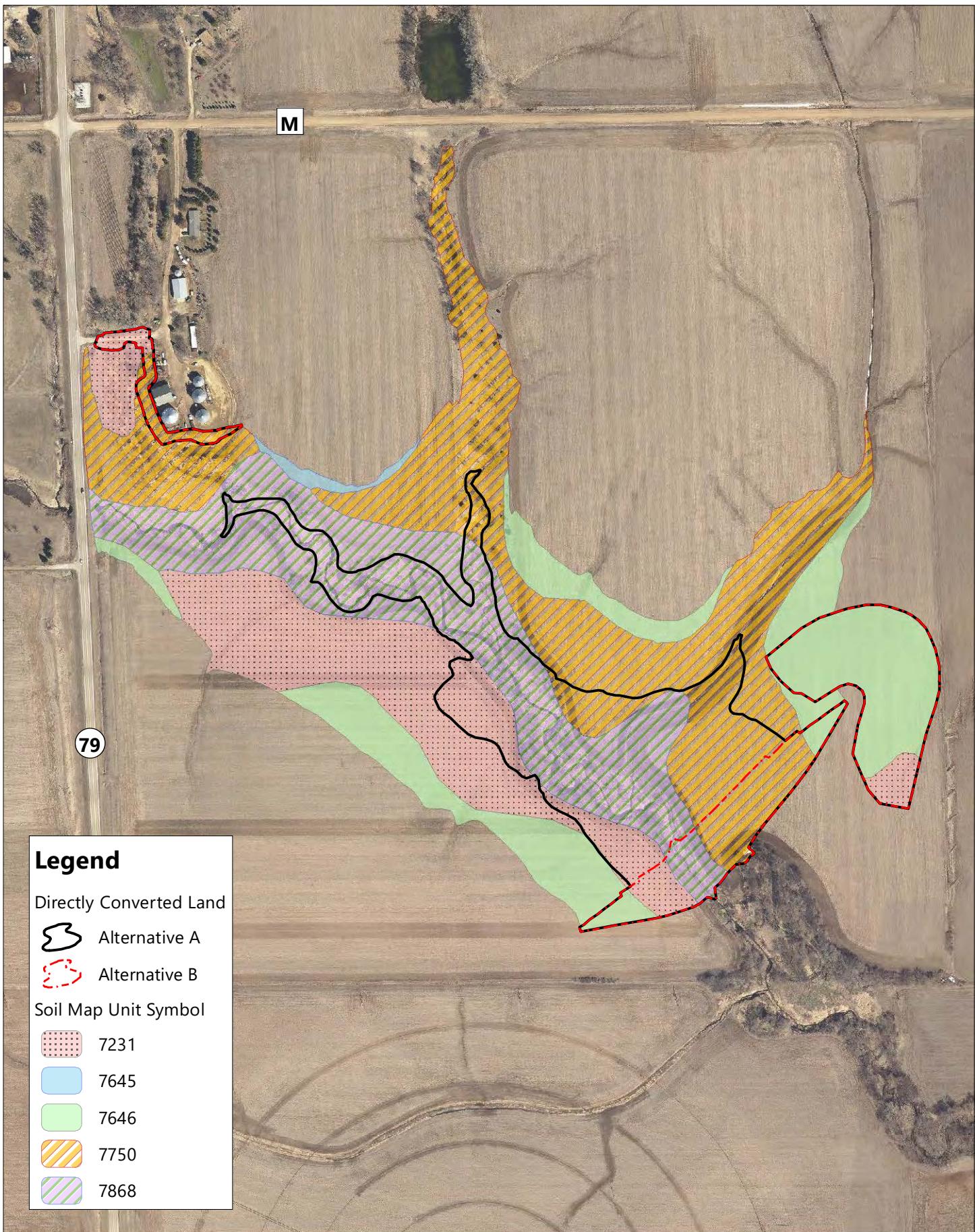


Figure C2.6. Prime and Unique Farmland
Site 82

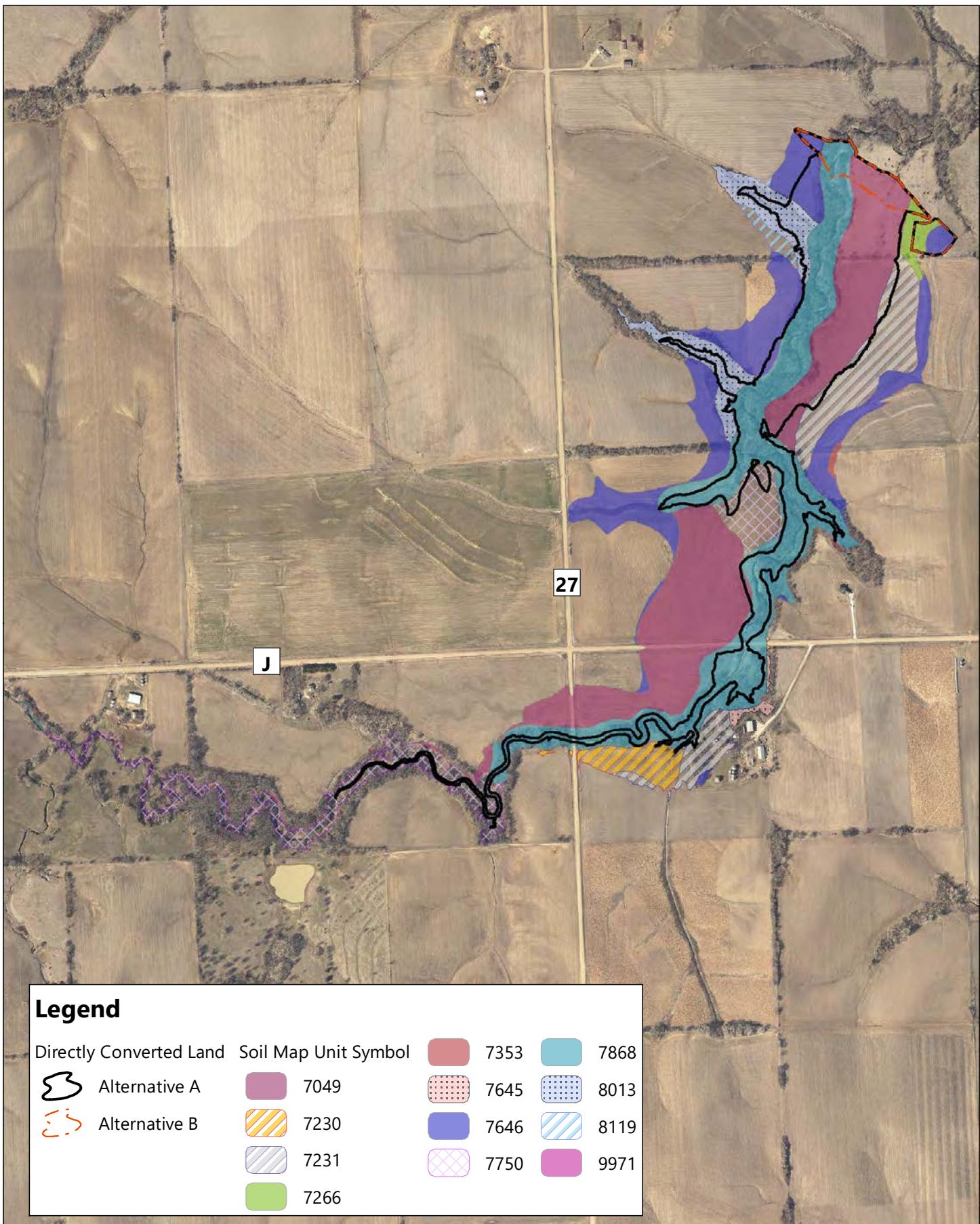
Upper Wahoo Creek Watershed Plan-EA
Natural Resource Conservation Service
Lower Platte North NRD



0 200 400 800 Feet



FYRA
ENGINEERING



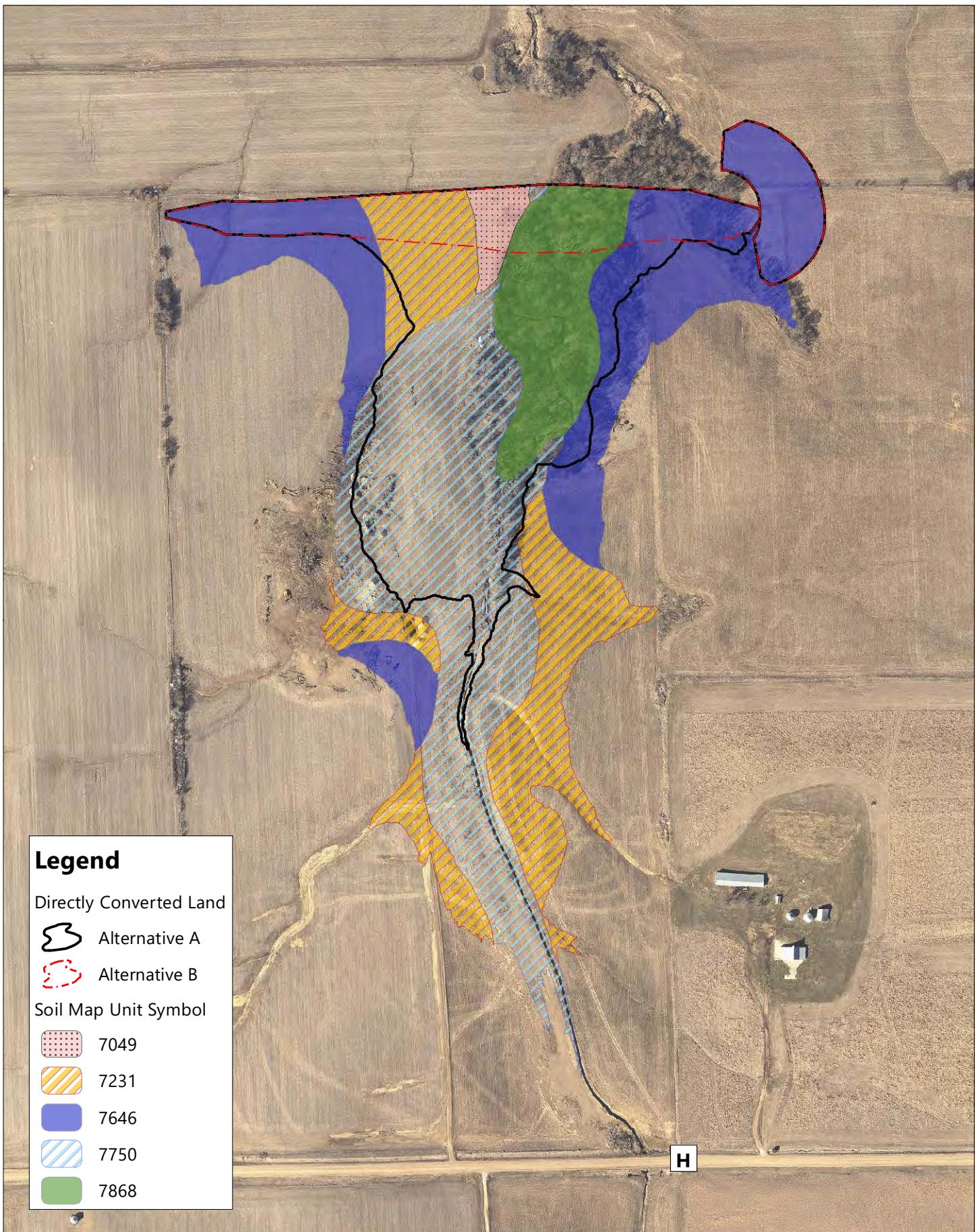


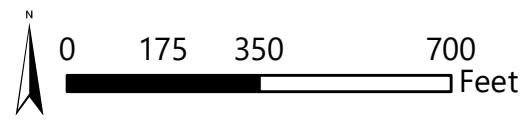
Figure C2.8. Prime and Unique Farmland

Site 85

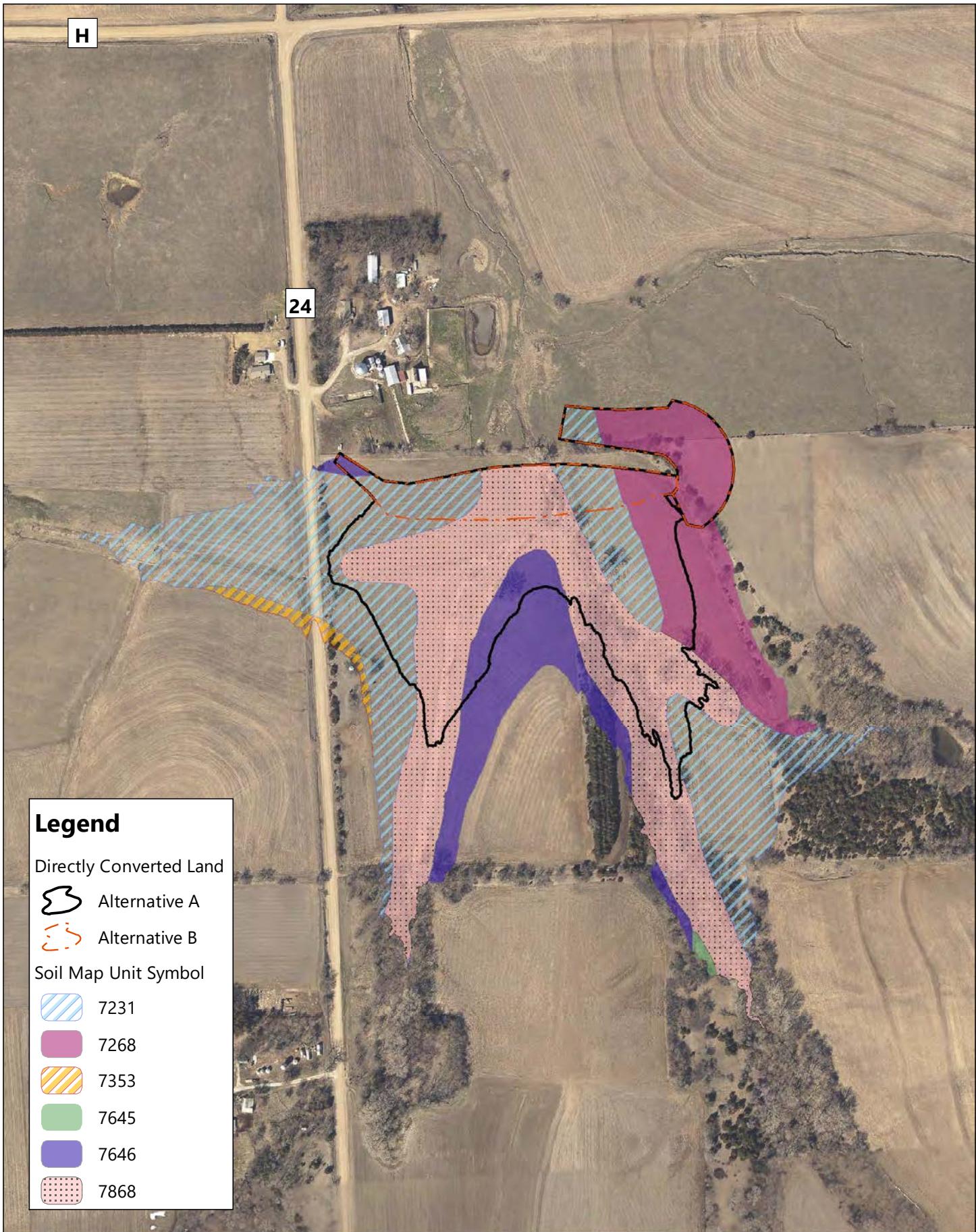
Upper Wahoo Creek Watershed Plan-EA

Natural Resource Conservation Service

Lower Platte North NRD

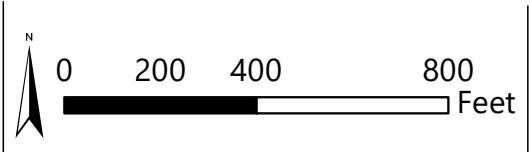


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**Figure C2.9. Prime and Unique Farmland
Site 86**

Upper Wahoo Creek Watershed Plan-EA
Natural Resource Conservation Service
Lower Platte North NRD



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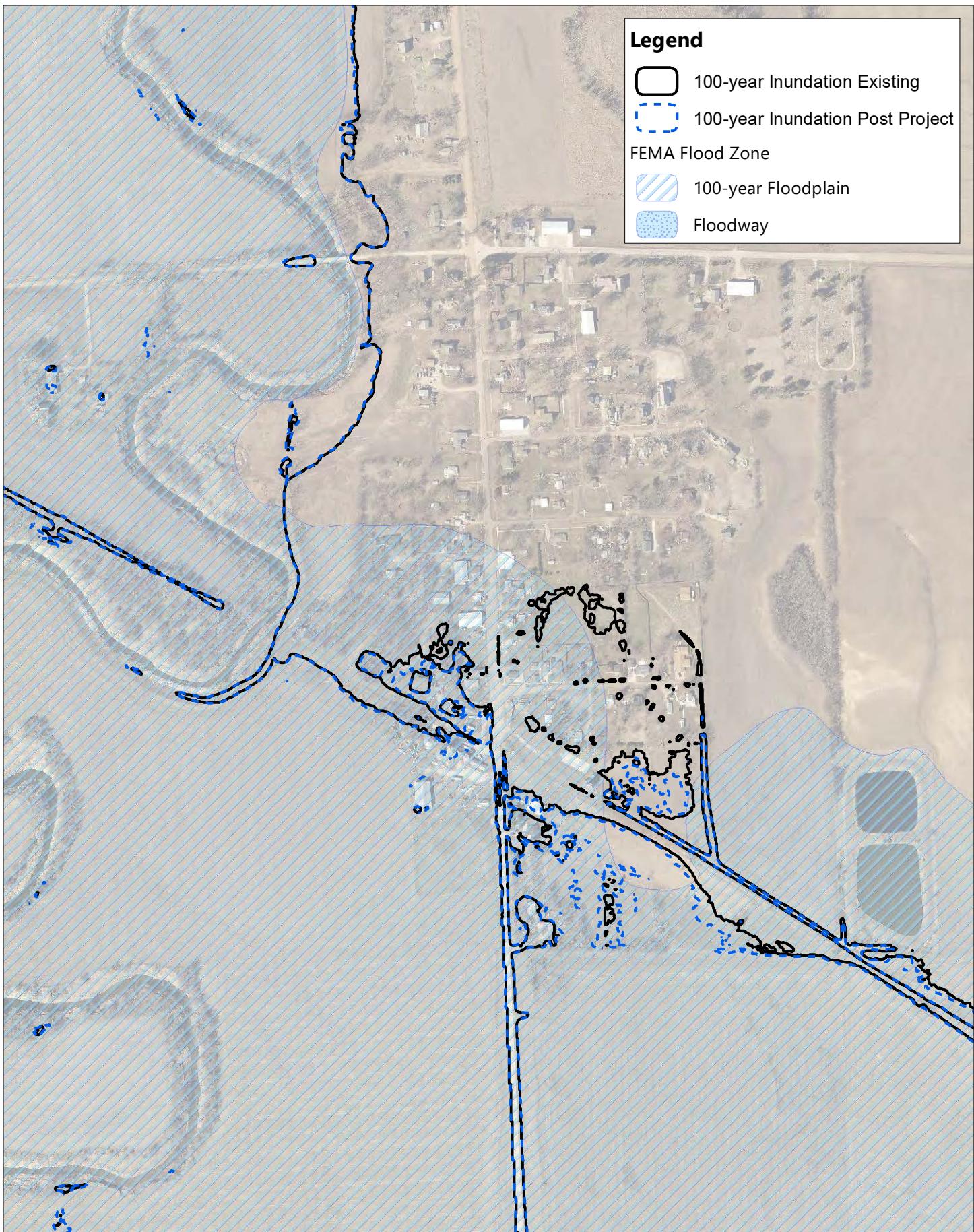


Figure C3.1. Ithaca 100-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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ENGINEERING

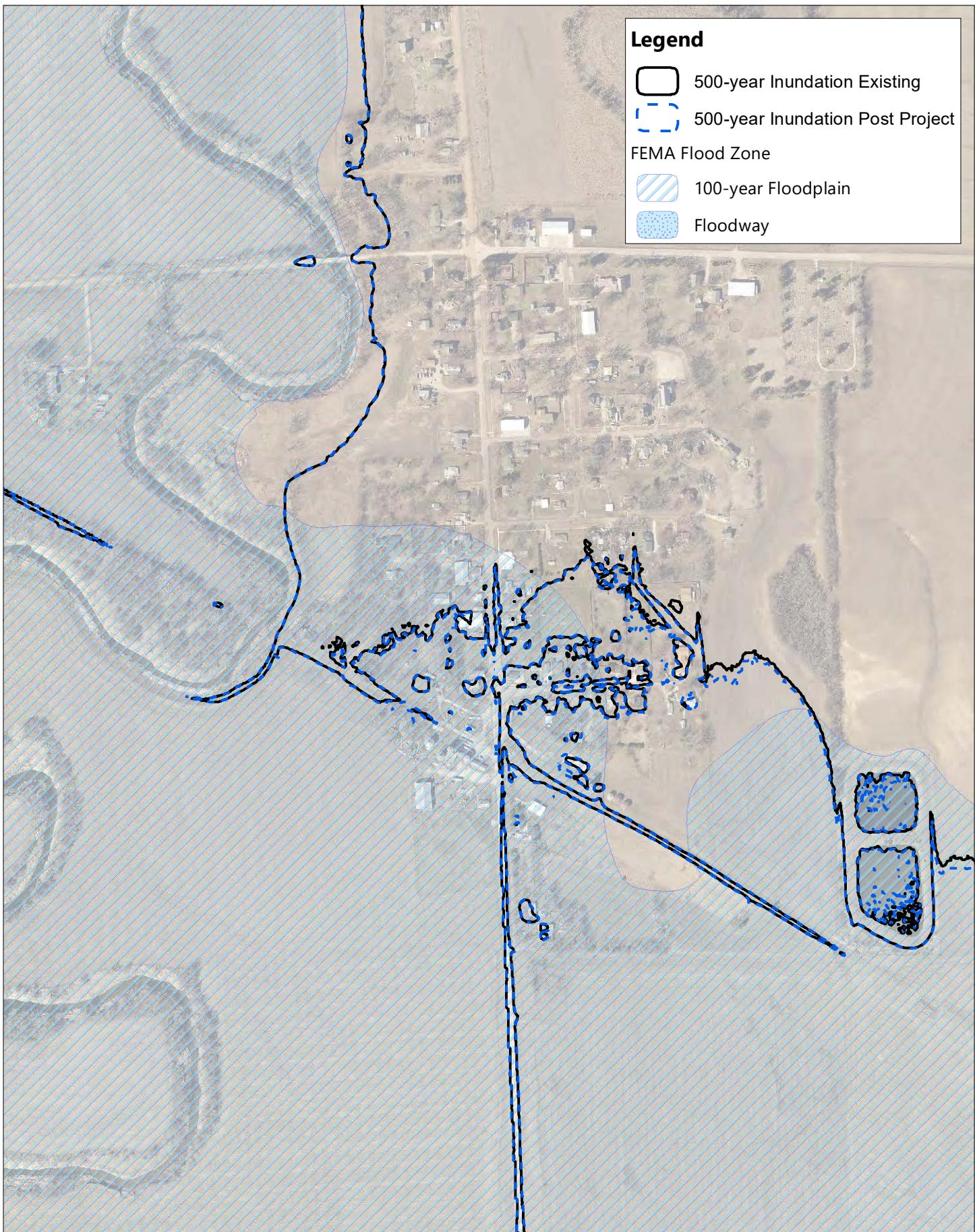


Figure C3.2. Ithaca 500-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 250 500 Feet



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Figure C3.3. Memphis 100-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 250 500 Feet



FYRA
ENGINEERING

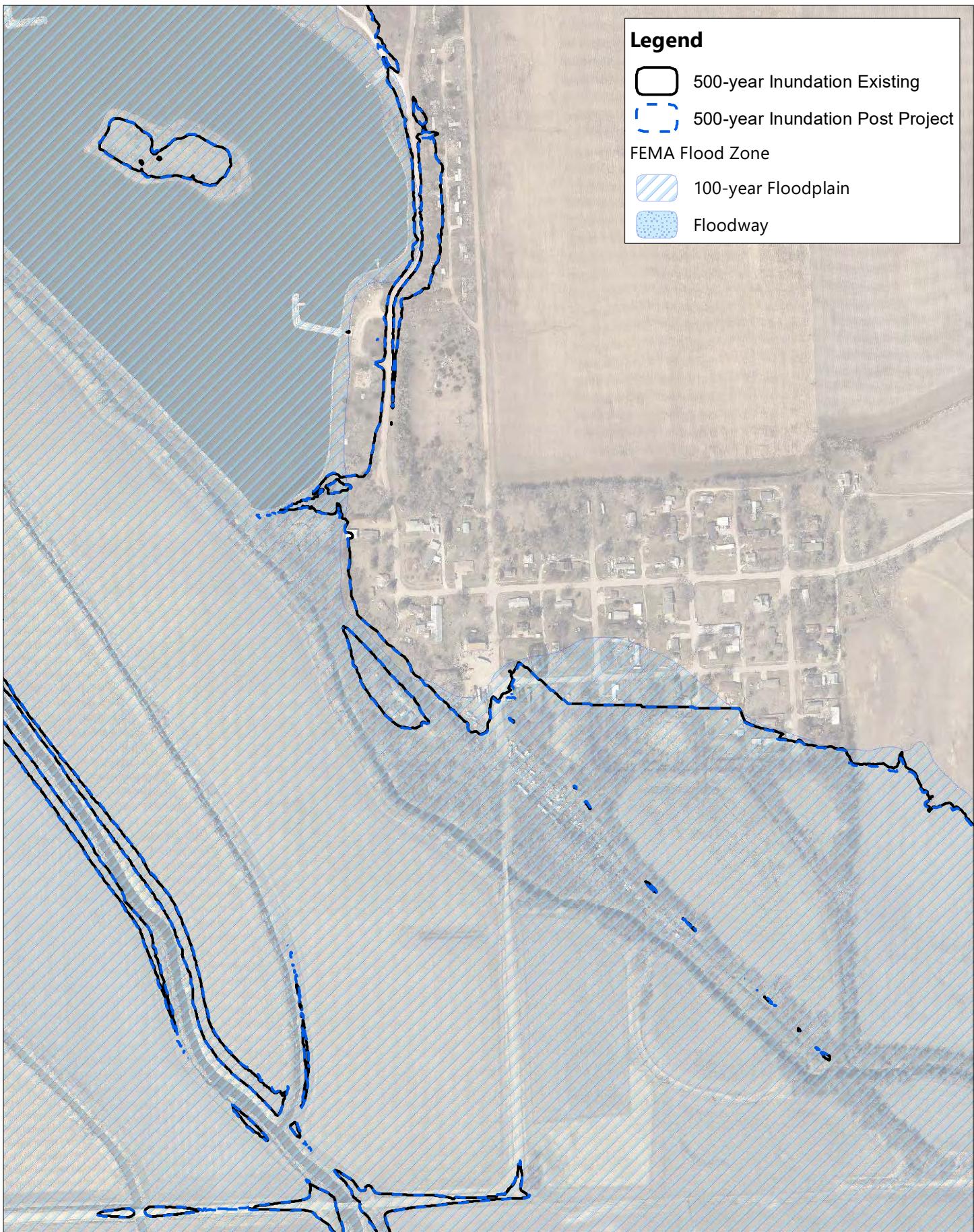
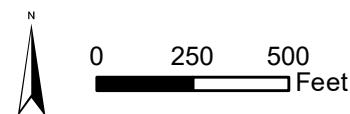


Figure C3.4. Memphis 500-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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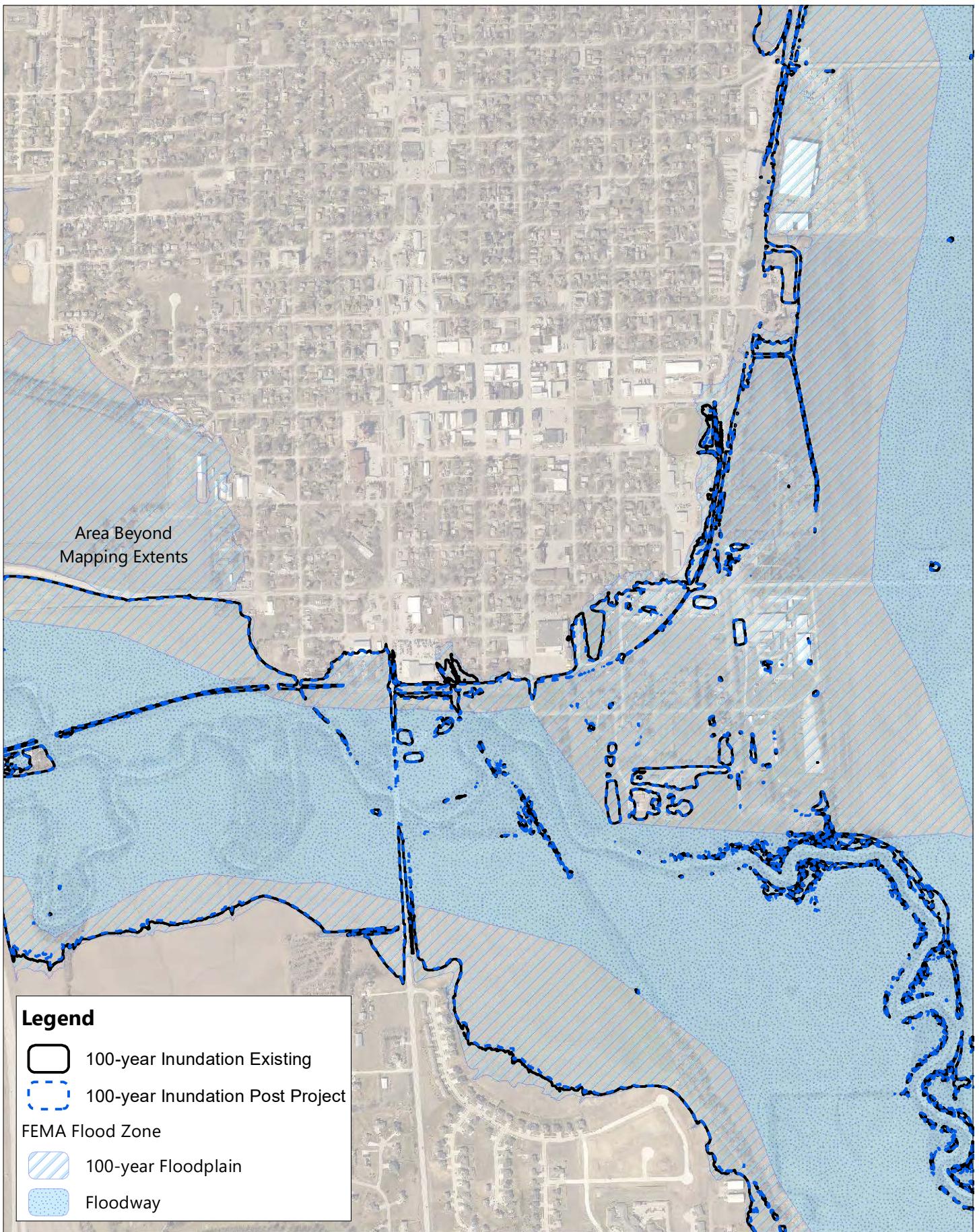


Figure C3.5. Wahoo 100-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 500 1,000 Feet



FYRA
ENGINEERING

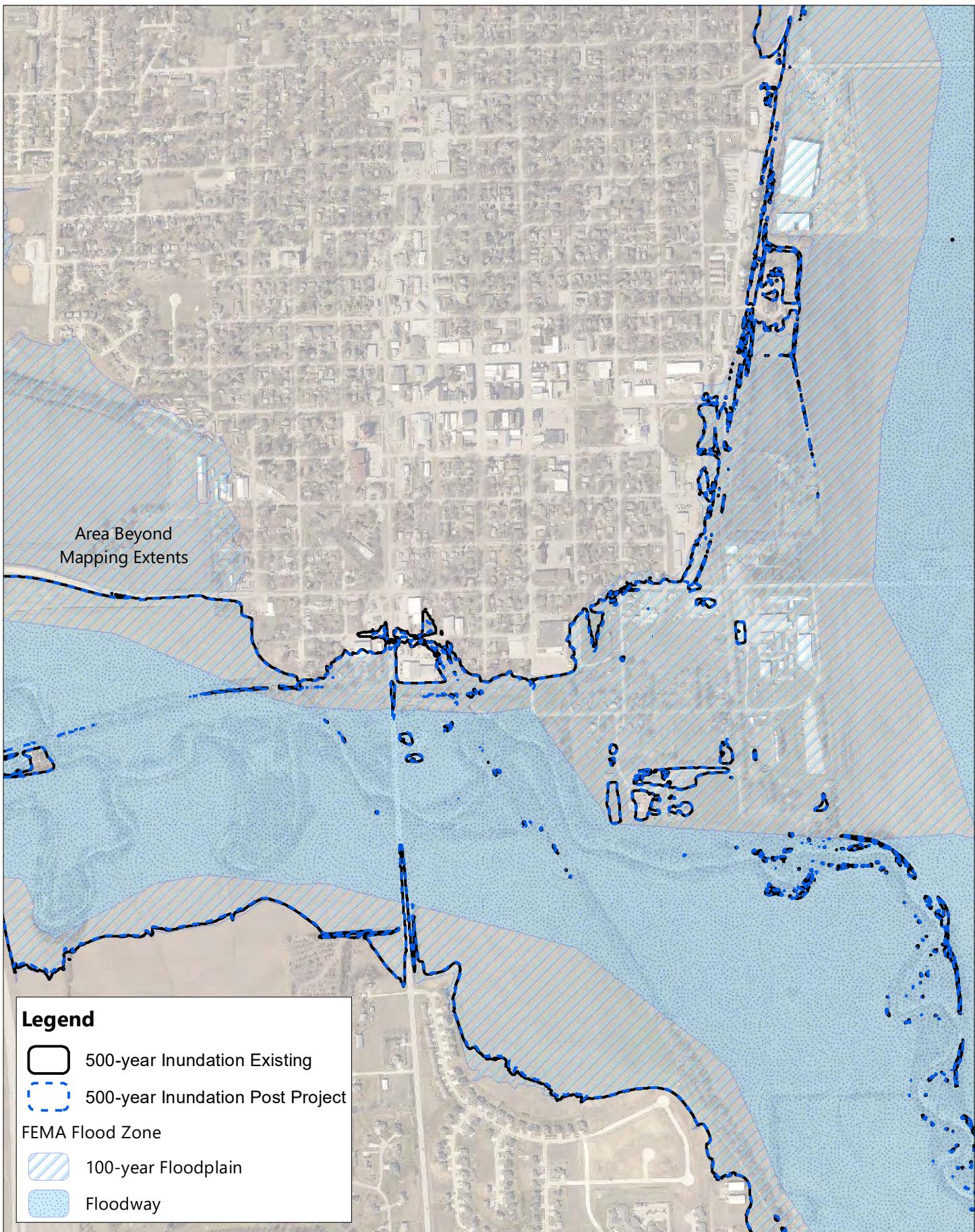


Figure C3.6. Wahoo 500-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 500 1,000 Feet



FYRA
ENGINEERING

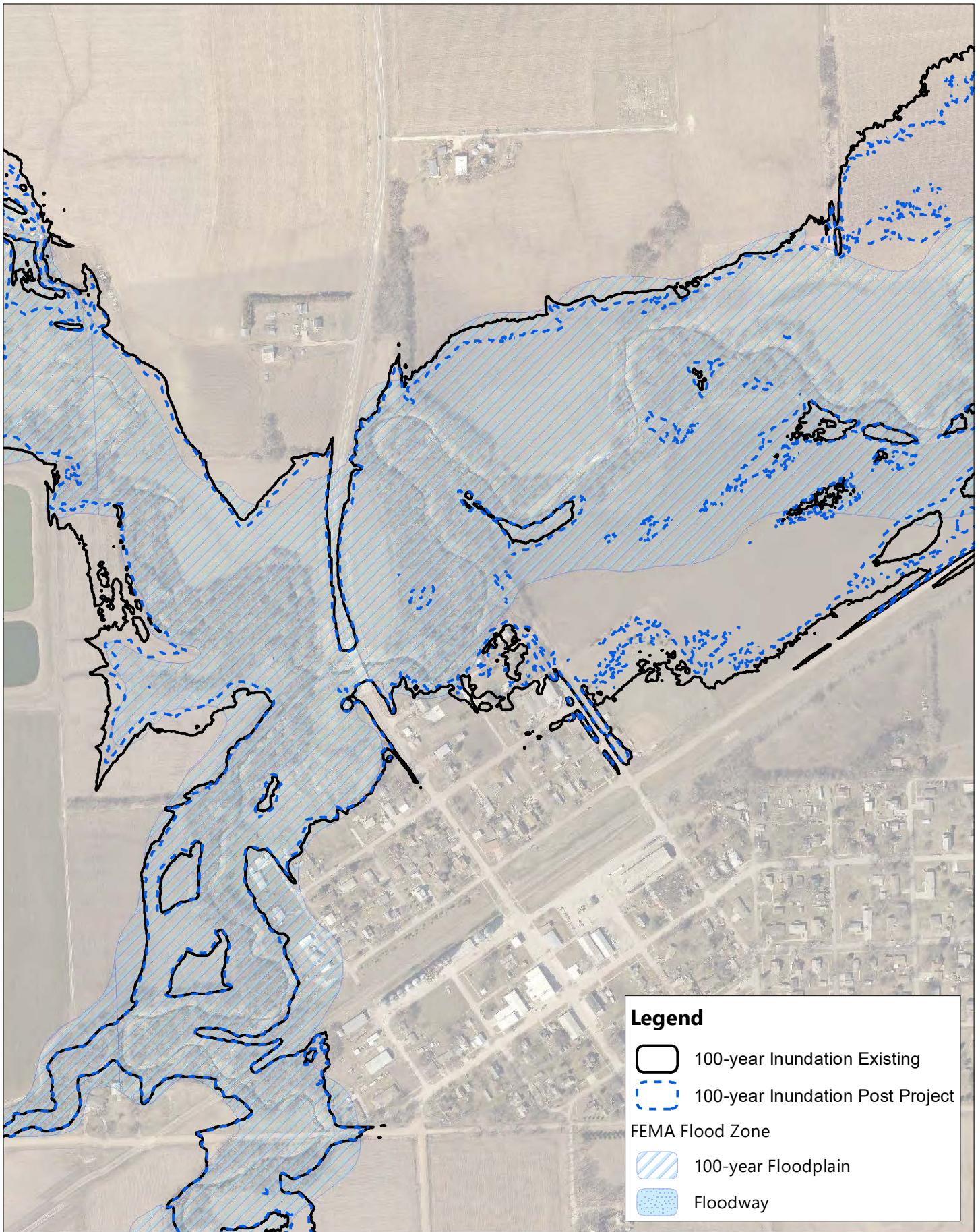


Figure C3.7. Weston 100-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 250 500 Feet



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ENGINEERING

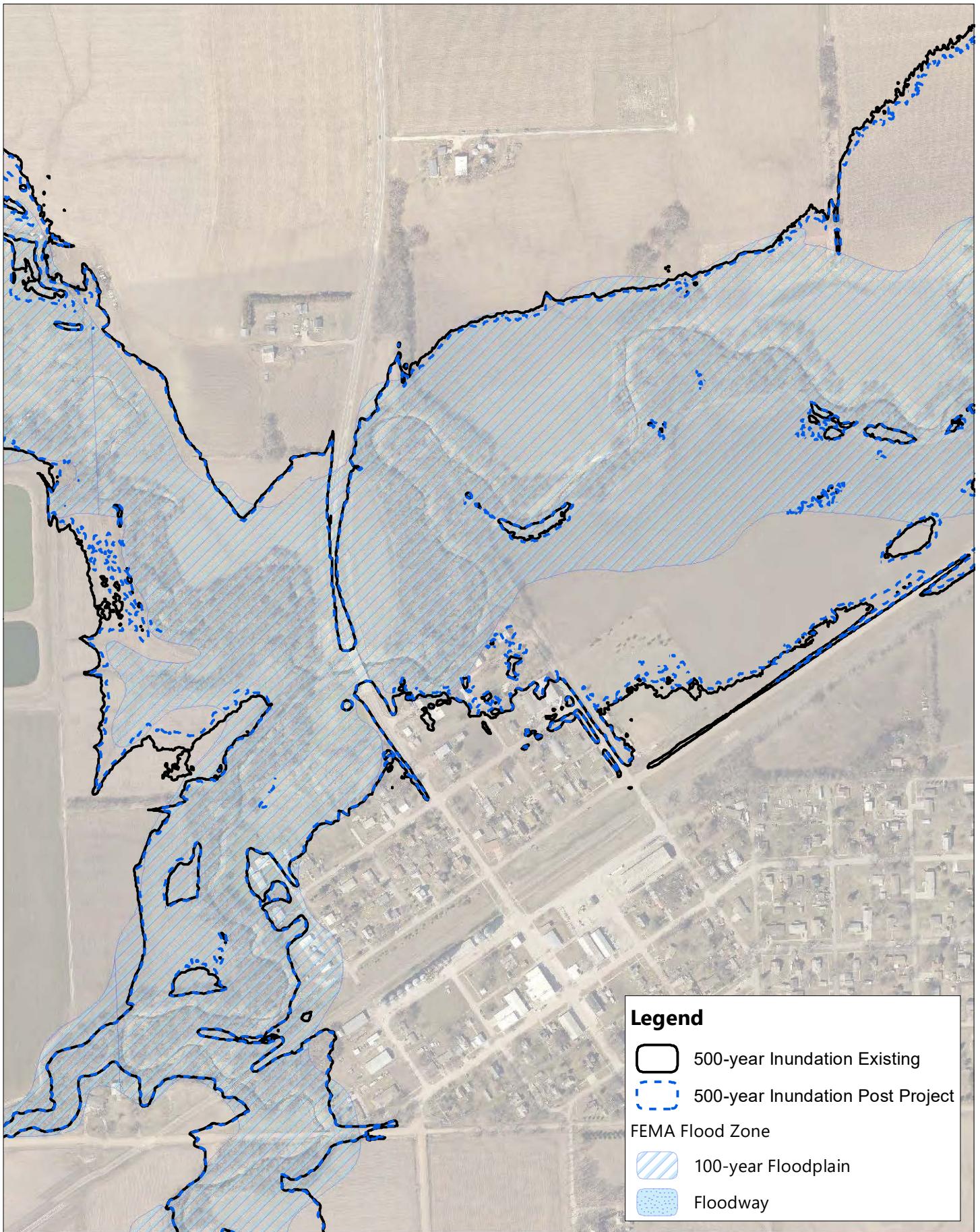


Figure C3.8. Weston 500-Year Flood

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 250 500 Feet



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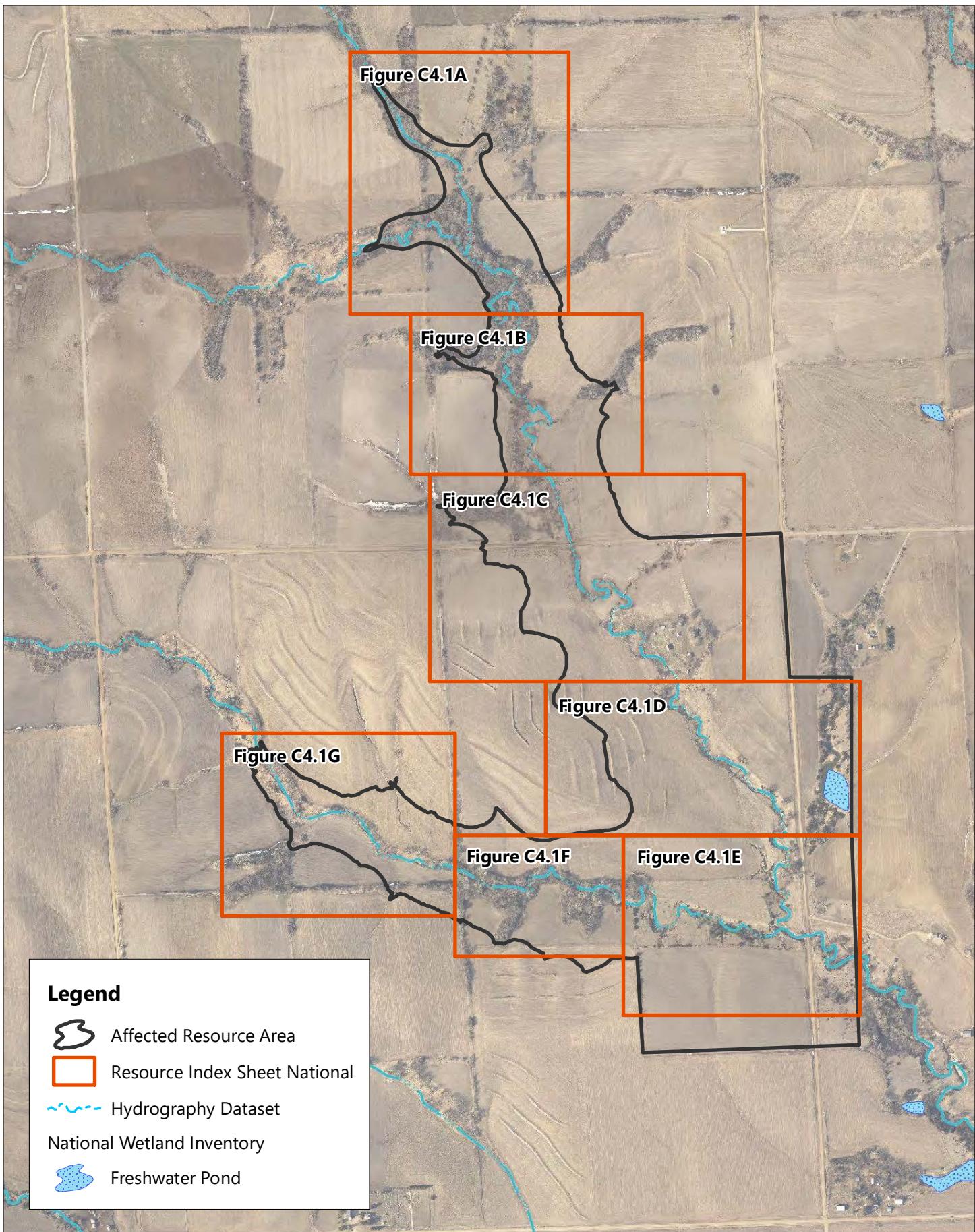
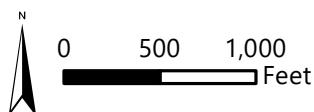


Figure C4.1. Site 26 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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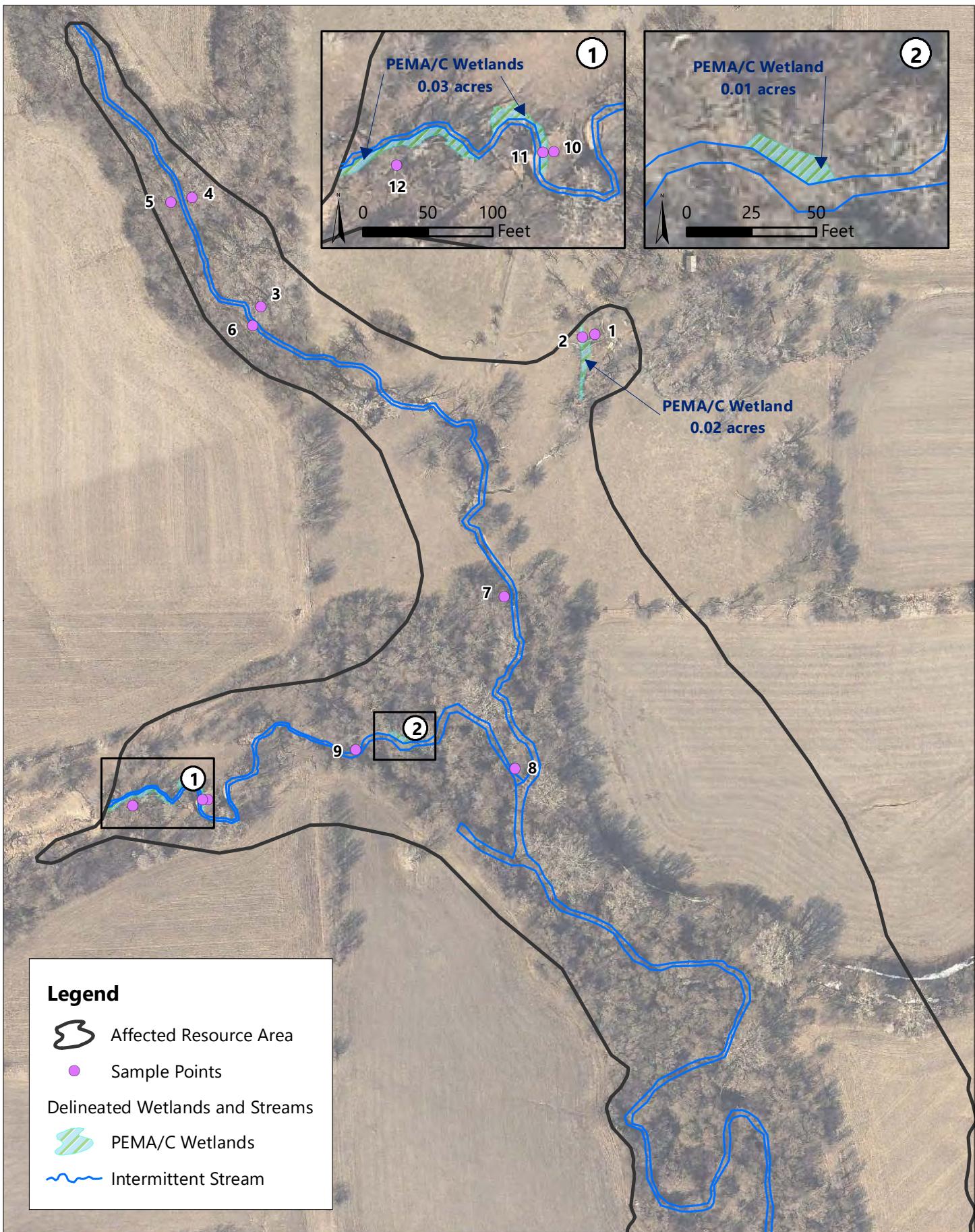
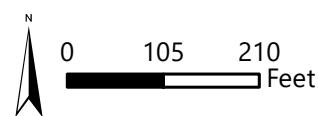


Figure C4.1A. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



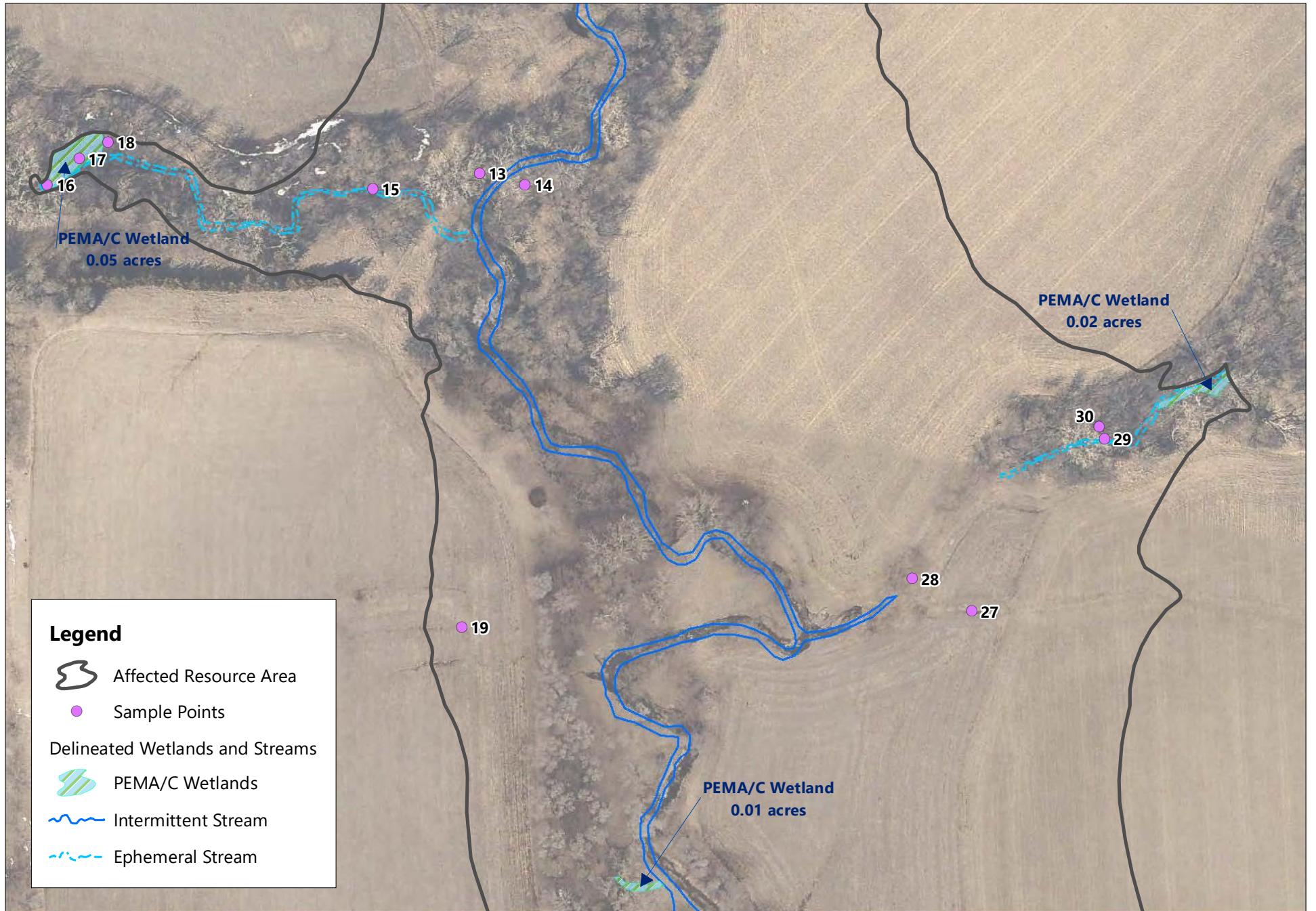


Figure C4.1B. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 75 150 300 Feet



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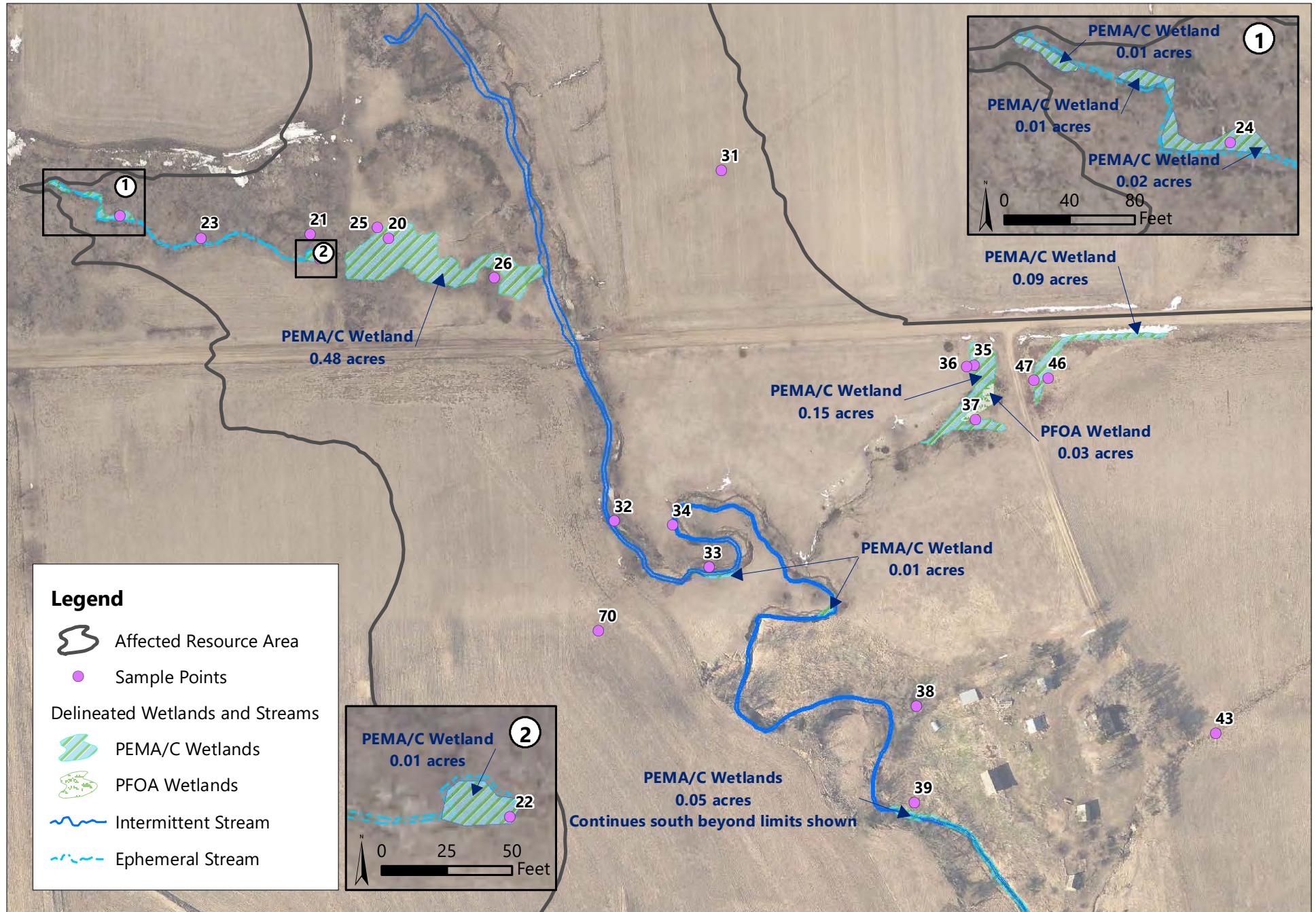


Figure C4.1C. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 120 240 480 Feet



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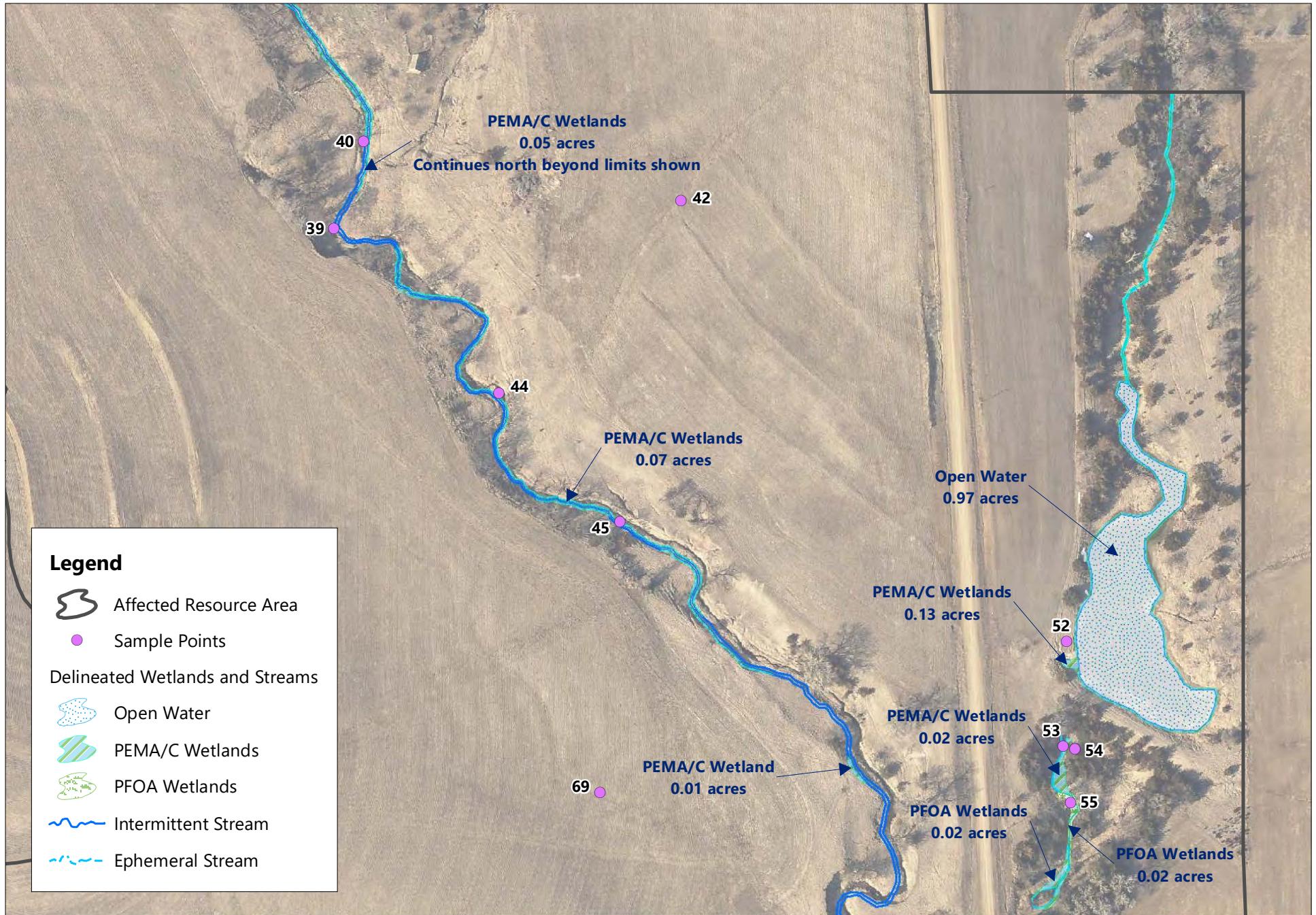


Figure C4.1D. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400
Feet



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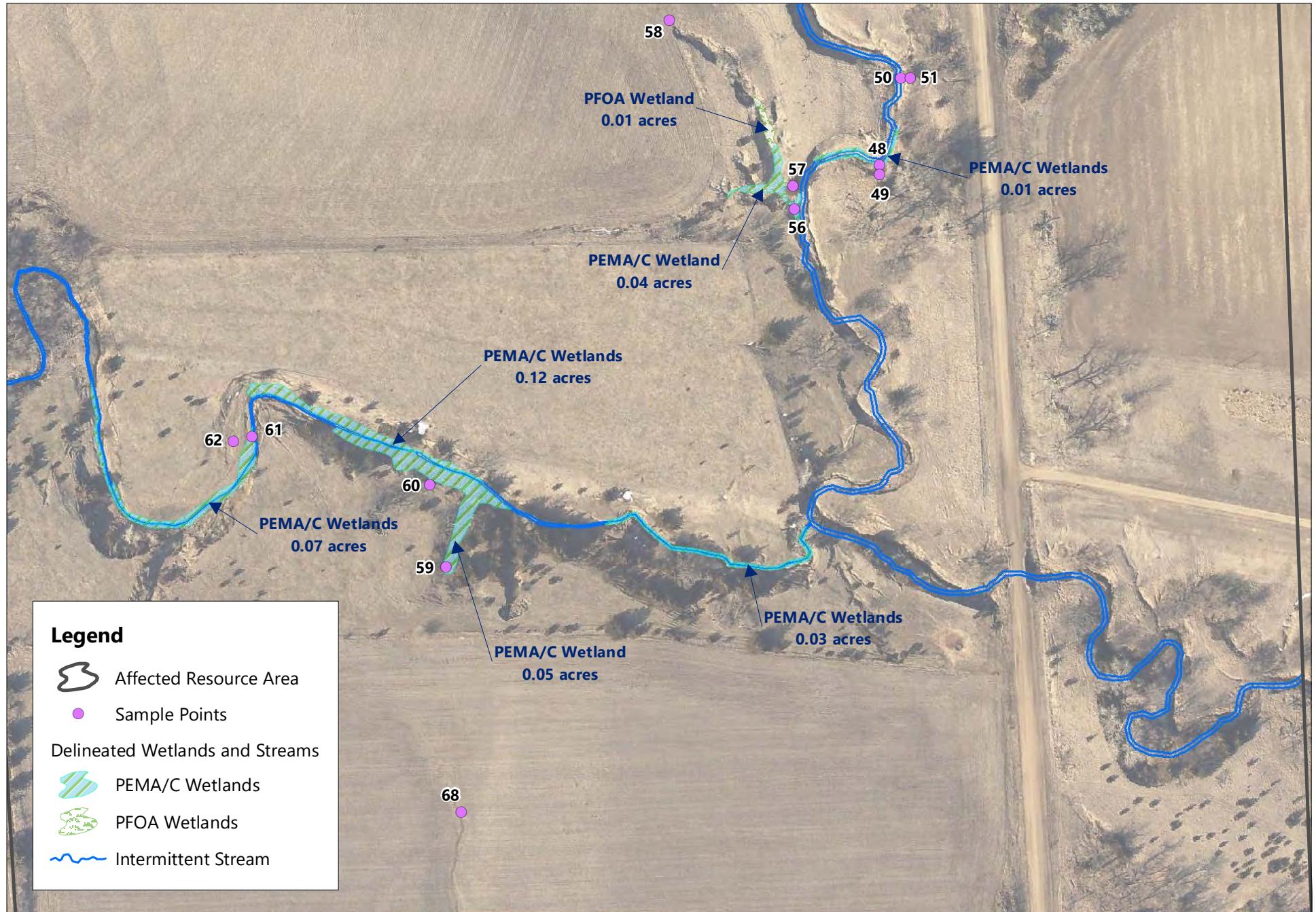


Figure C4.1E. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 85 170 340 Feet



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Figure C4.1F. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 75 150 300
Feet



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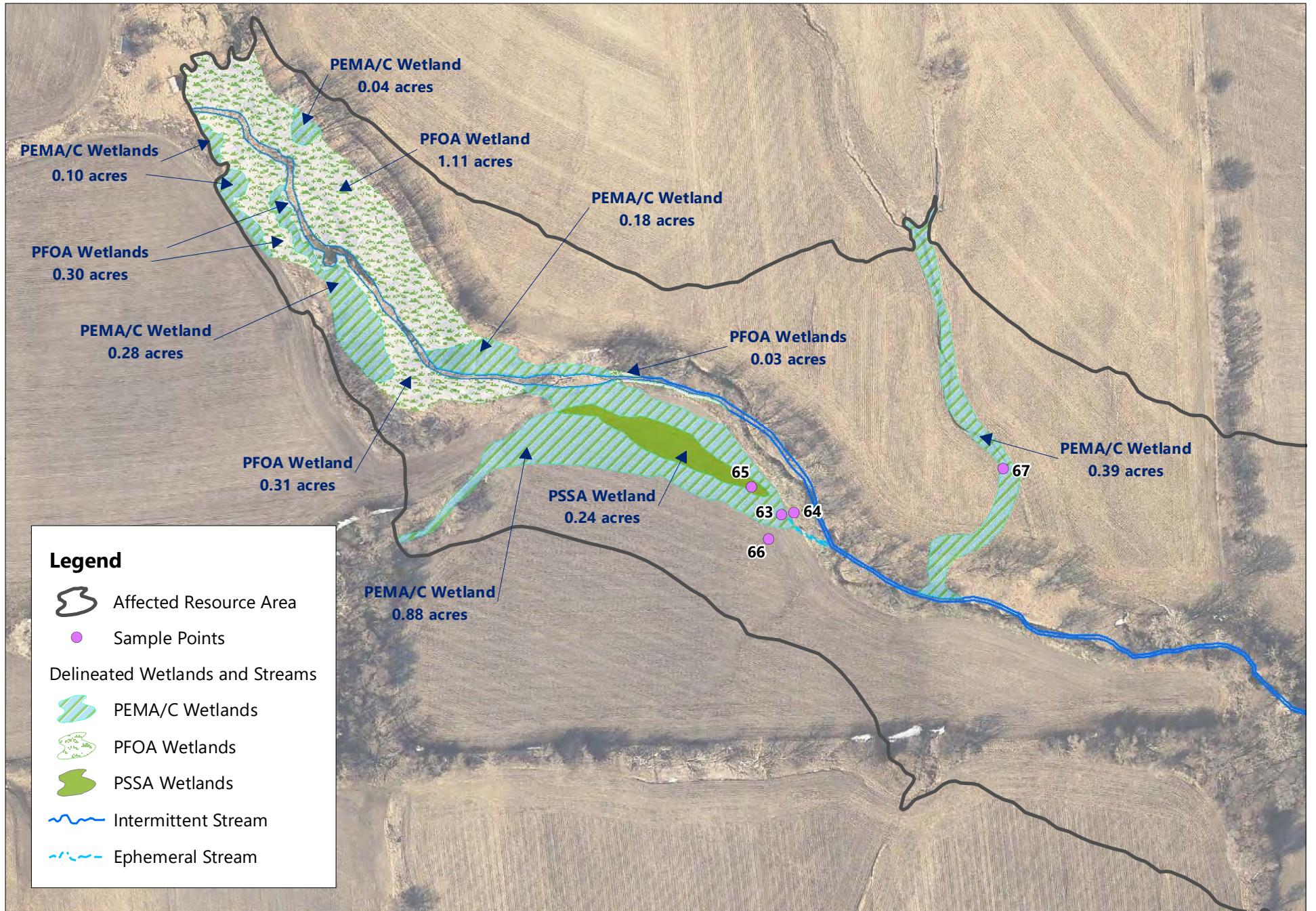


Figure C4.1G. Site 26 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400 Feet



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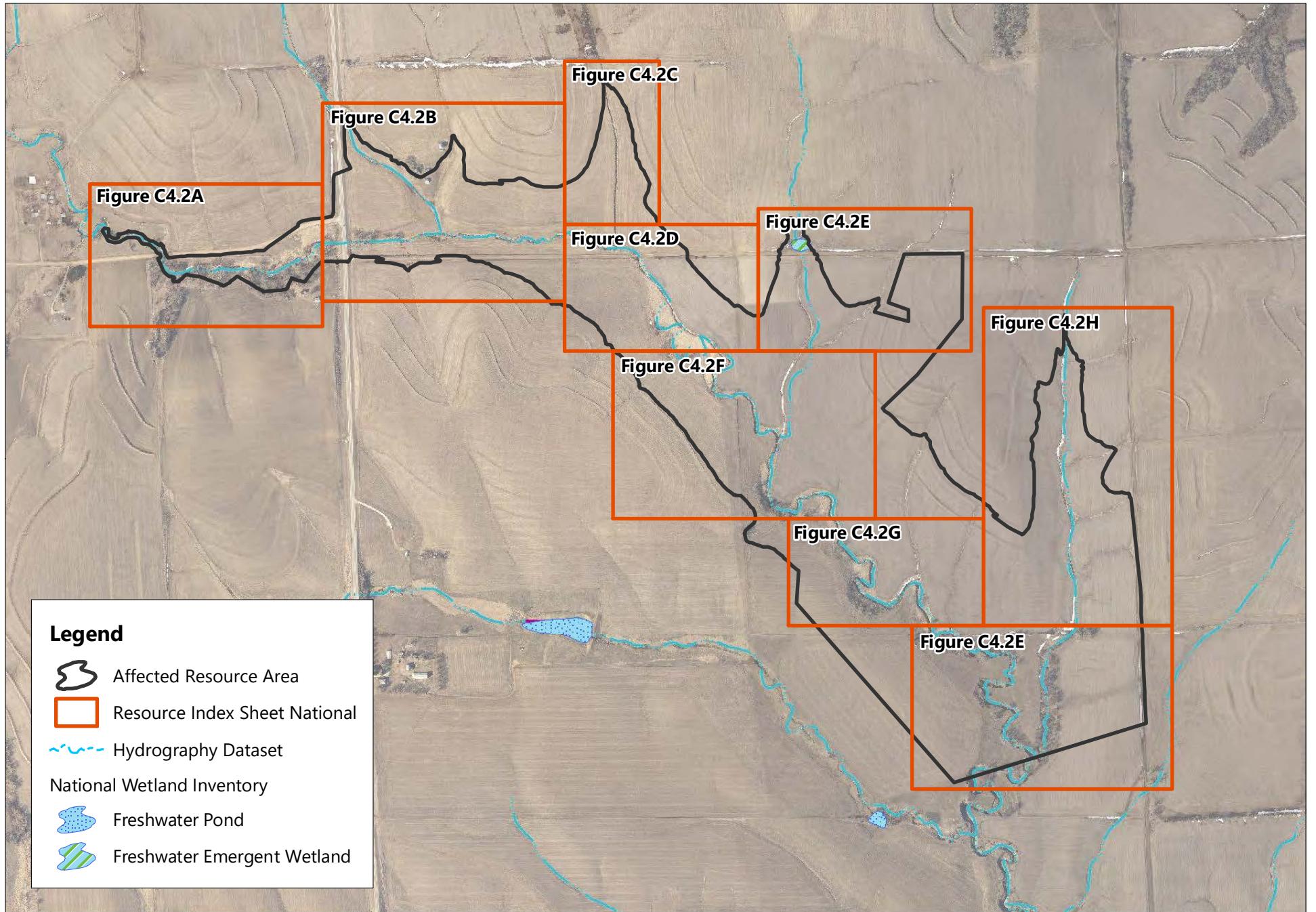


Figure C4.2. Site 27 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 450 900 1,800
Feet



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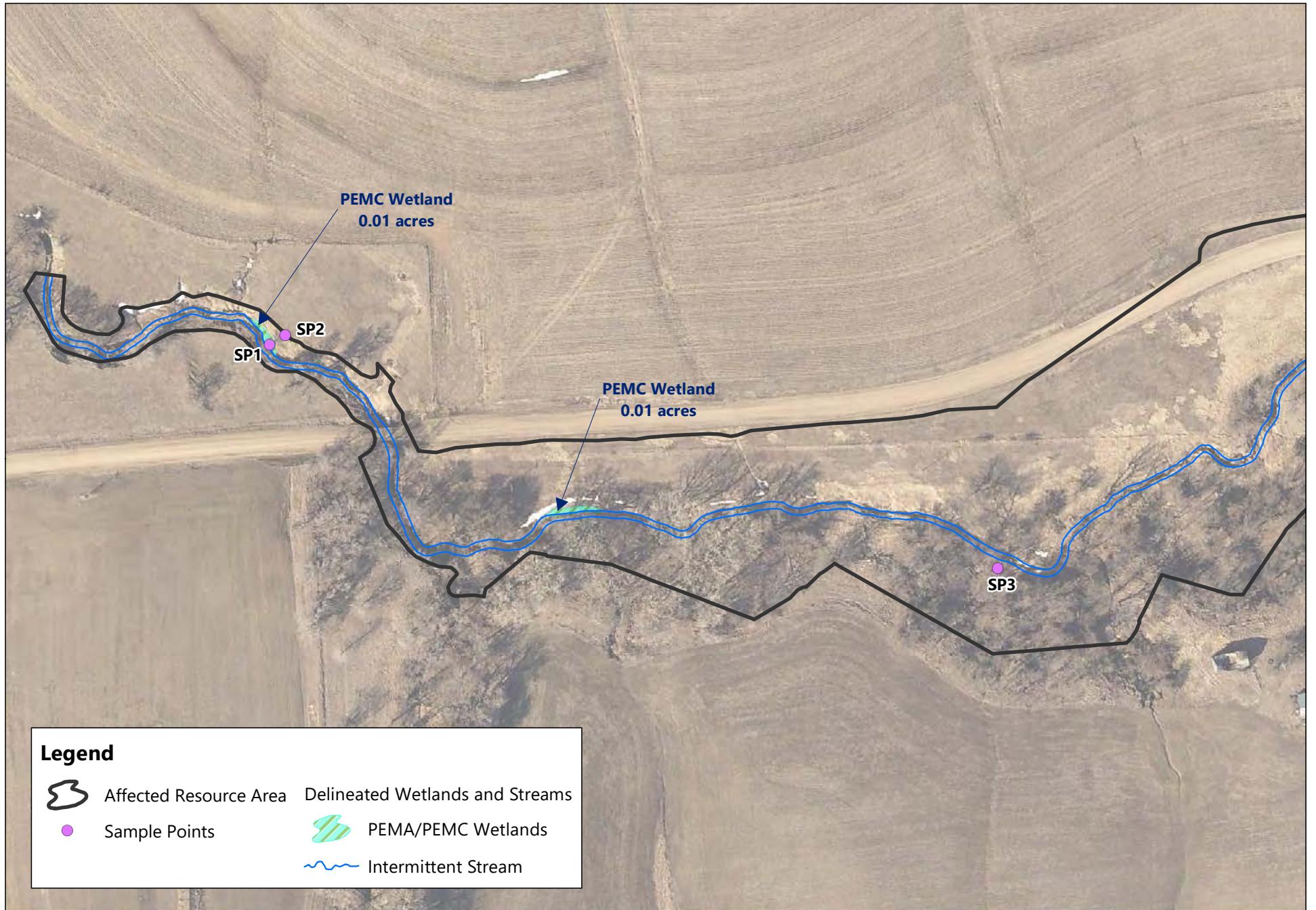


Figure C4.2A. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 75 150 300 Feet



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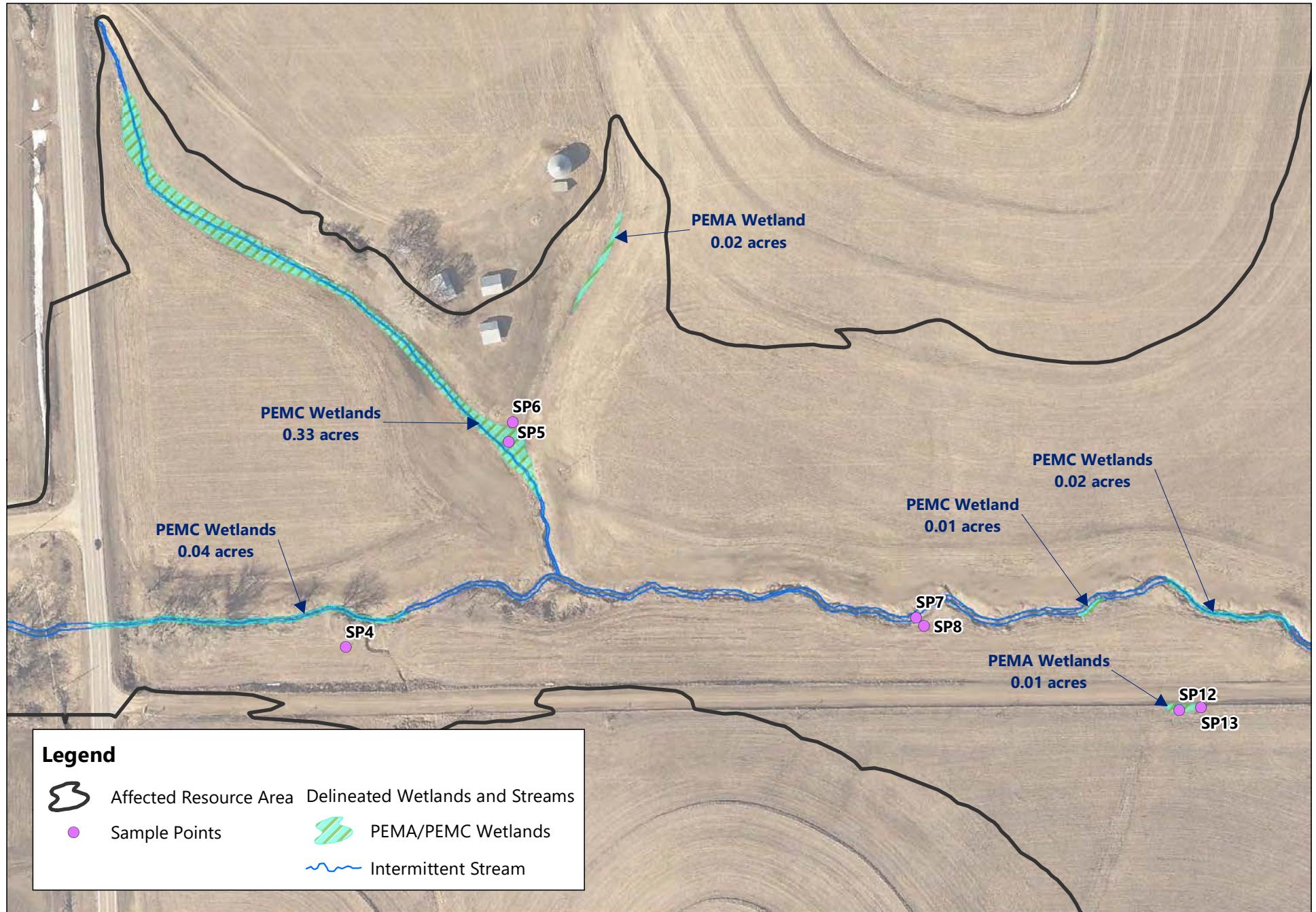


Figure C4.2B. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 95 190 380
Feet



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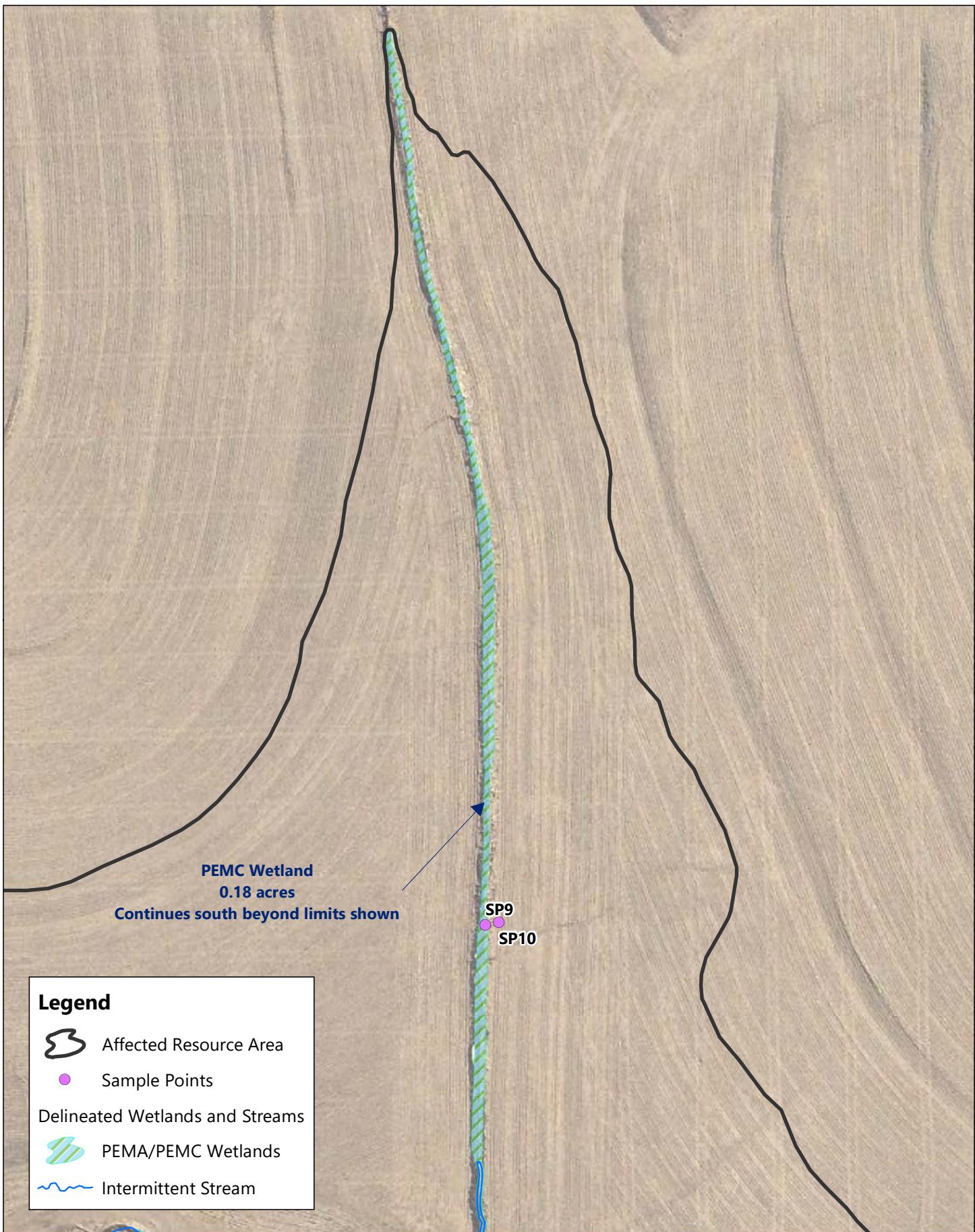
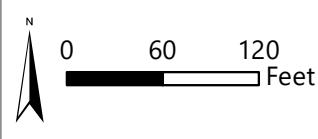


Figure C4.2C. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



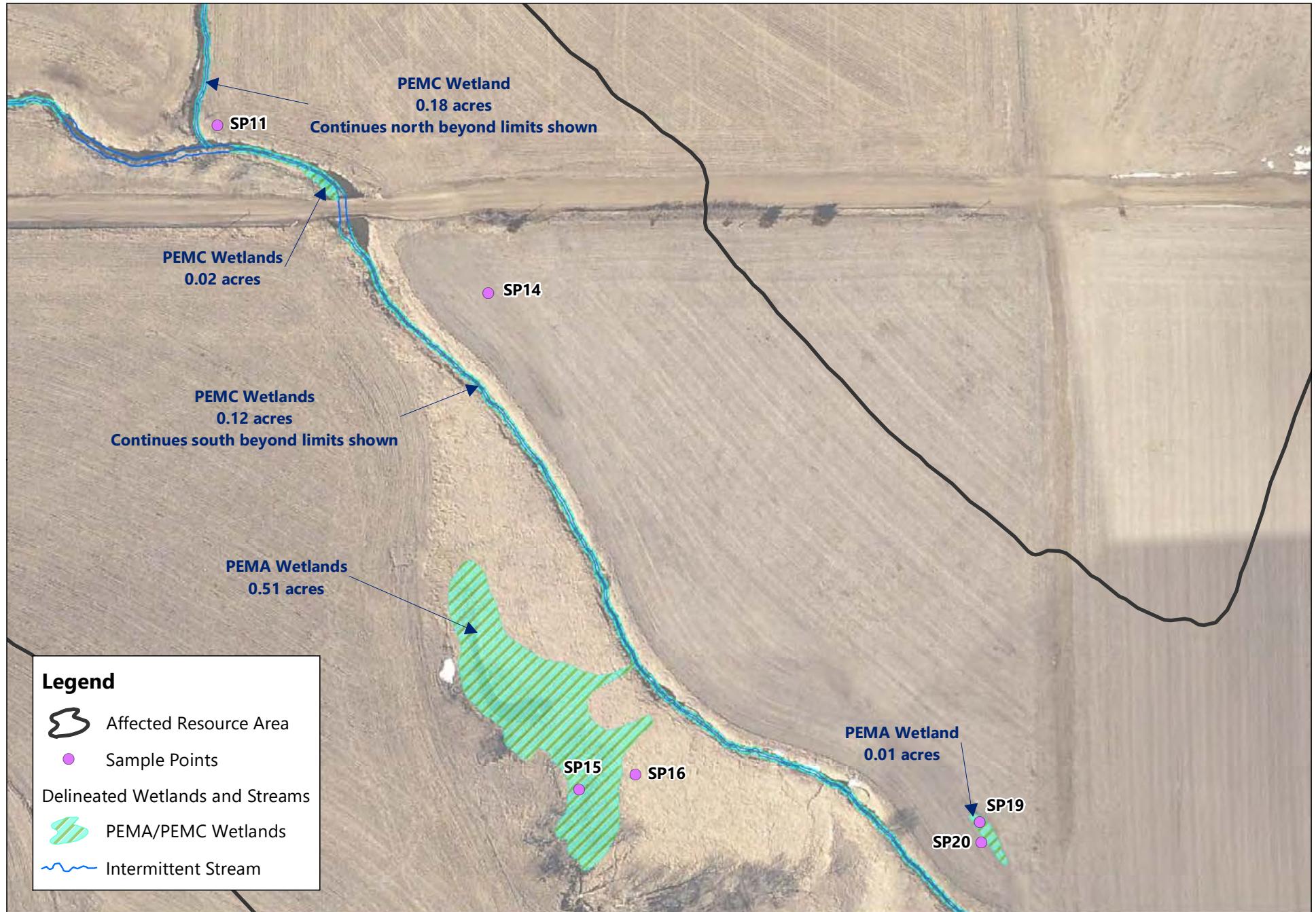


Figure C4.2D. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 65 130 260 Feet



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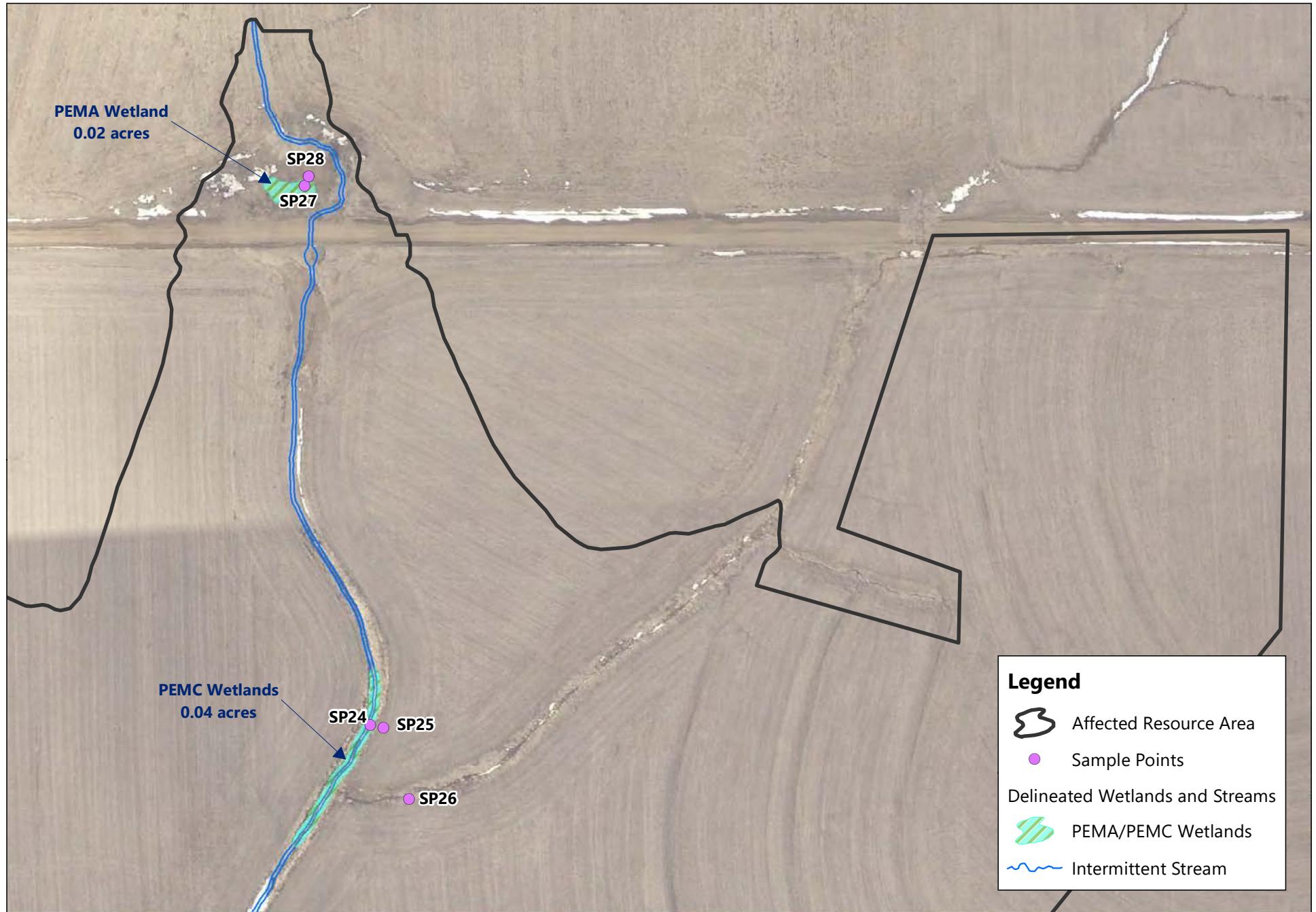


Figure C4.2E. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 75 150 300 Feet



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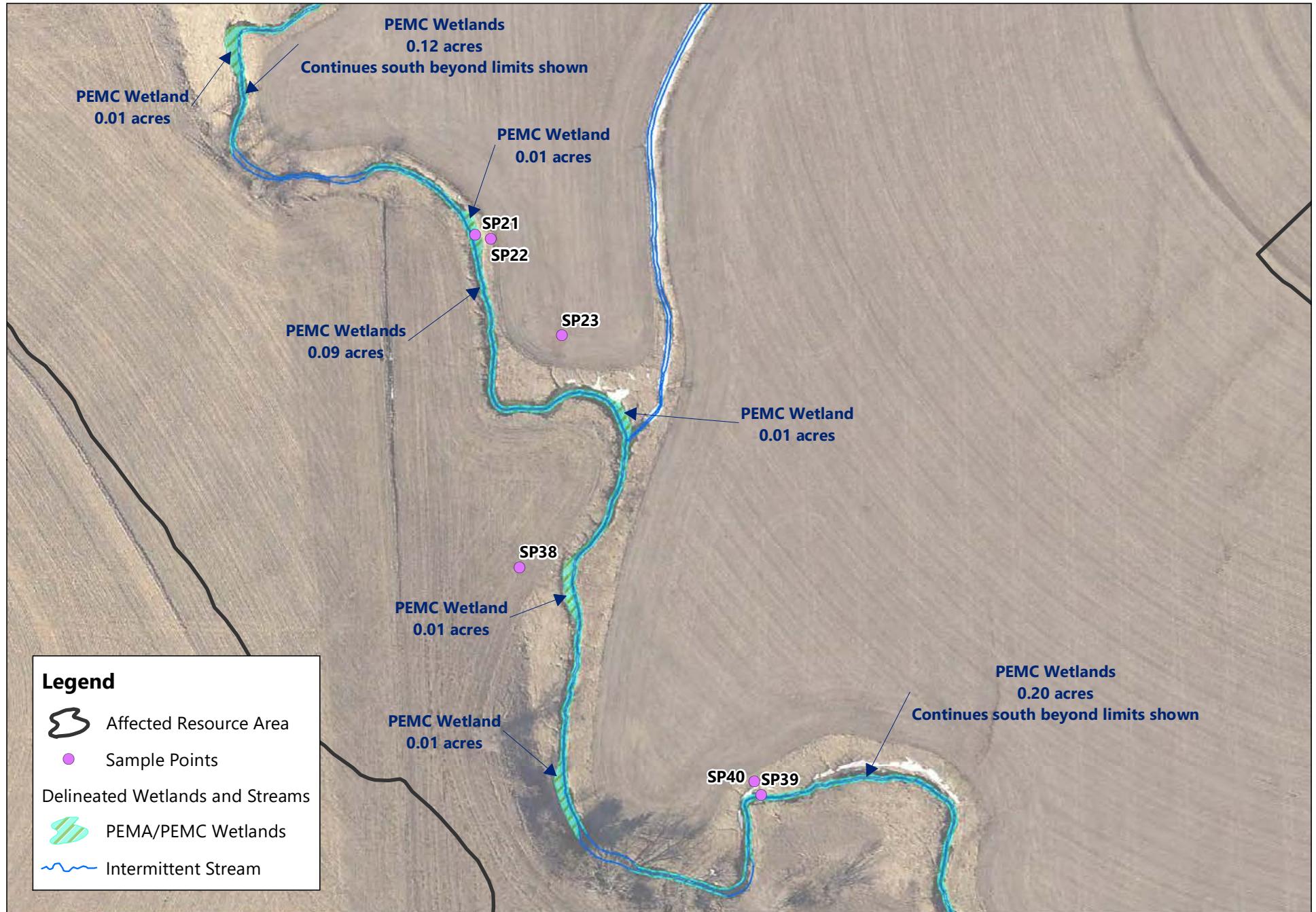


Figure C4.2F. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 75 150 300 Feet



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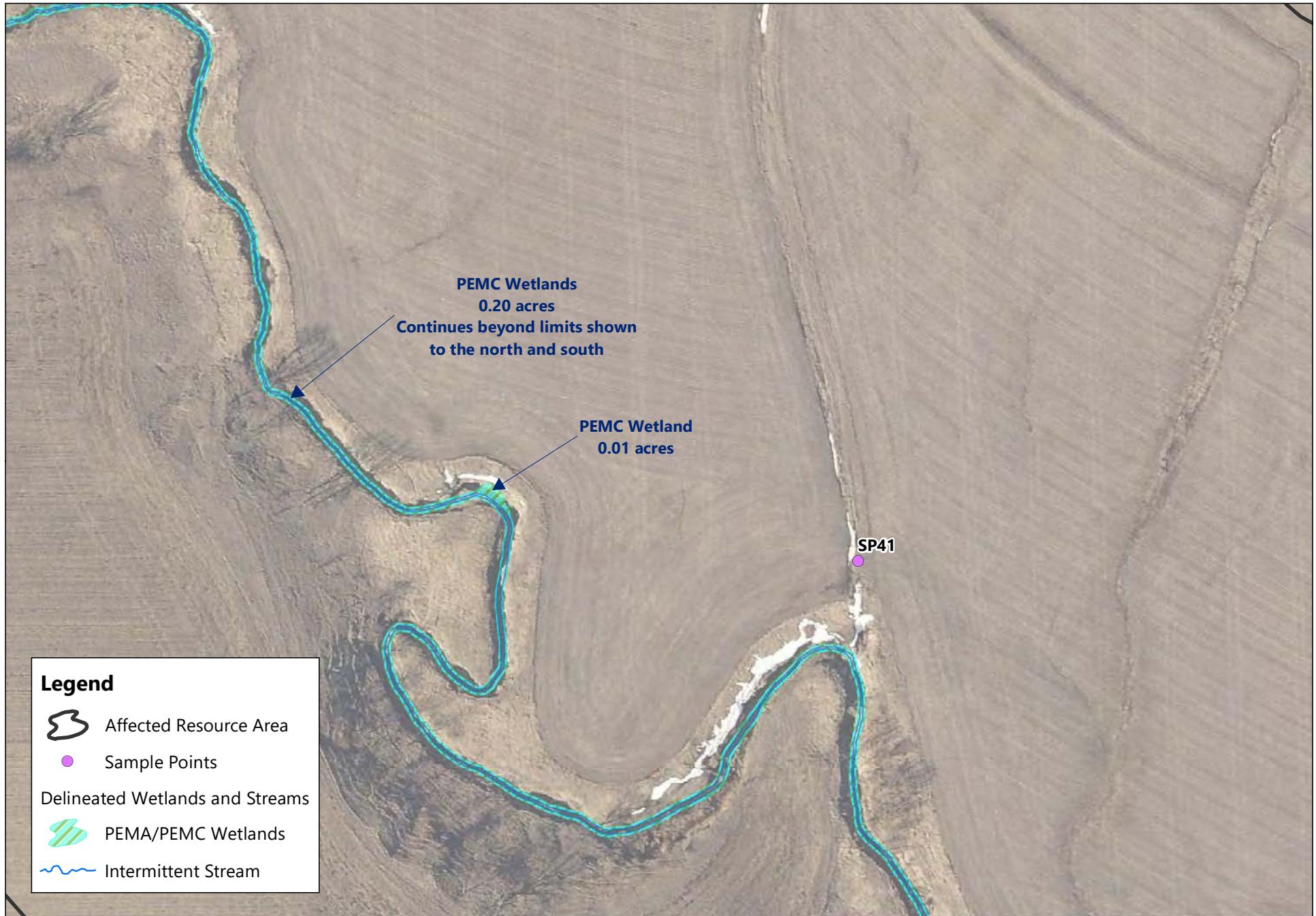


Figure C4.2G. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 60 120 240 Feet



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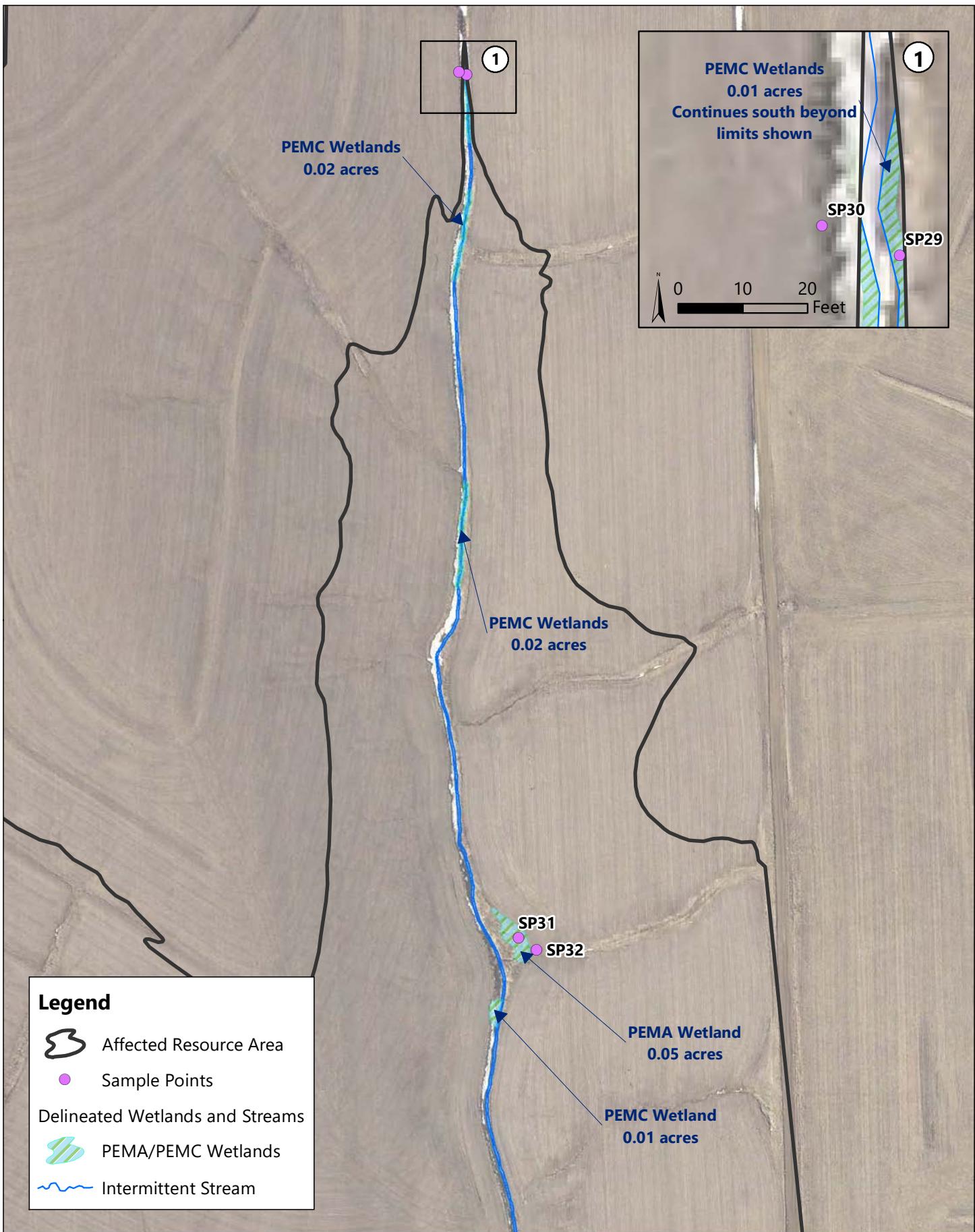
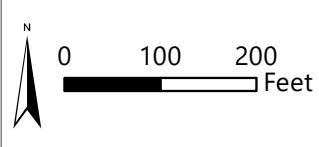


Figure C4.2H. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



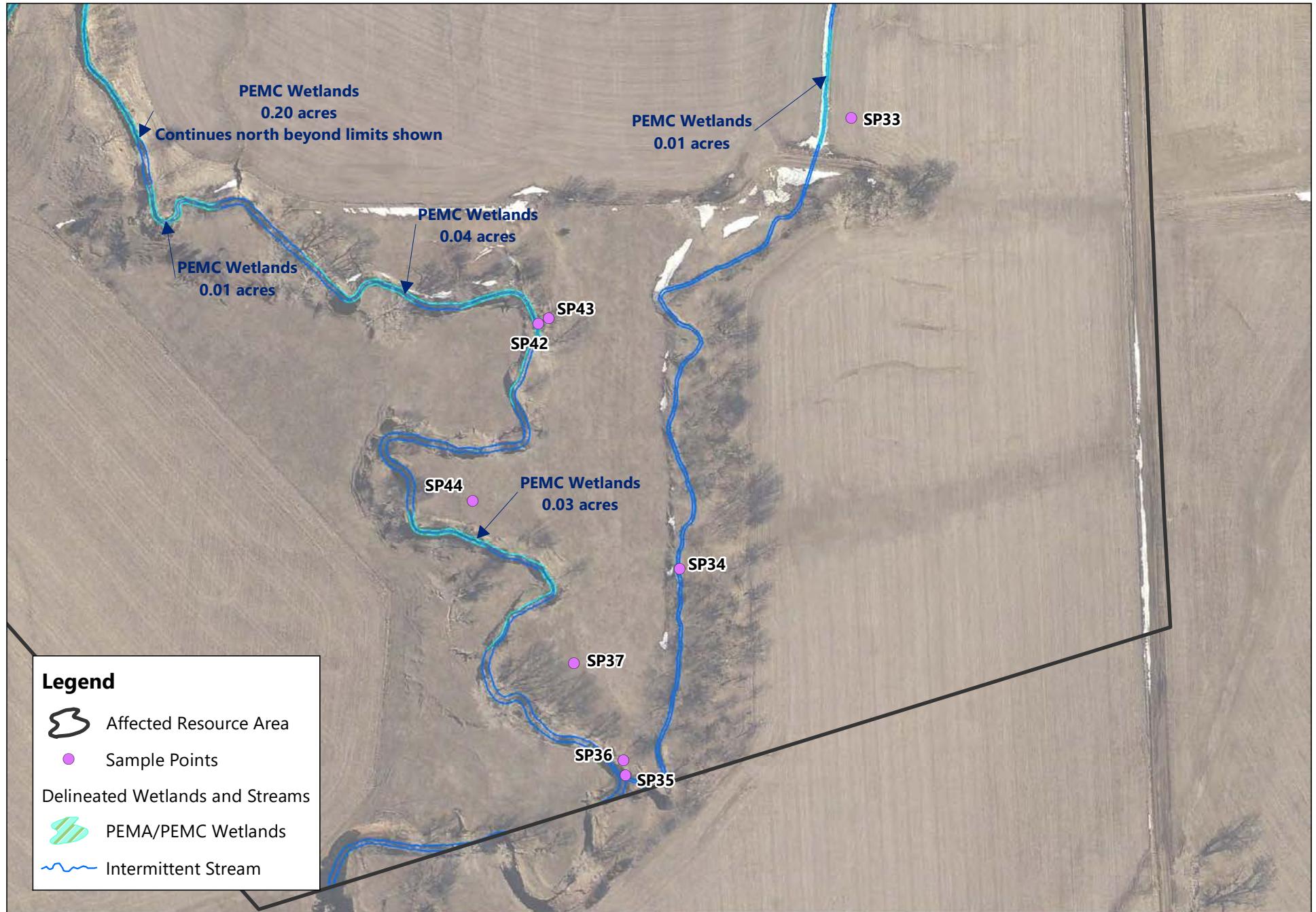


Figure C4.2I. Site 27 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 95 190 380 Feet



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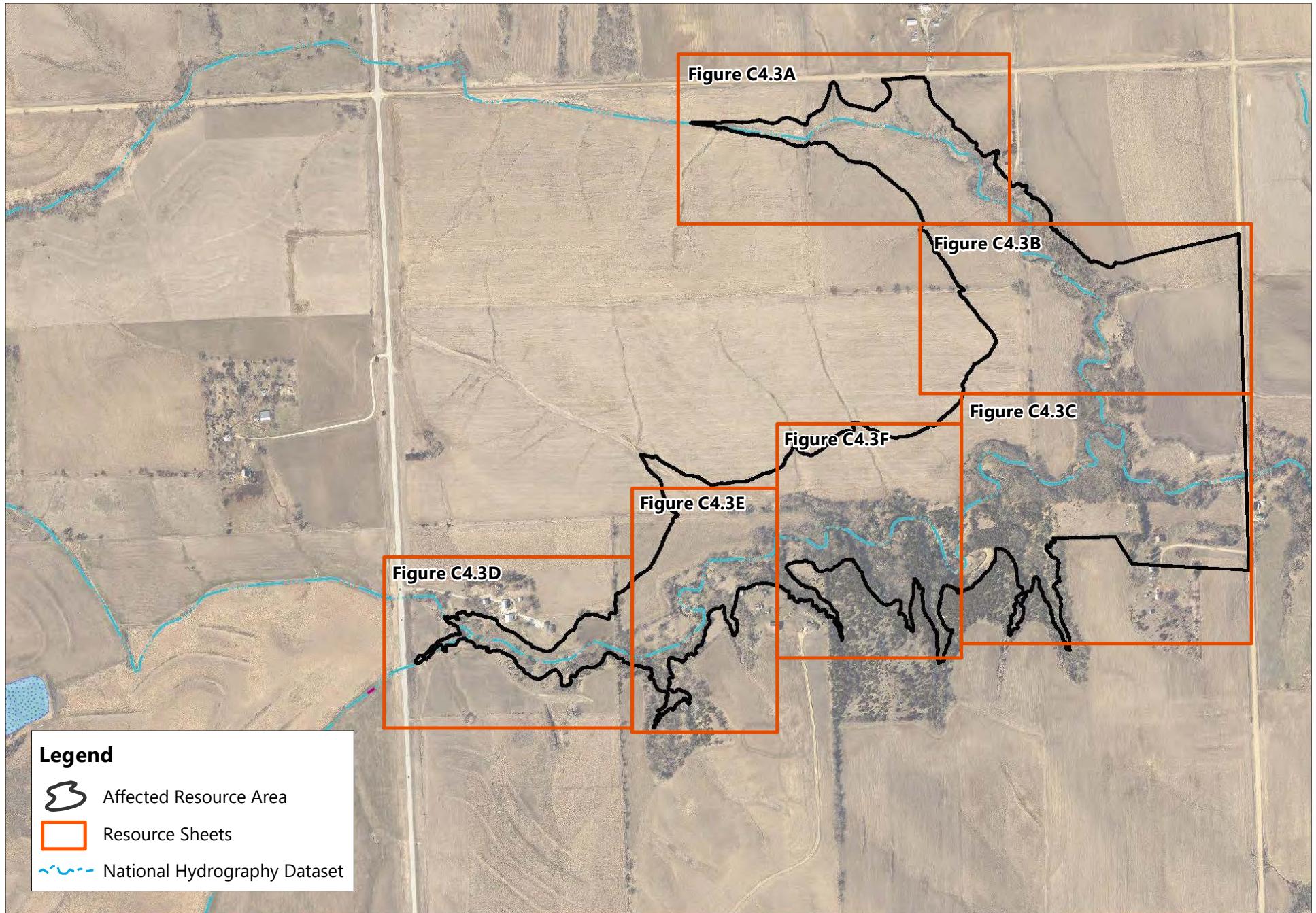


Figure C4.3. Site 55 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD



0 400 800 1,600 Feet



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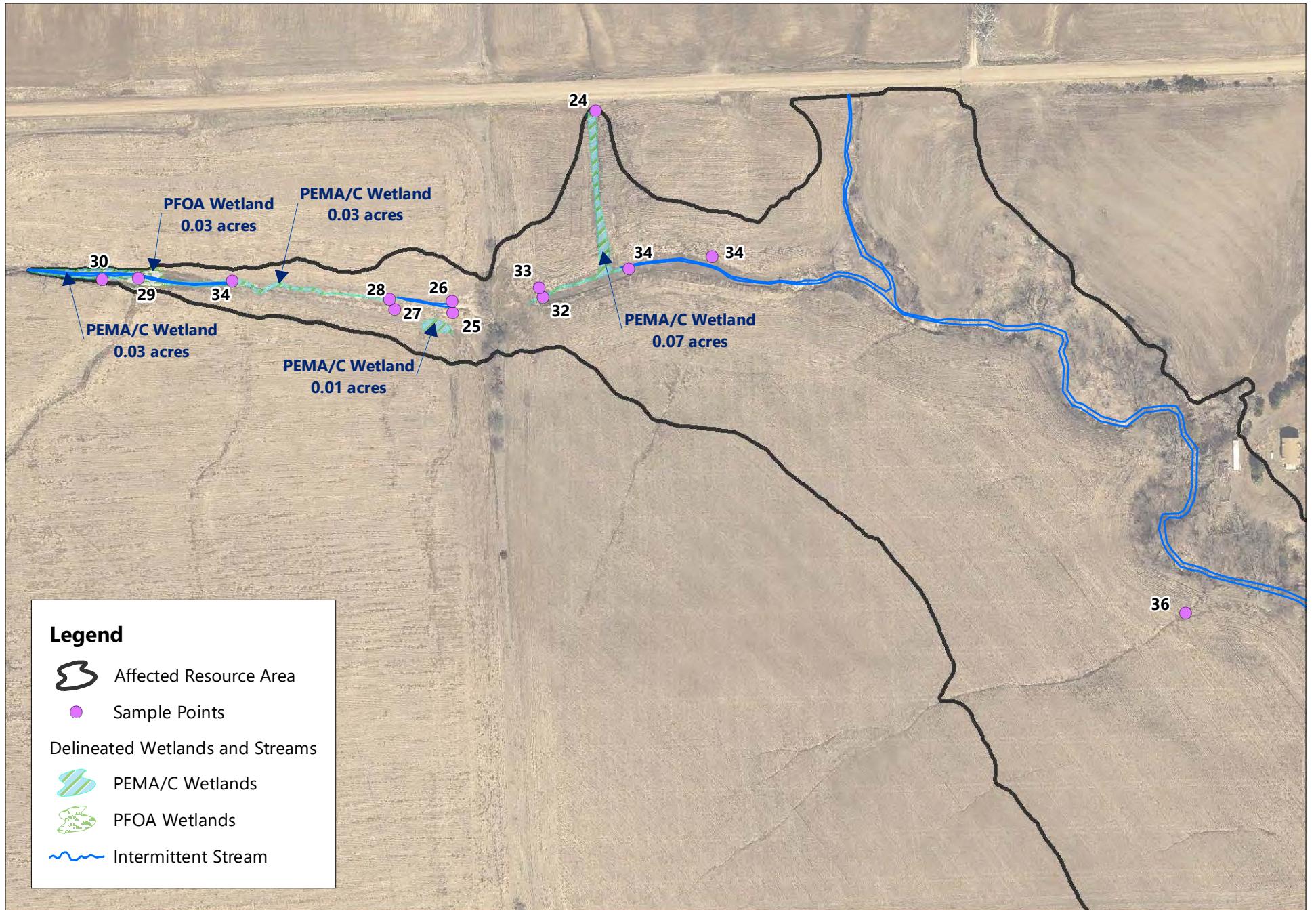


Figure C4.3A. Site 55 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400 Feet



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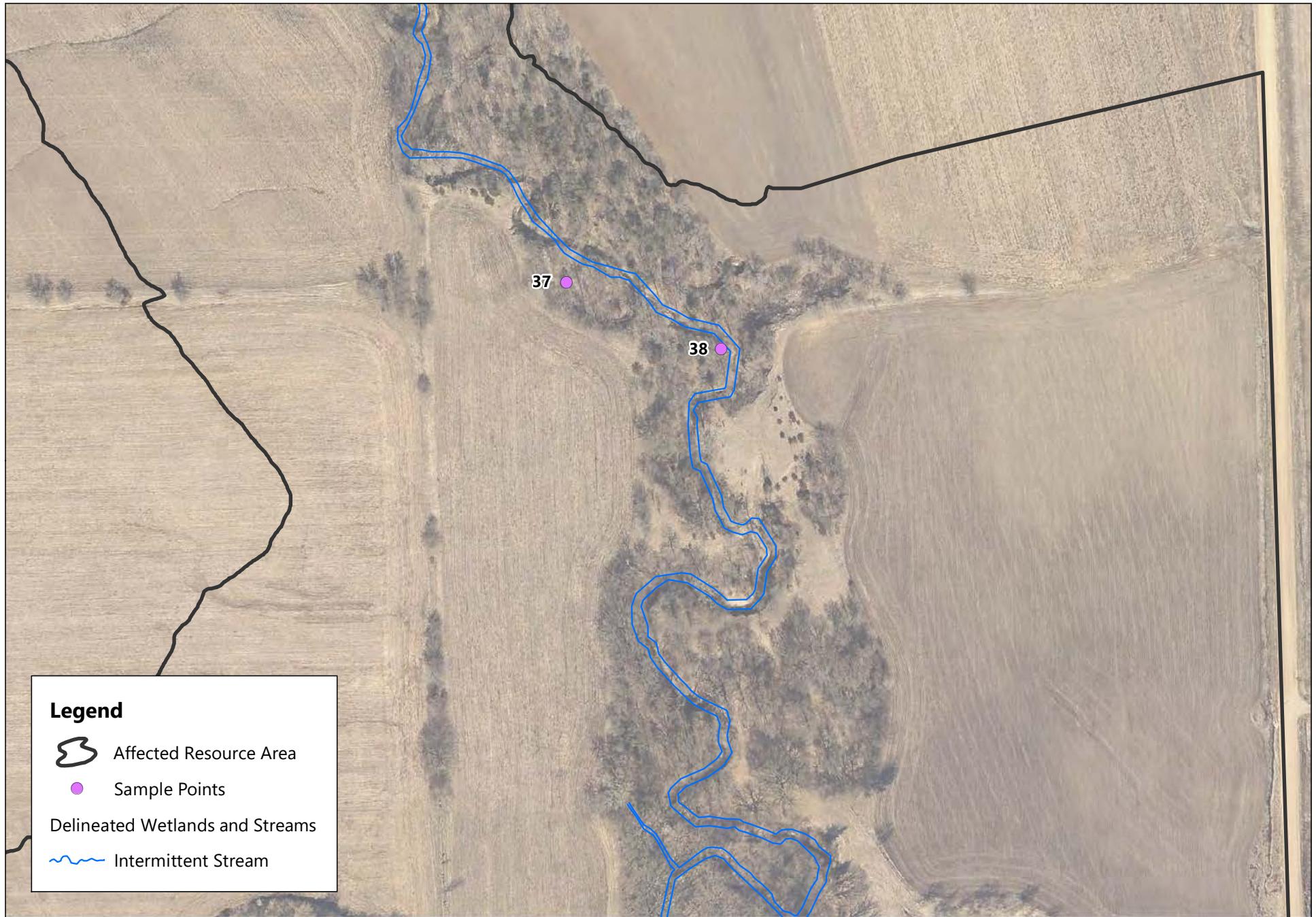


Figure C4.3B. Site 55 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400
Feet



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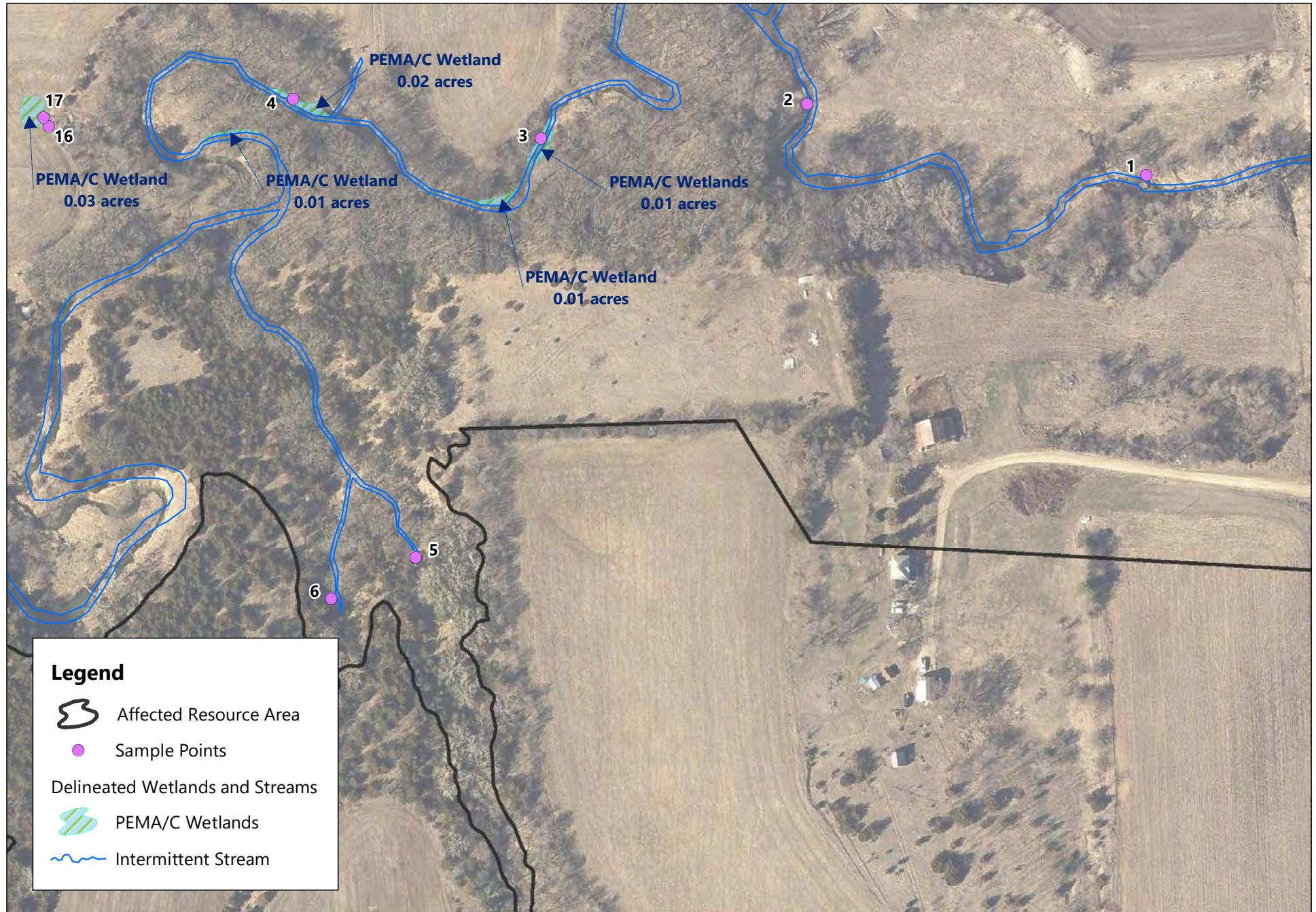


Figure C4.3C. Site 55 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 90 180 360 Feet



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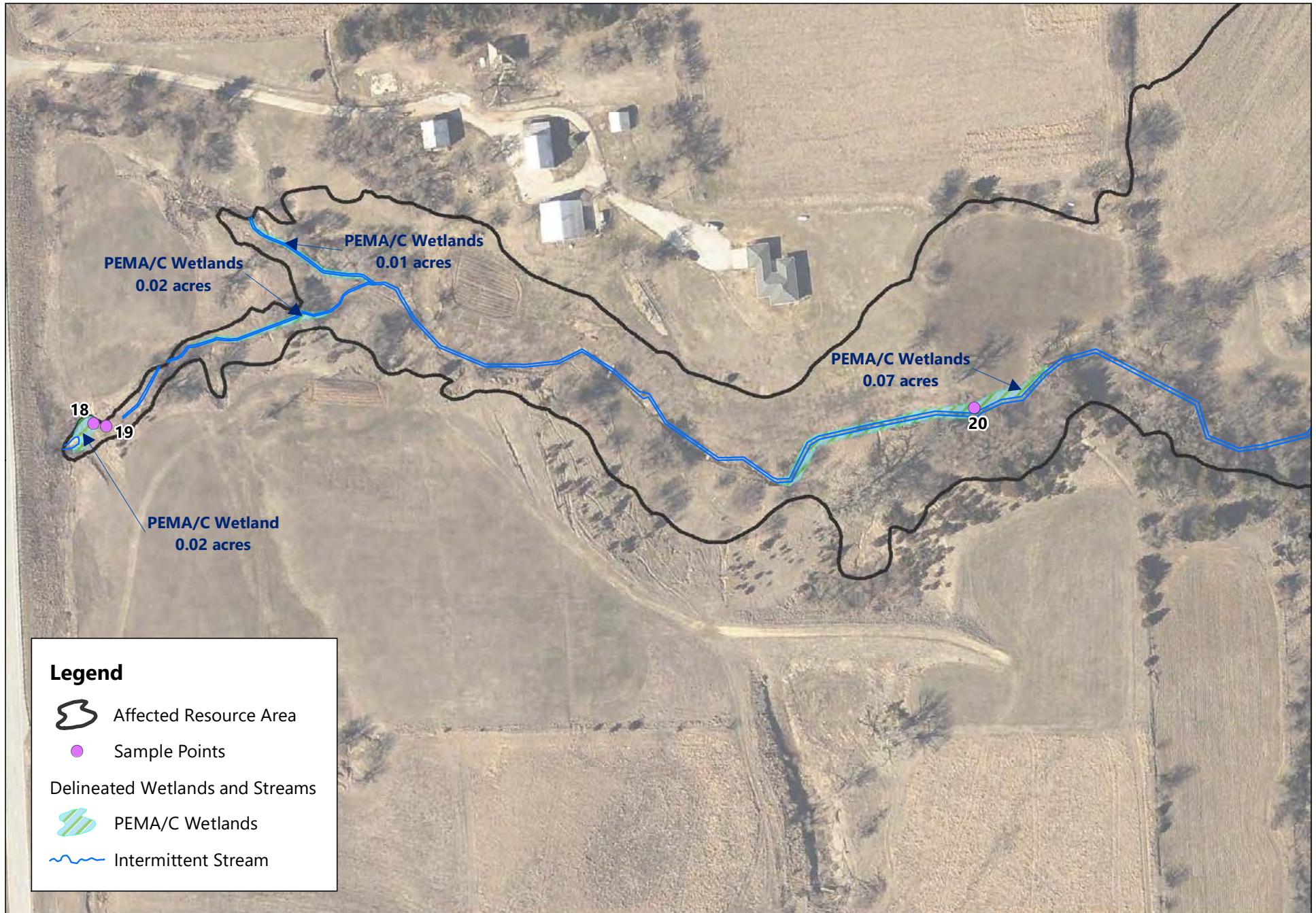


Figure C4.3D. Site 55 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 75 150 300 Feet



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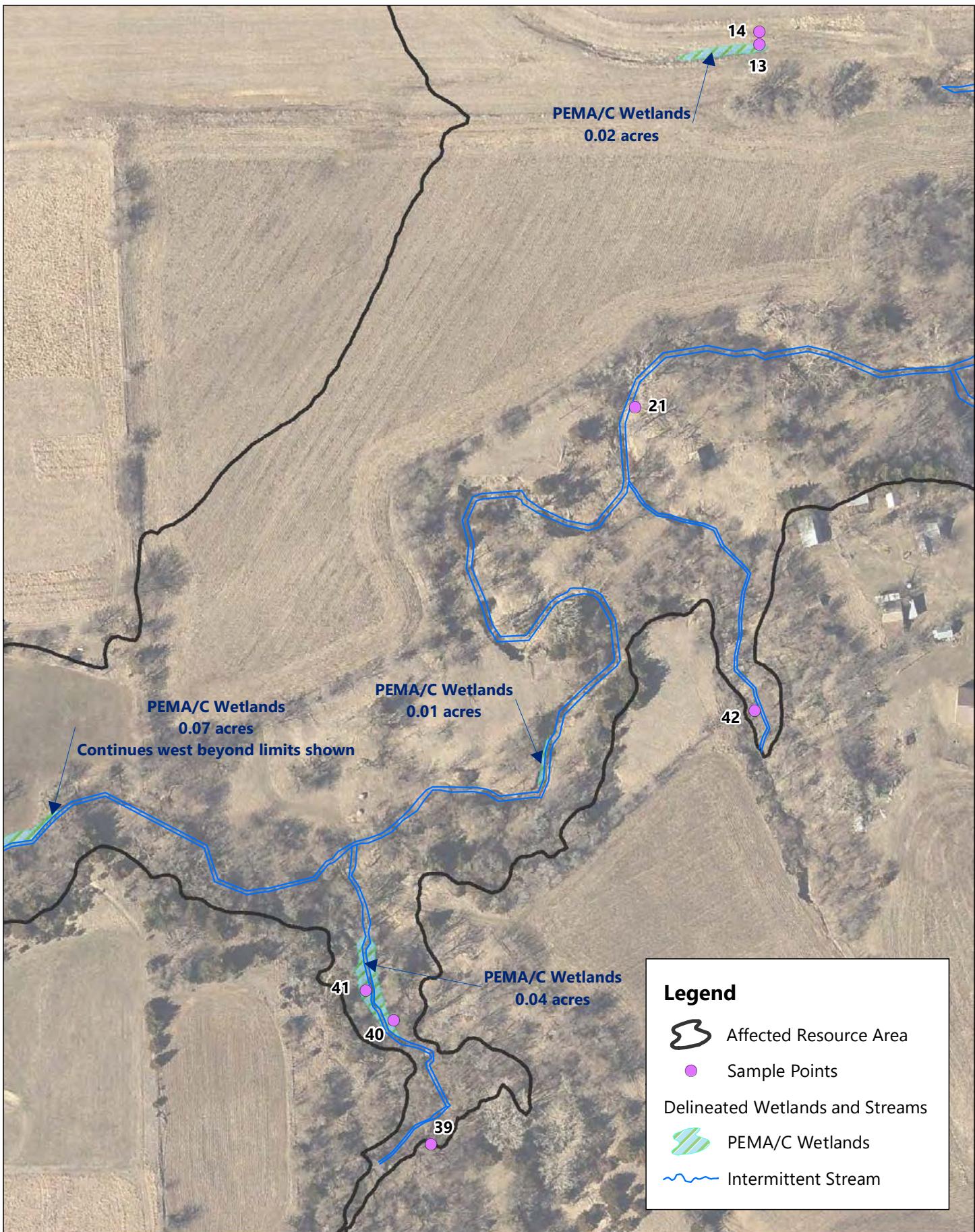
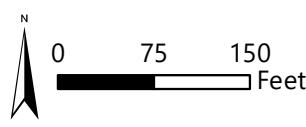


Figure C4.3E. Site 55 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD



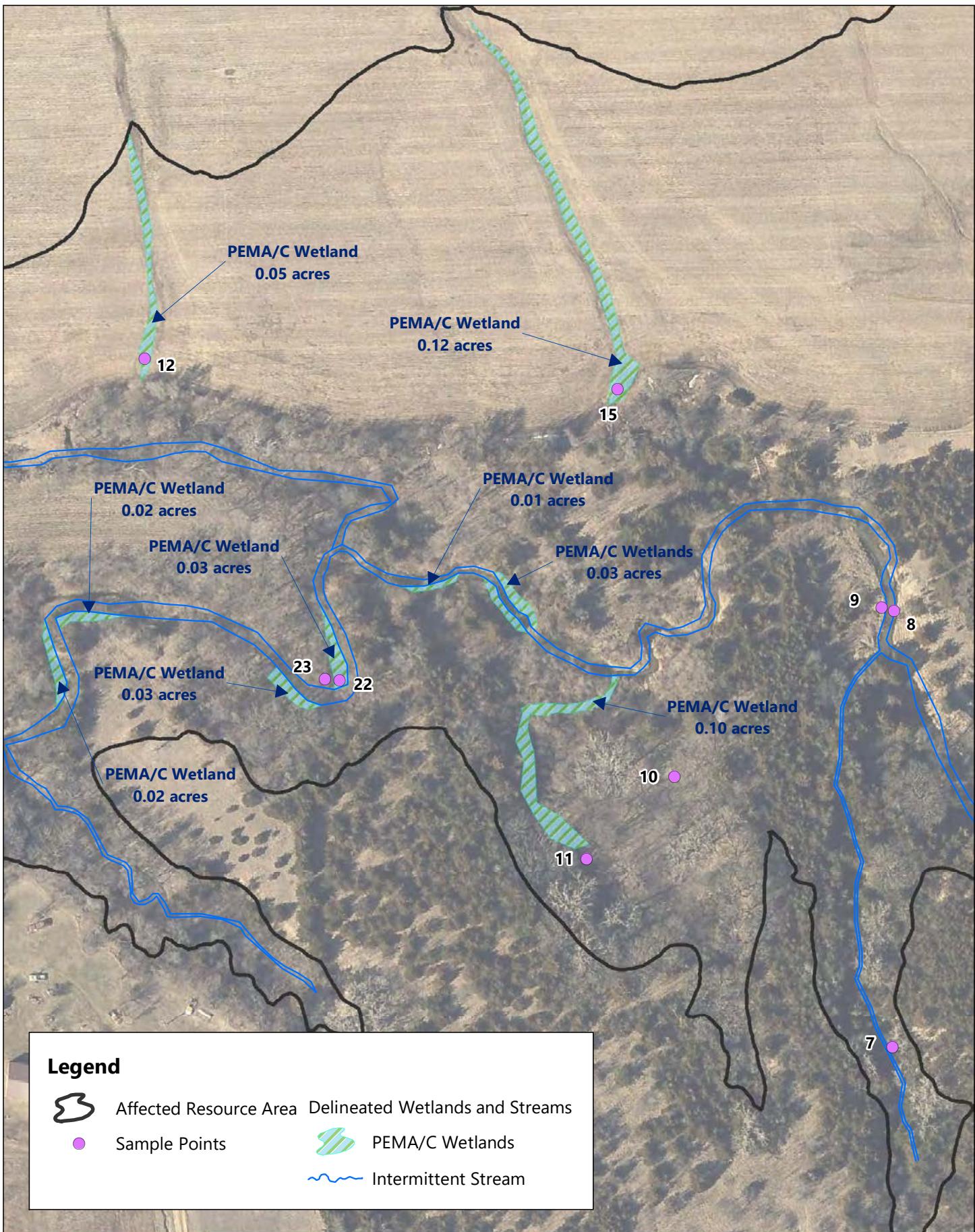
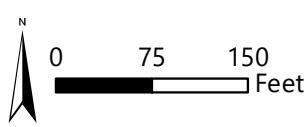


Figure C4.3F. Site 55 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



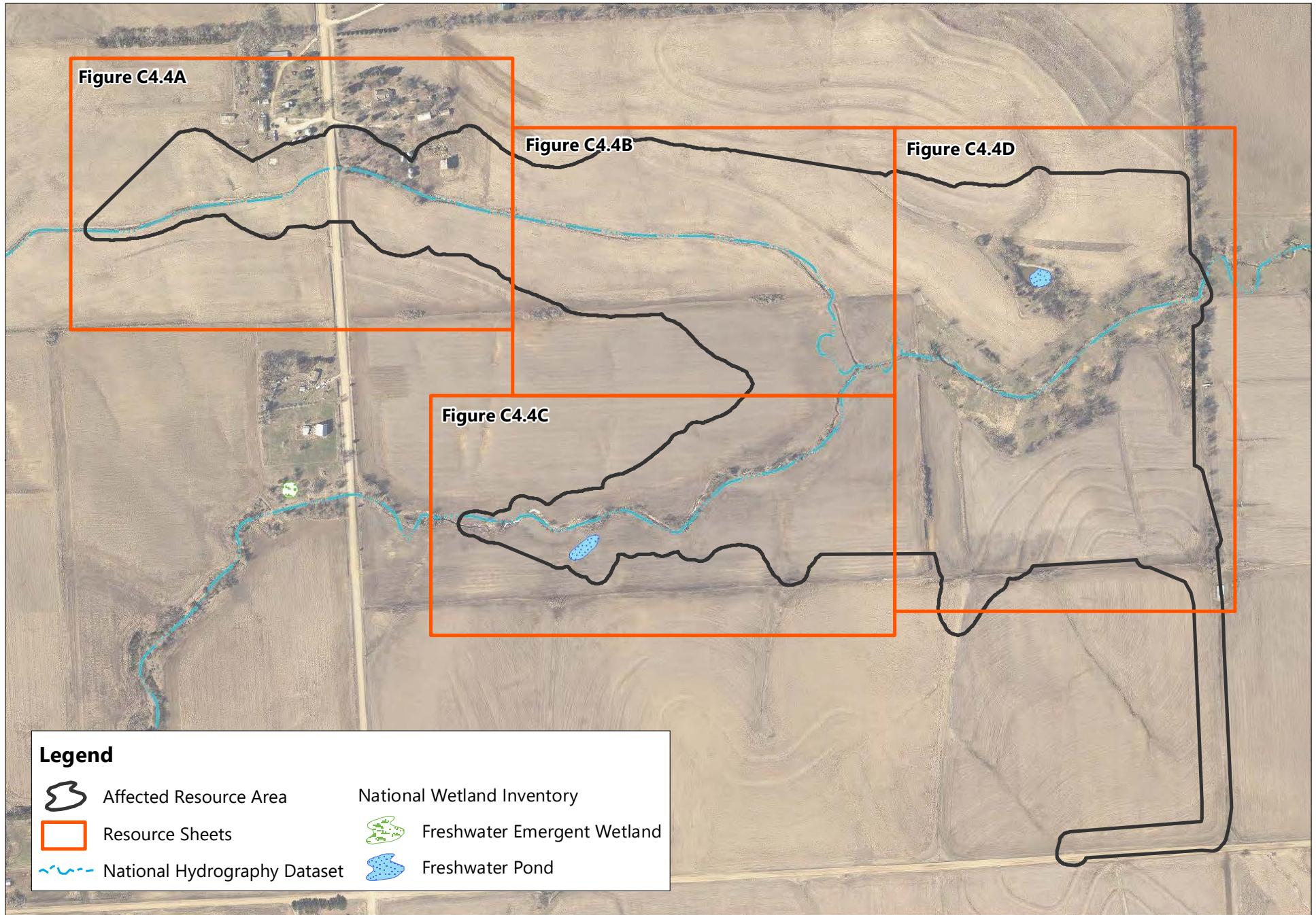


Figure C4.4. Site 66 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
 Natural Resources Conservation Service
 Lower Platte North NRD



0 600 1,200 Feet



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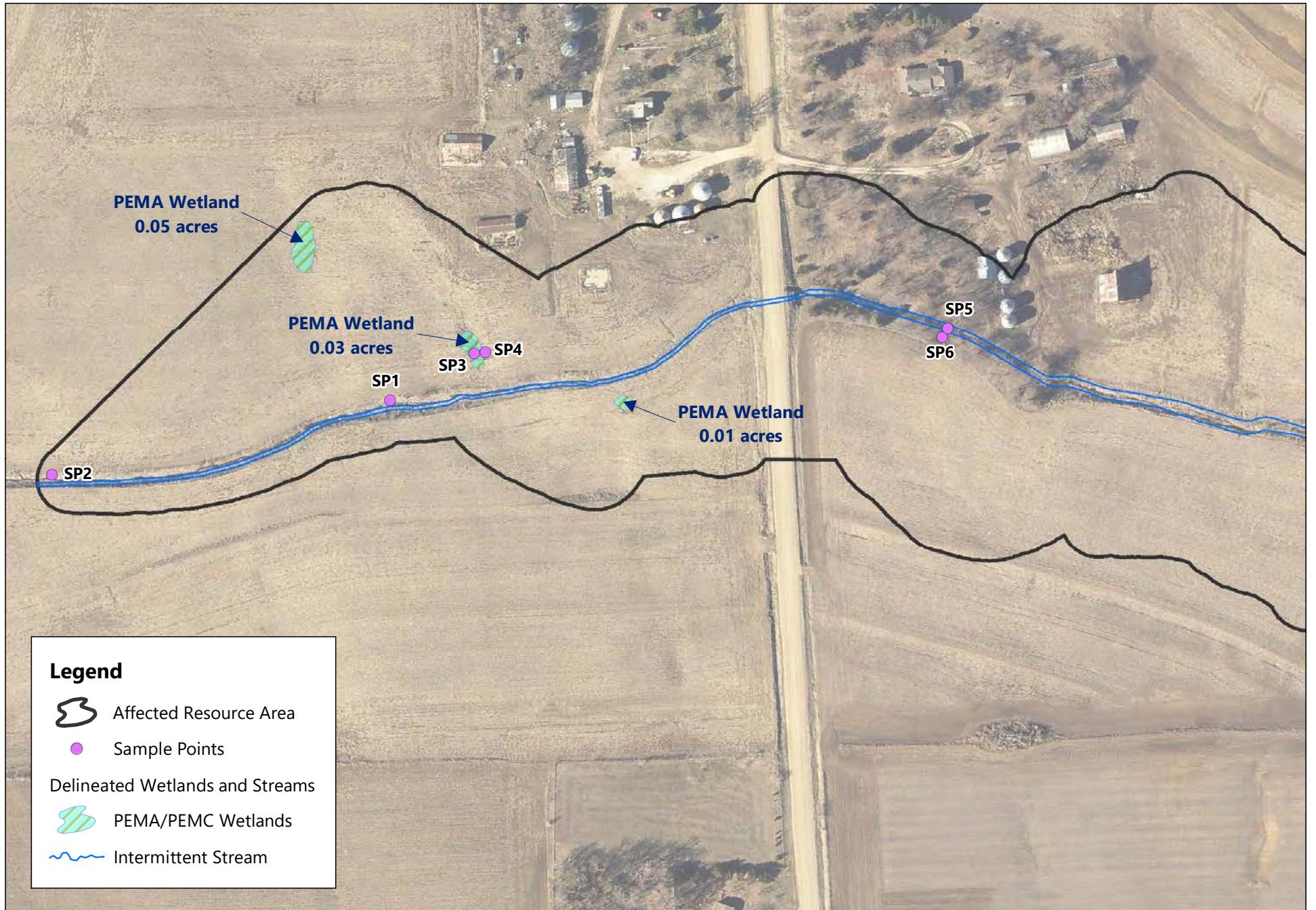


Figure C4.4A. Site 66 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400 Feet



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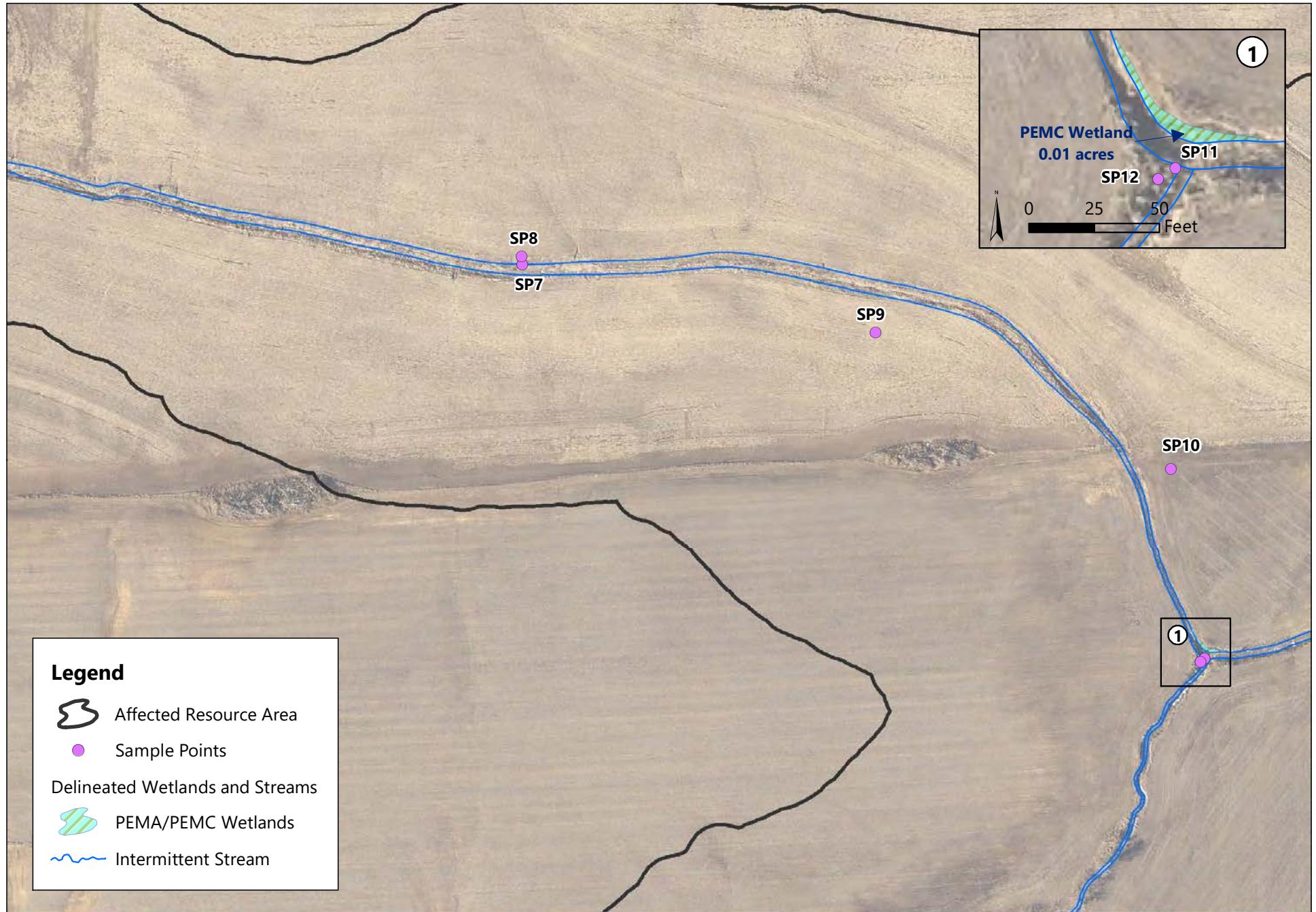


Figure C4.4B. Site 66 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400
Feet



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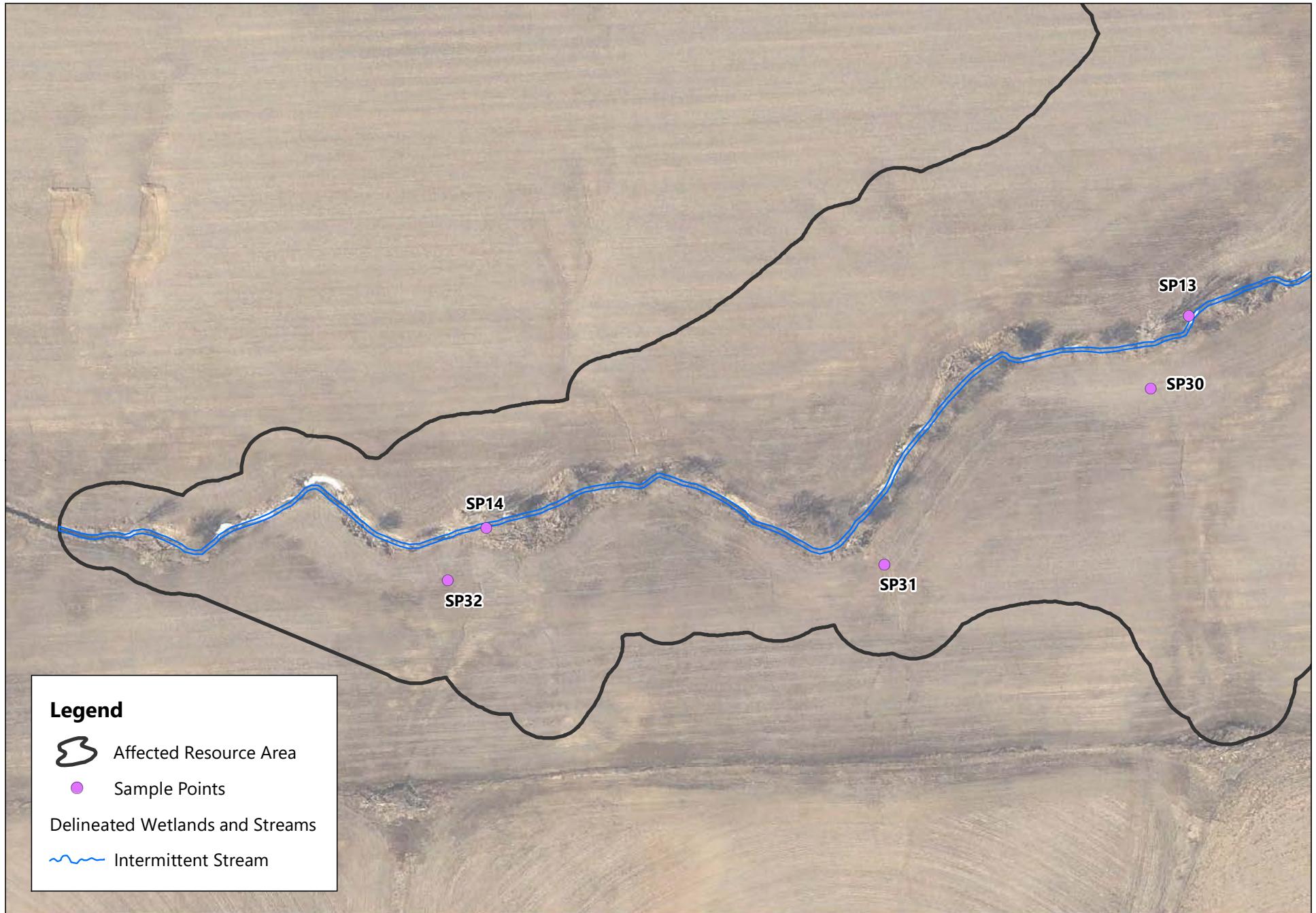


Figure C4.4C. Site 66 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 85 170 340
Feet



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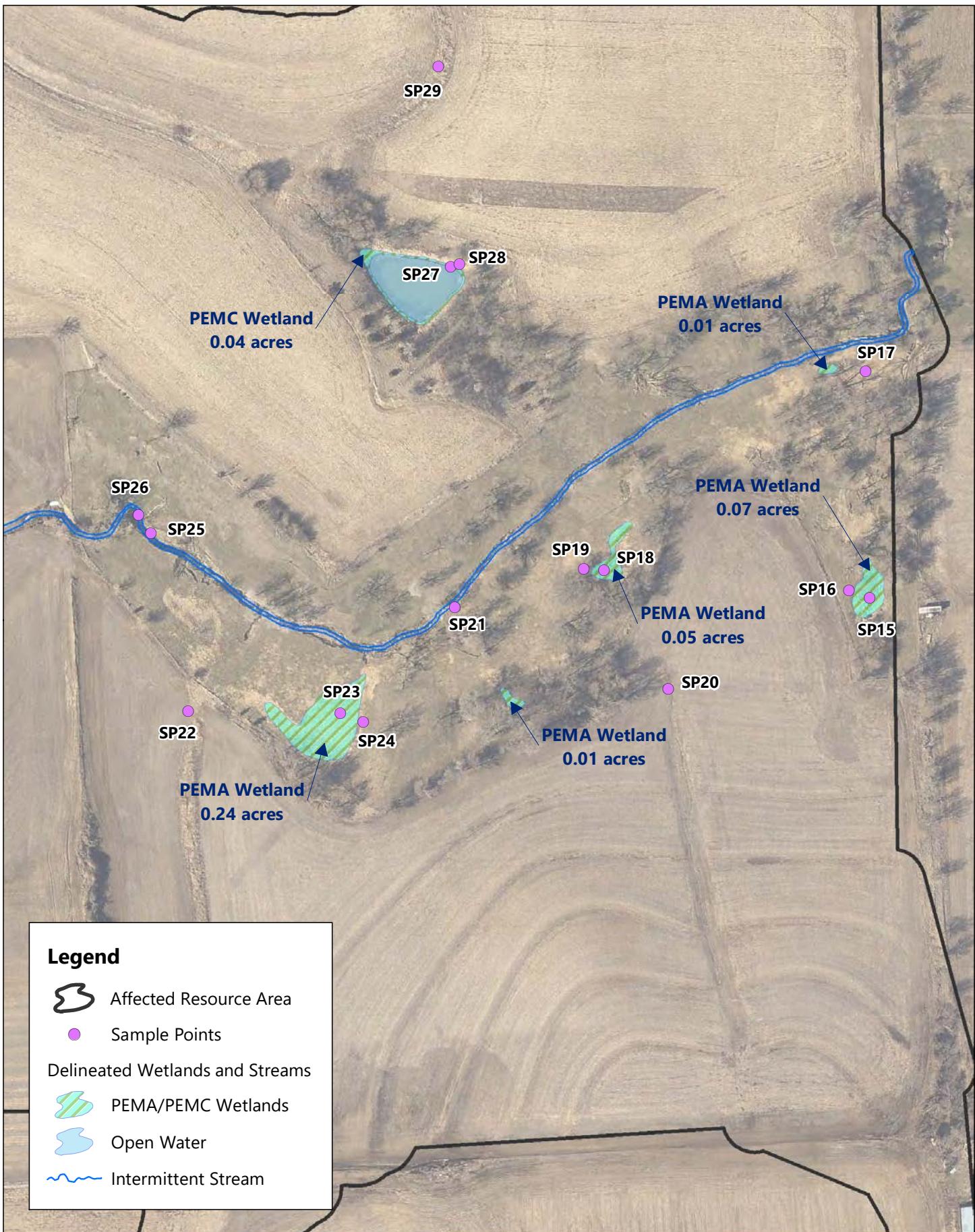
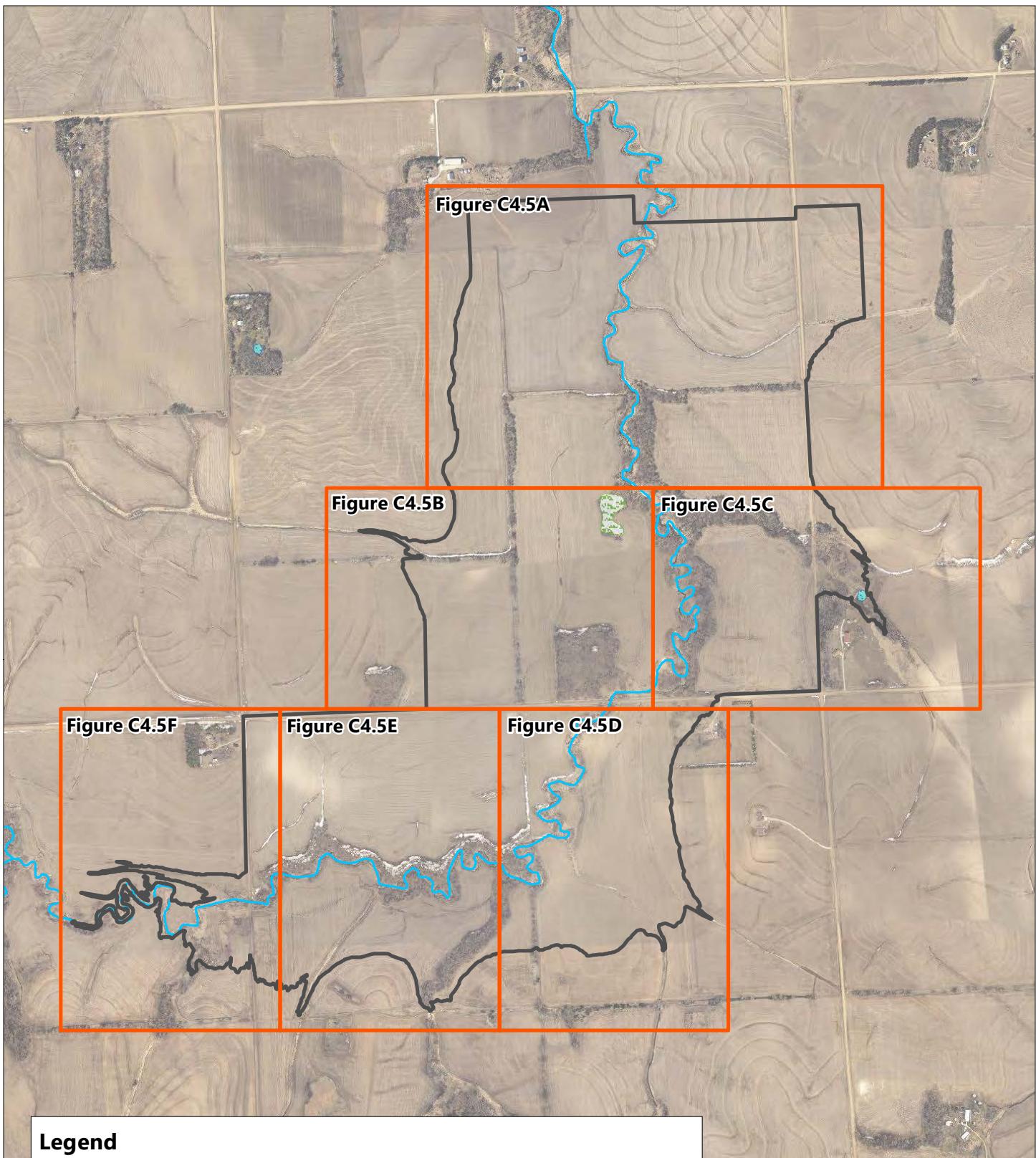


Figure C4.4D. Site 66 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 Feet



Legend

- | | |
|------------------------------|-----------------------------|
| Affected Resource Area | National Wetland Inventory |
| Resource Sheets | Freshwater Emergent Wetland |
| National Hydrography Dataset | Freshwater Pond |

Figure C4.5. Site 77 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 600 1,200 Feet



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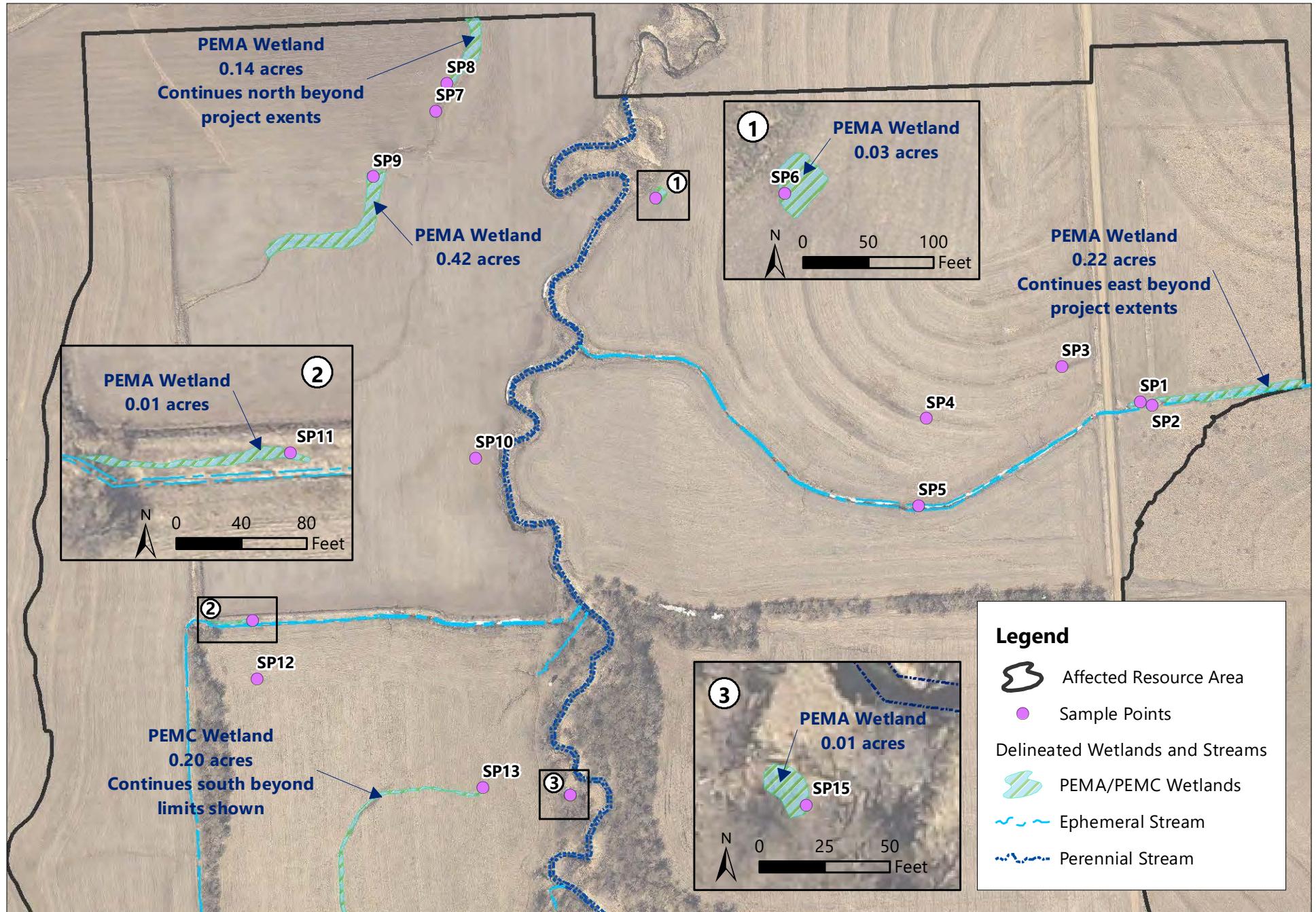


Figure C4.5A. Site 77 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD

N
0 185 370 740 Feet



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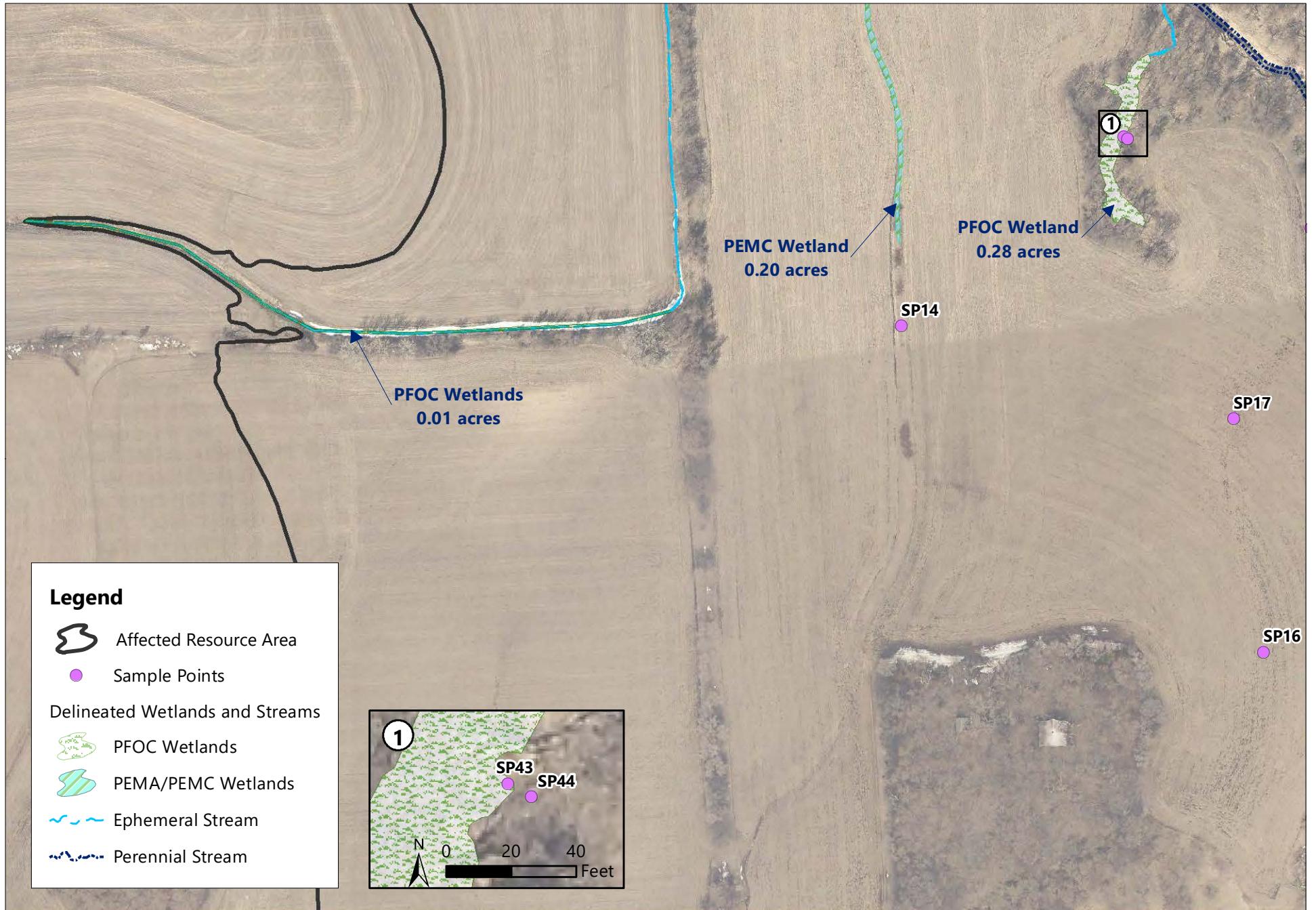


Figure C4.5B. Site 77 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 130 260 520 Feet



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ENGINEERING

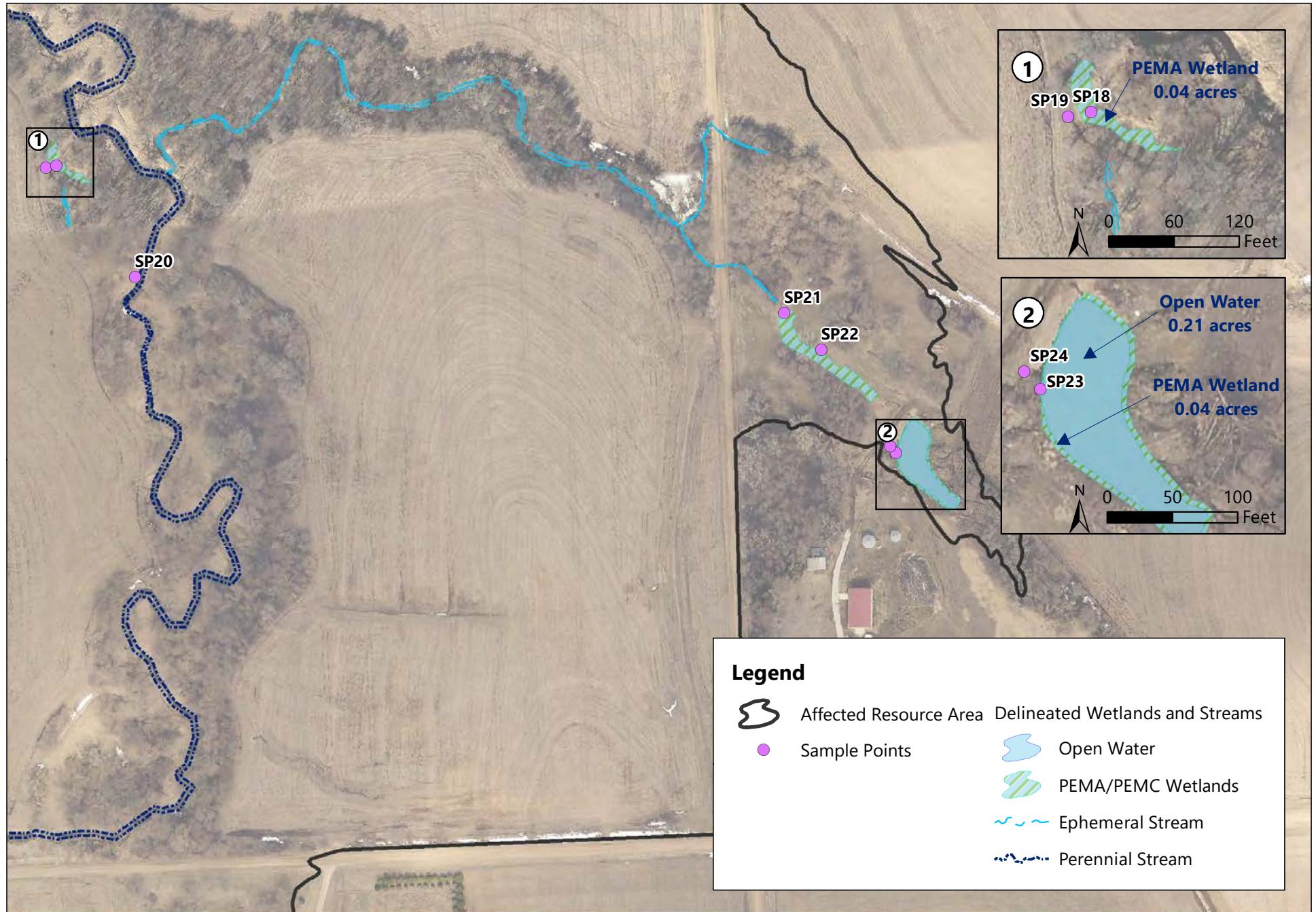


Figure C4.5C. Site 77 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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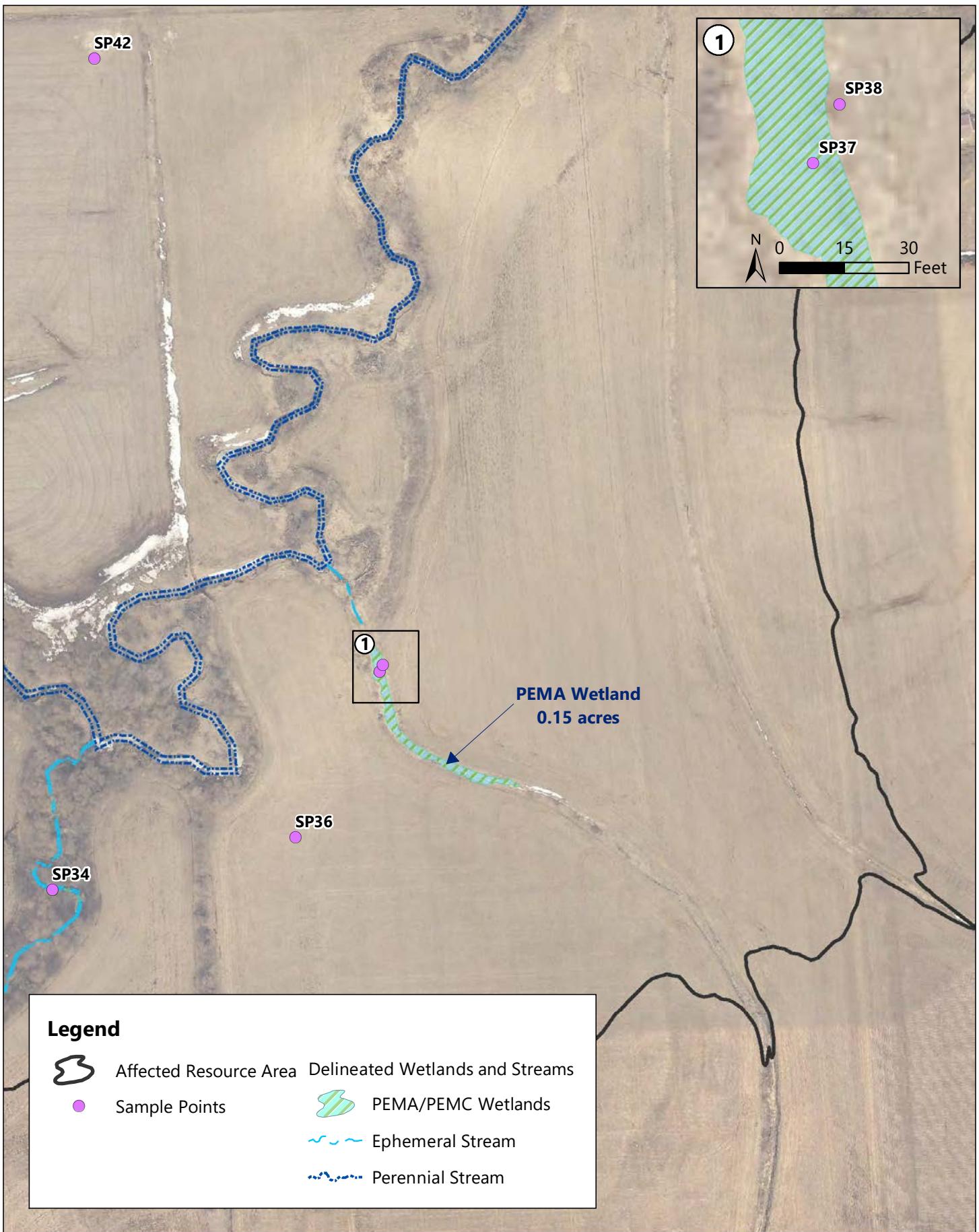
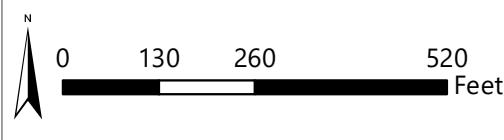


Figure C4.5D. Site 77 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD



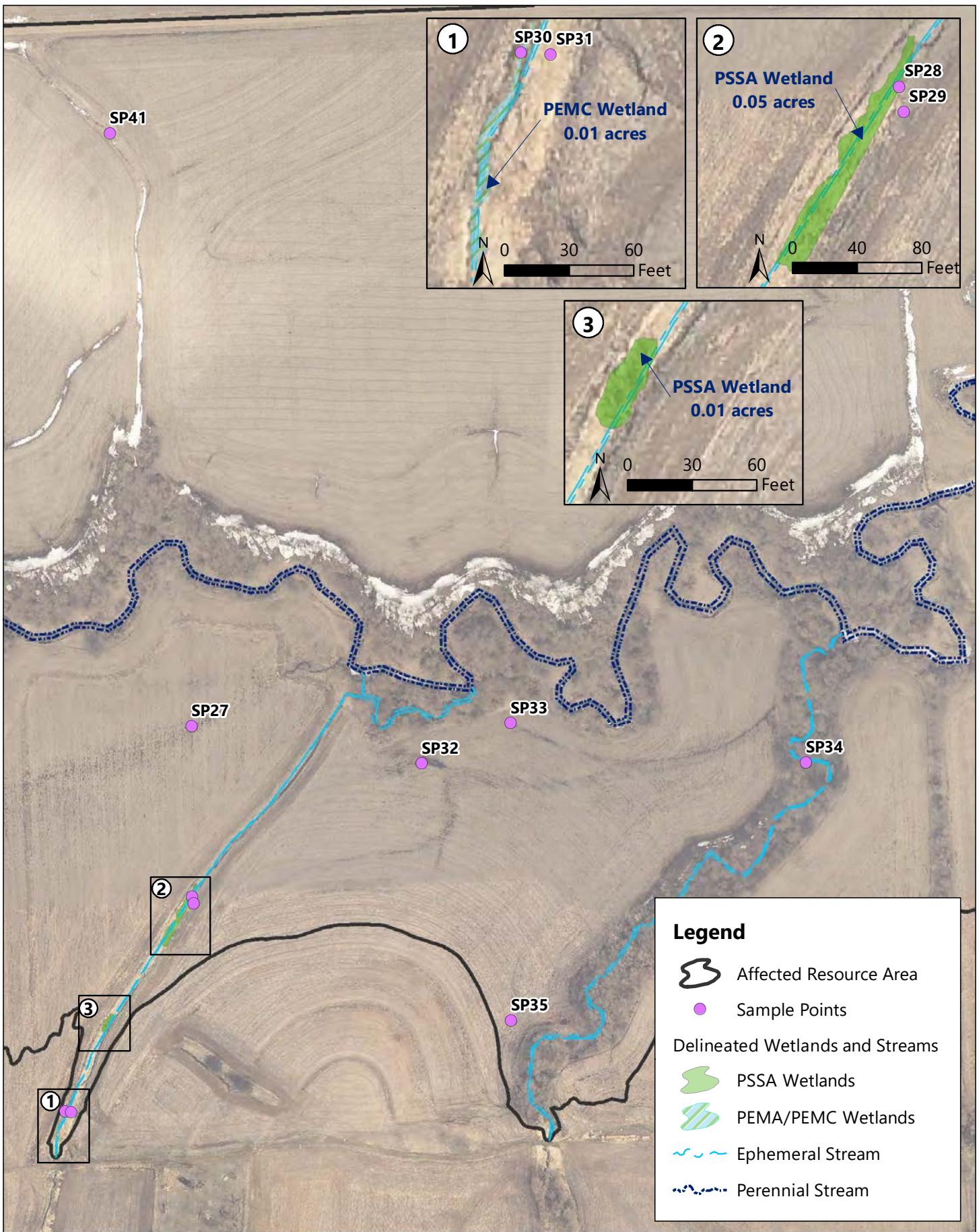
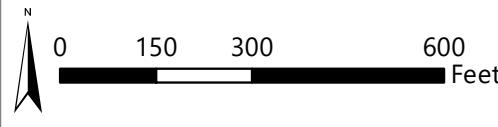


Figure C4.5E. Site 77 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD



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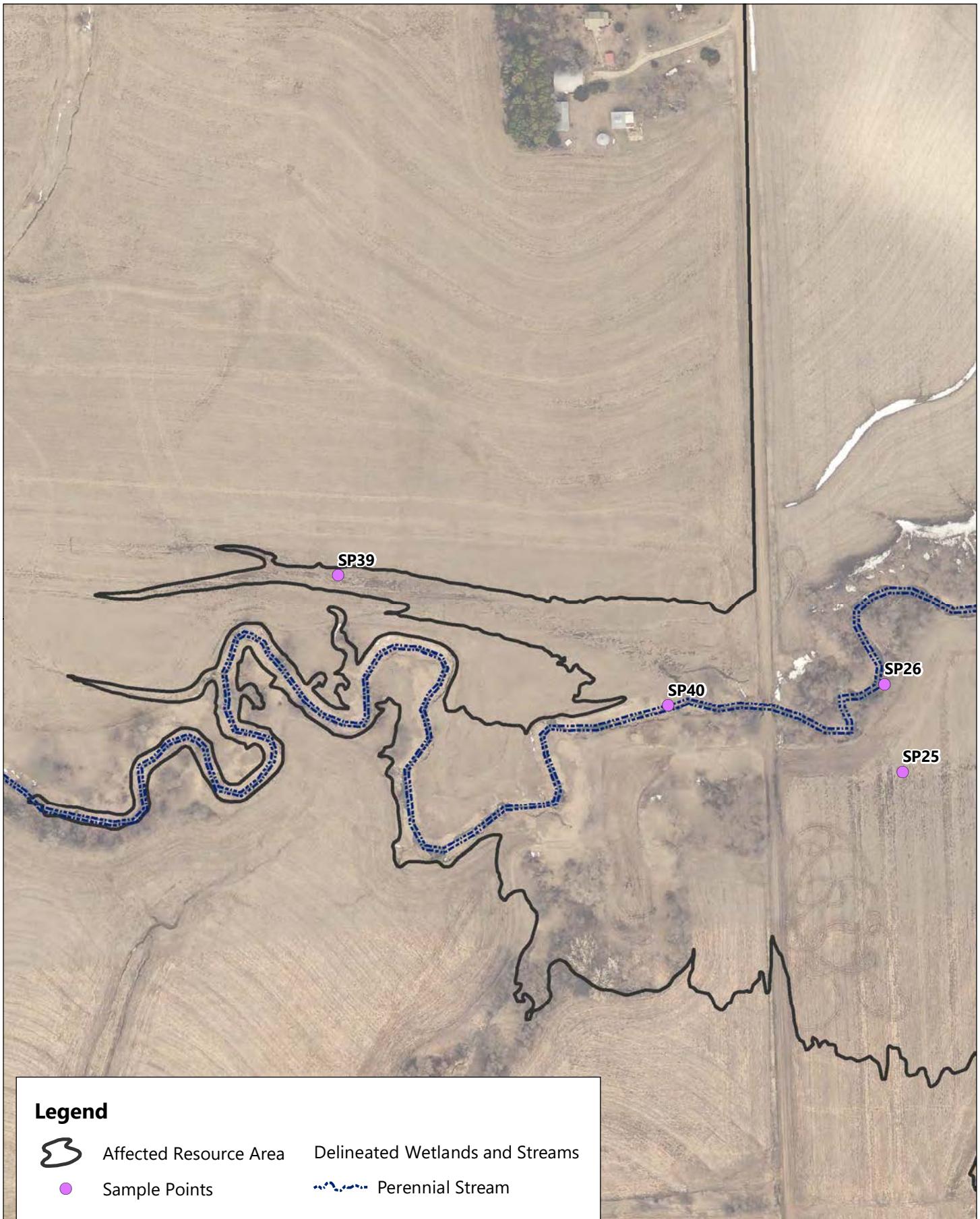
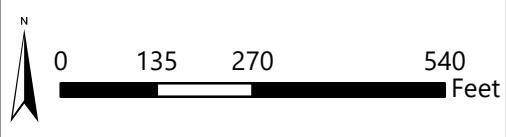


Figure C4.5F. Site 77 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



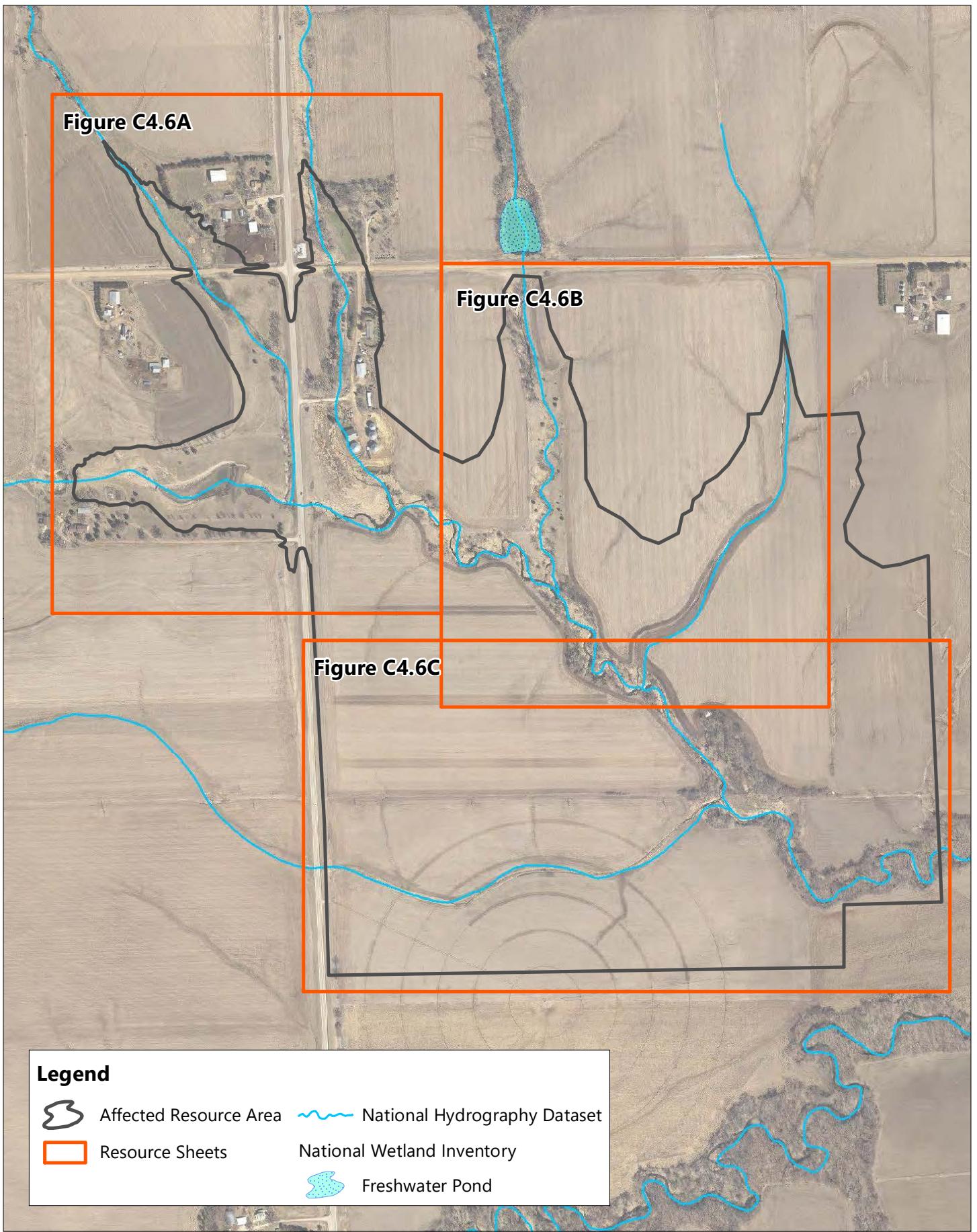


Figure C4.6. Site 82 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD

0 325 650 Feet



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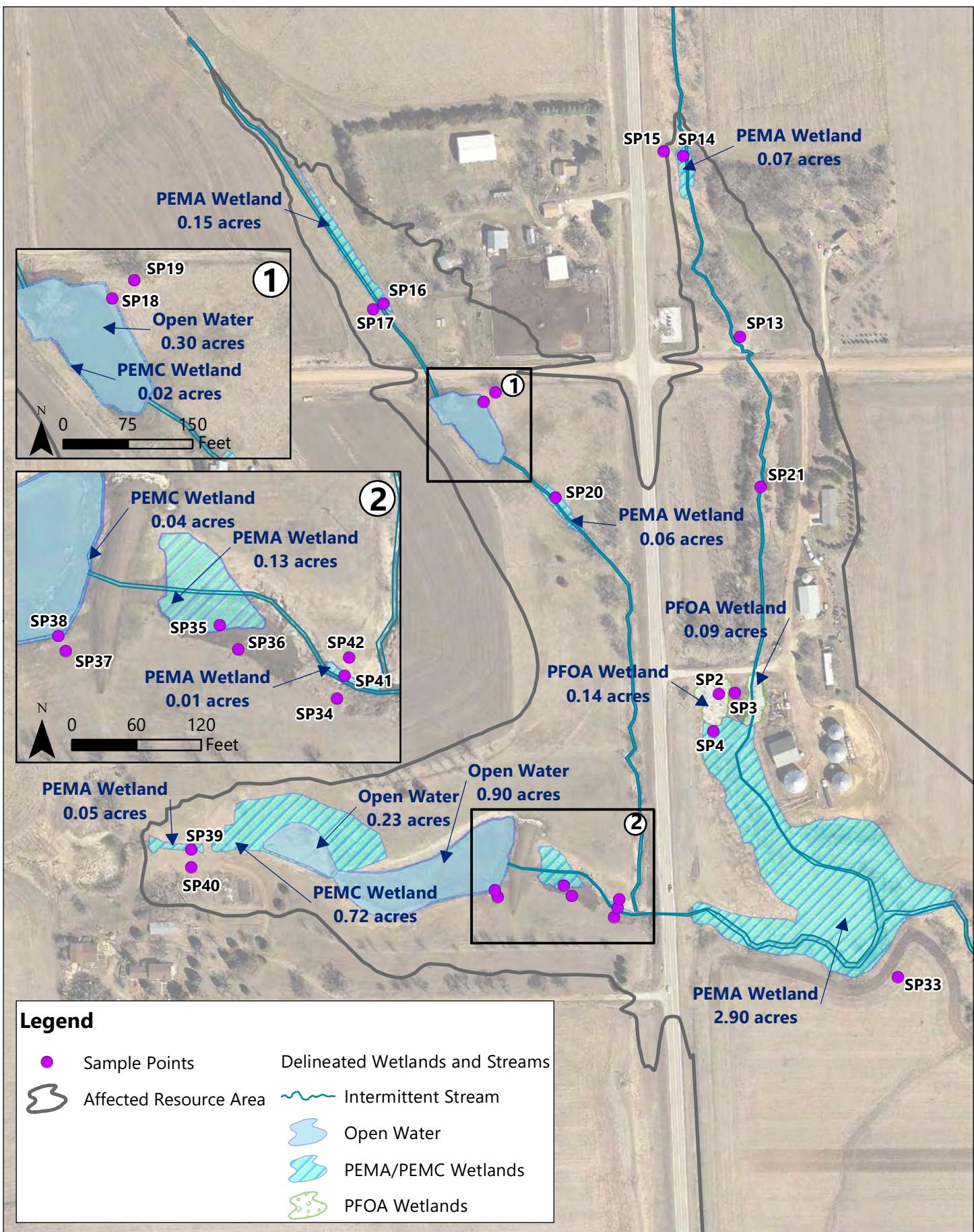
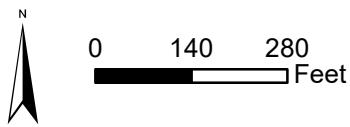


Figure C4.6A. Site 82 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



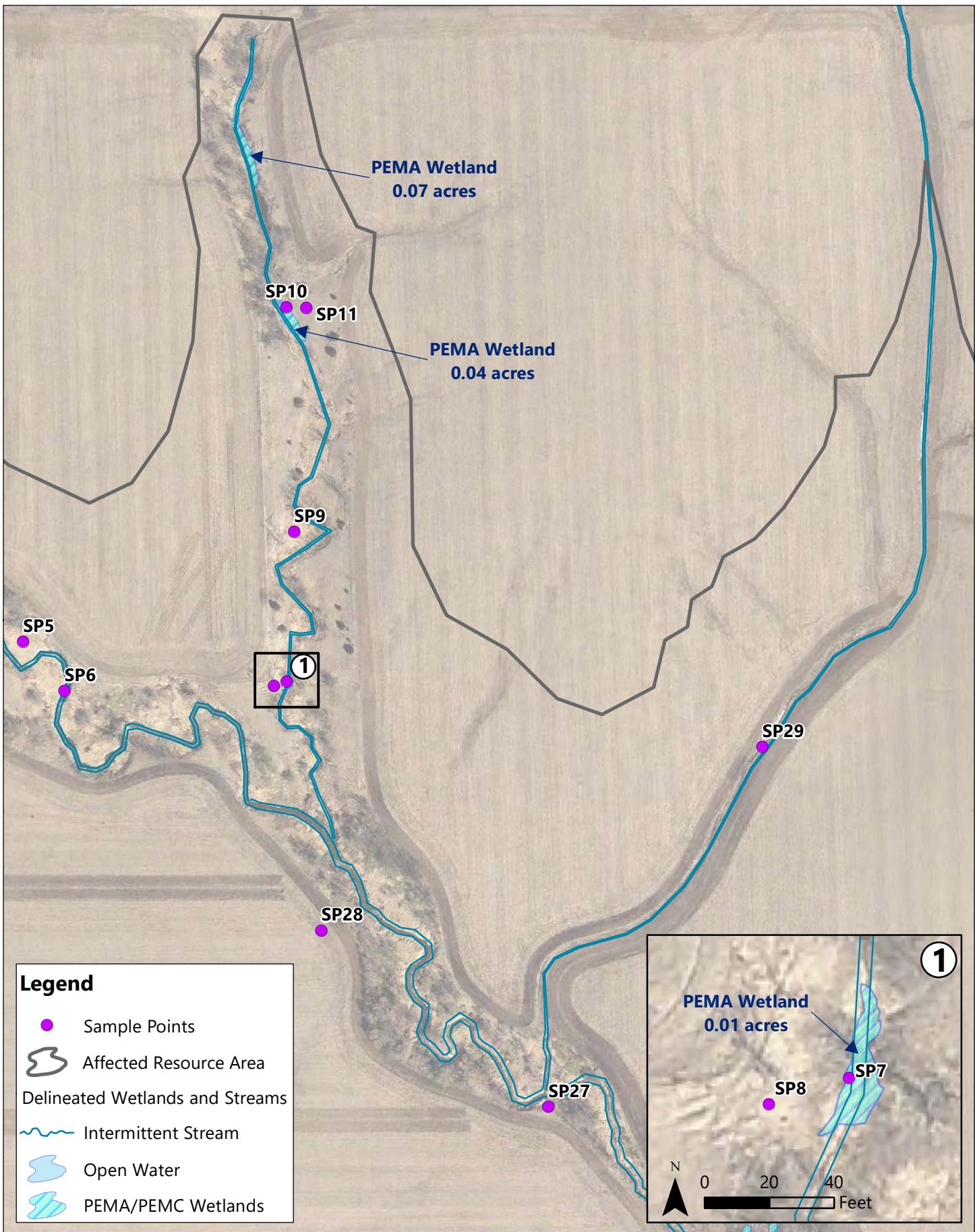


Figure C4.6B. Site 82 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD



0 125 250 Feet



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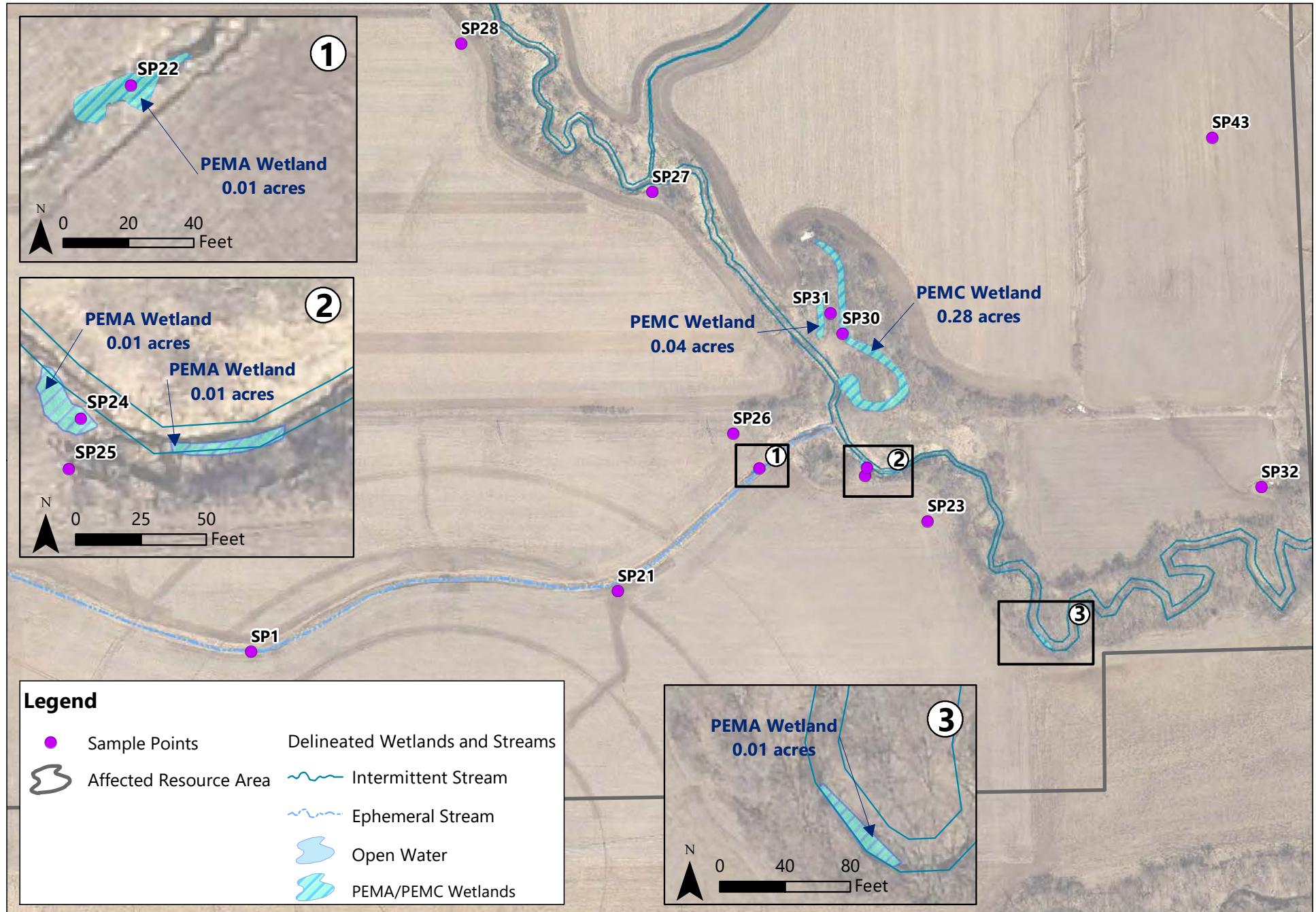


Figure C4.6C. Site 82 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 150 300 600 Feet



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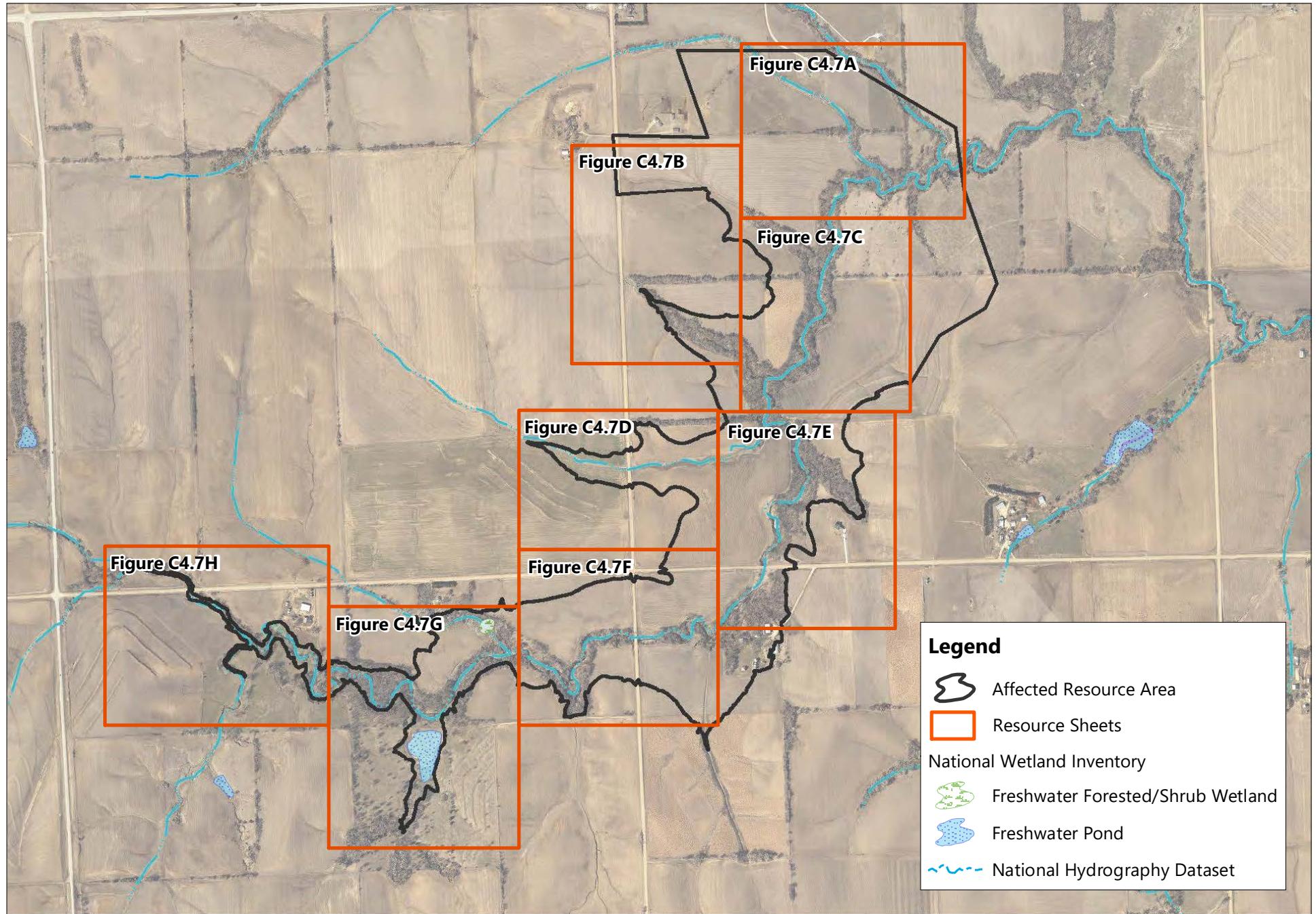


Figure C4.7. Site 84 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 600 1,200 2,400 Feet



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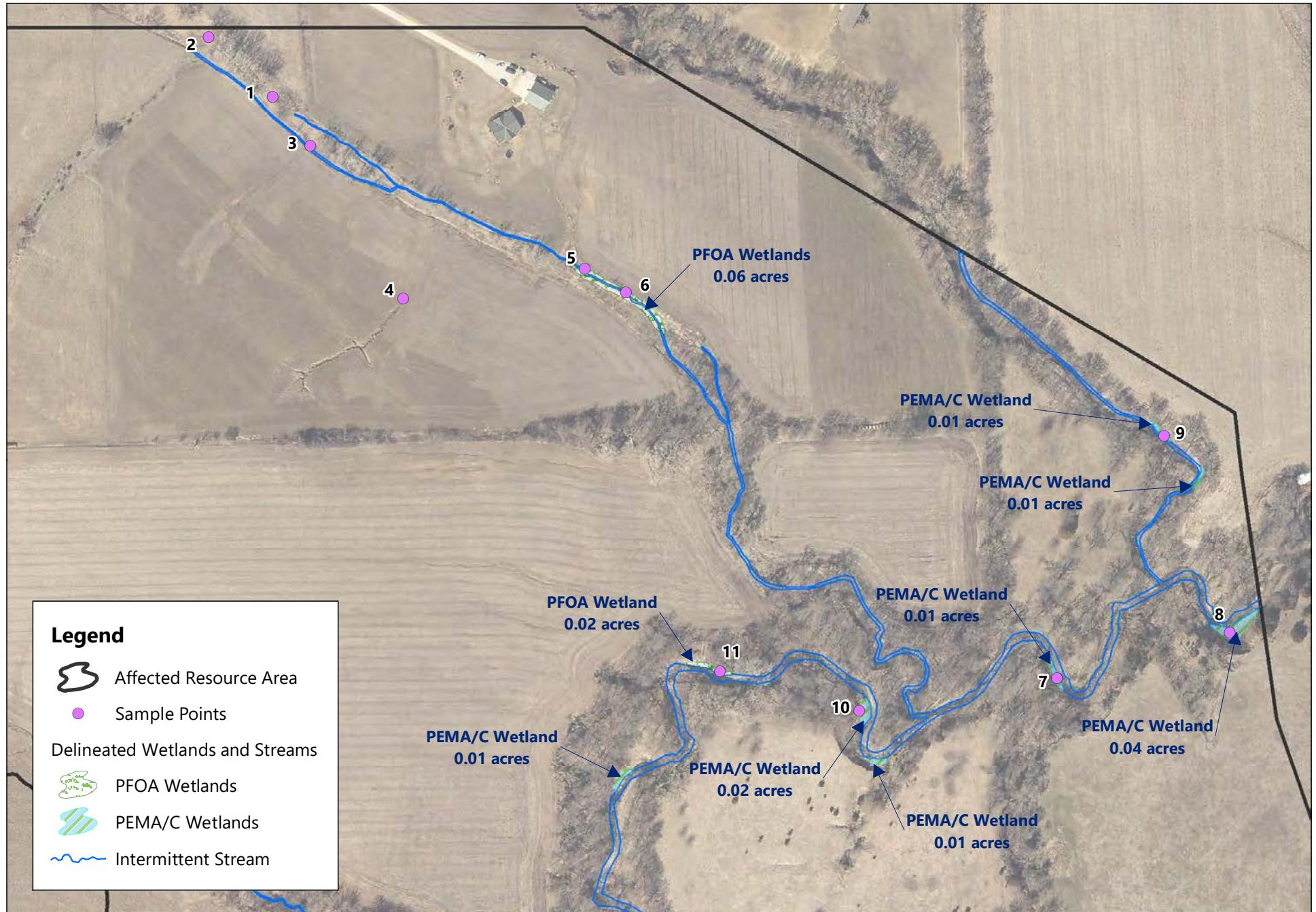


Figure C4.7A. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 120 240 480
Feet



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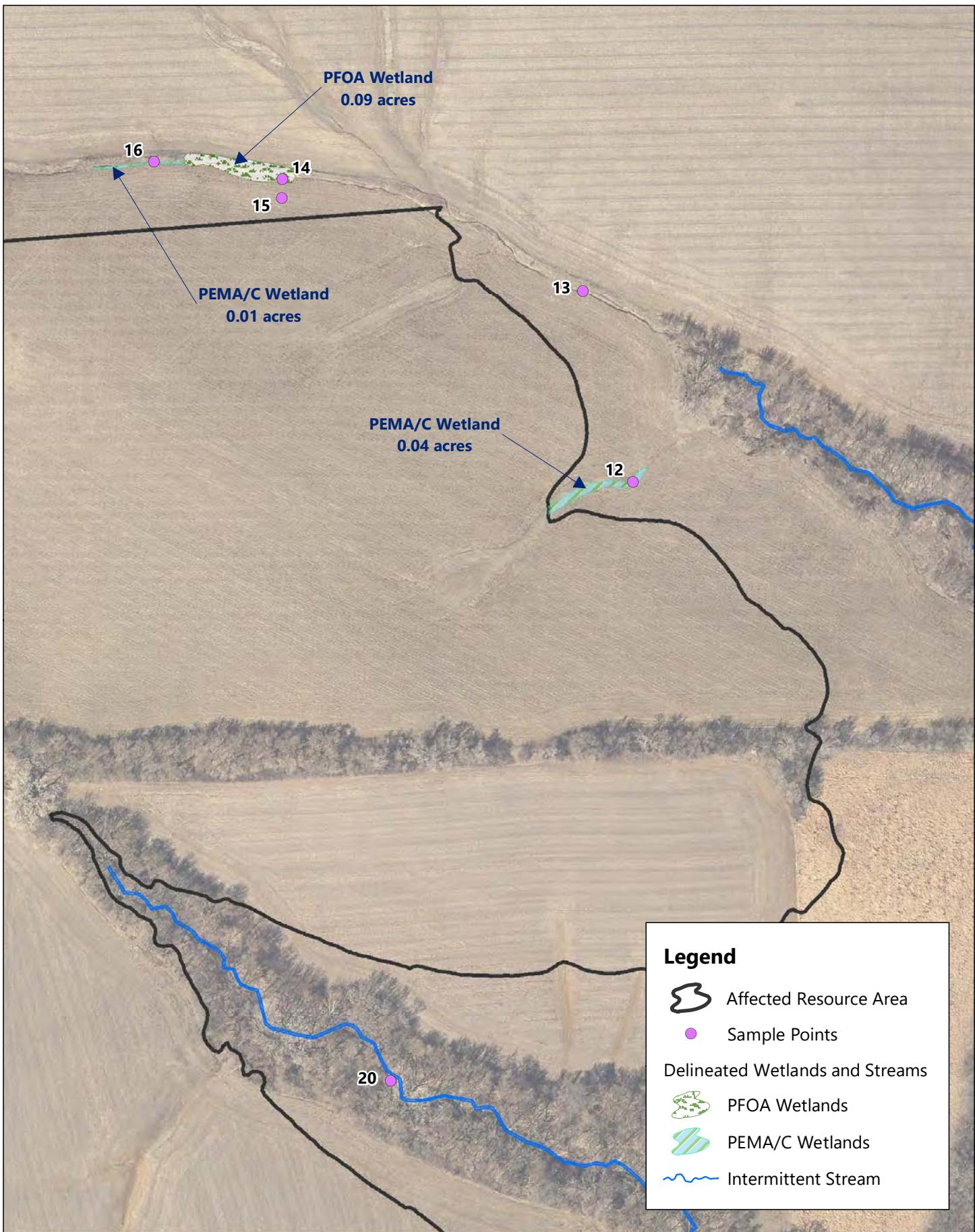
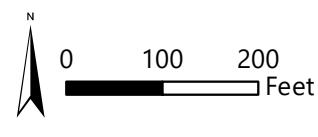


Figure C4.7B. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



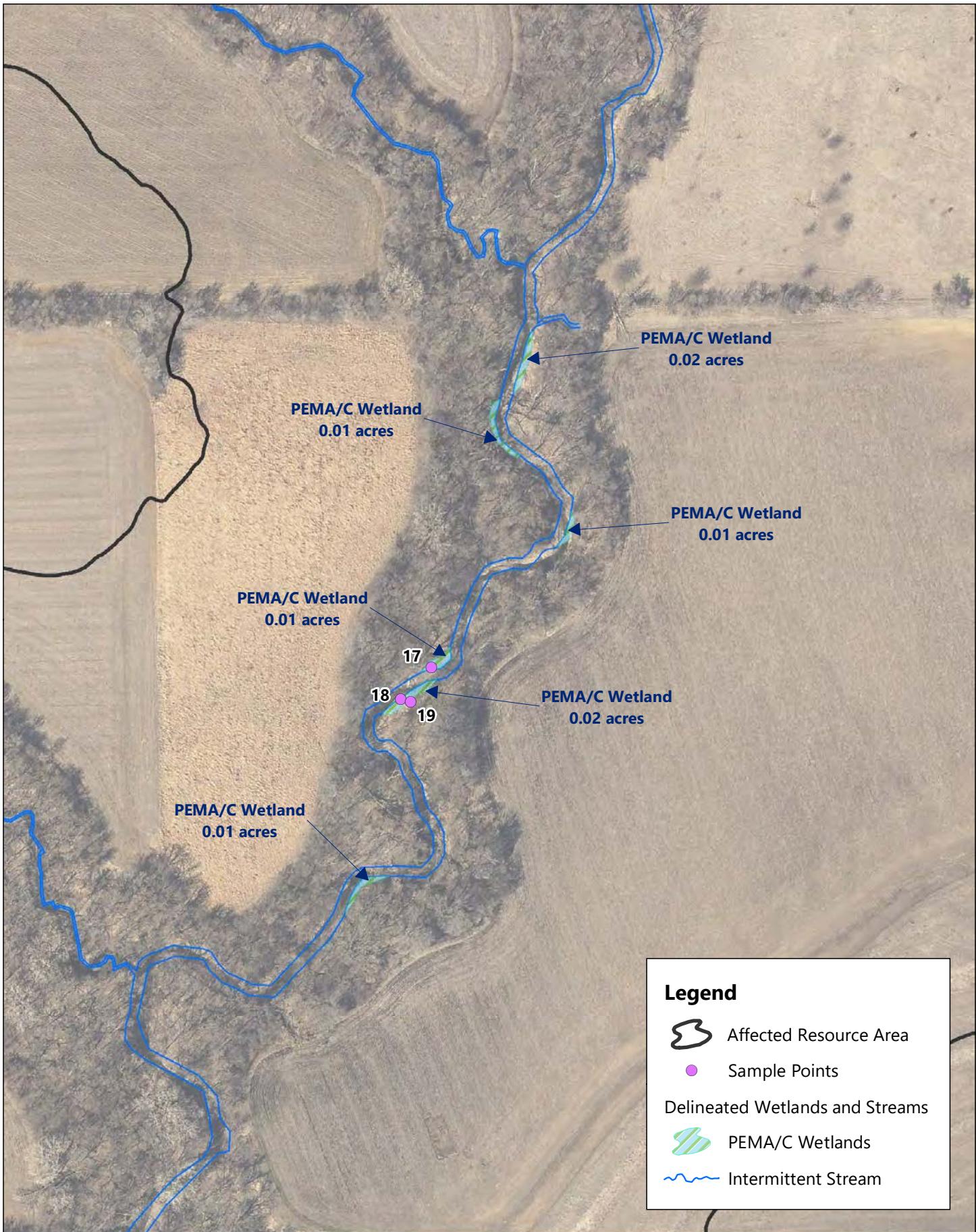
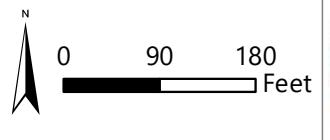


Figure C4.7C. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD



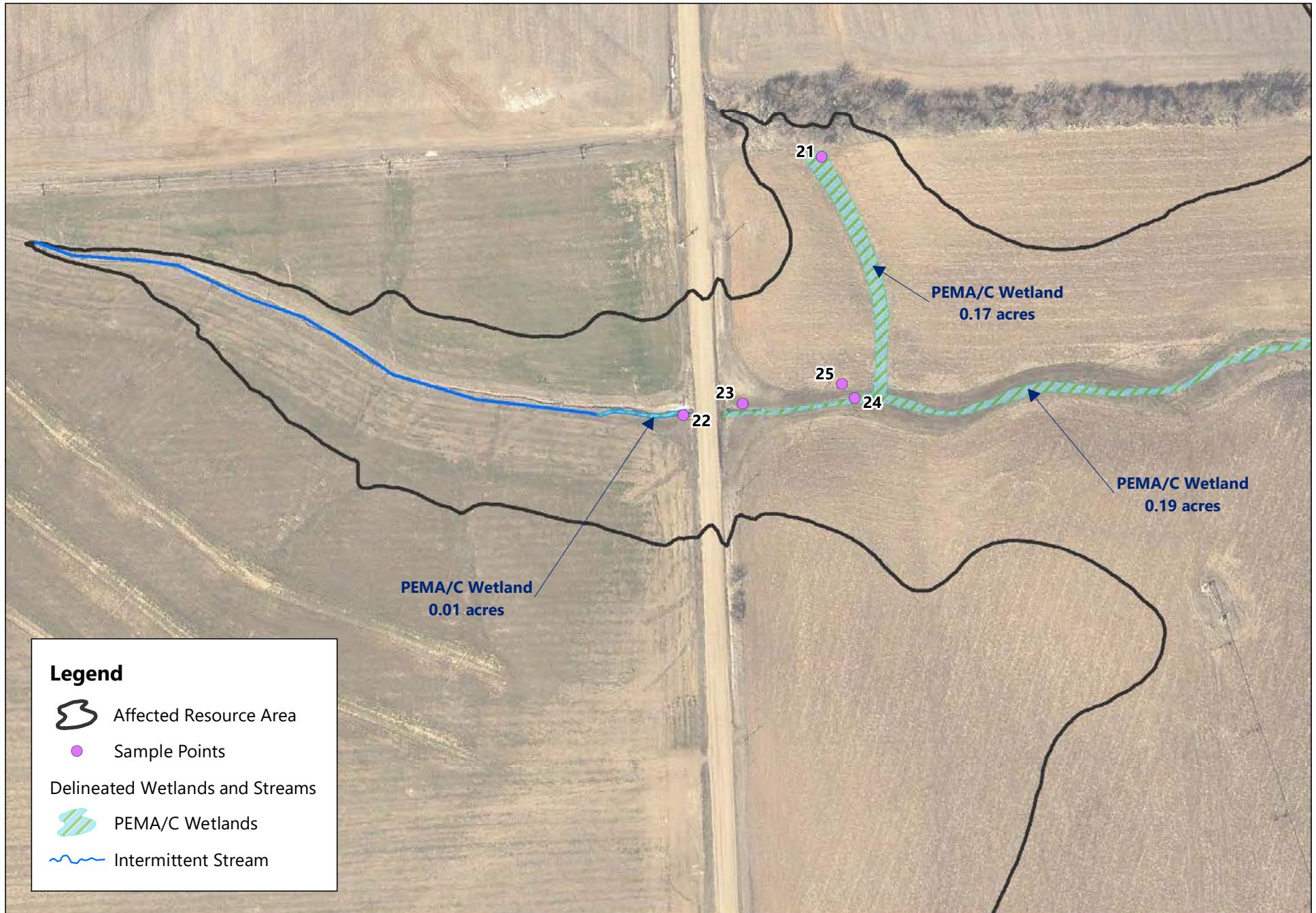


Figure C4.7D. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 90 180 360 Feet



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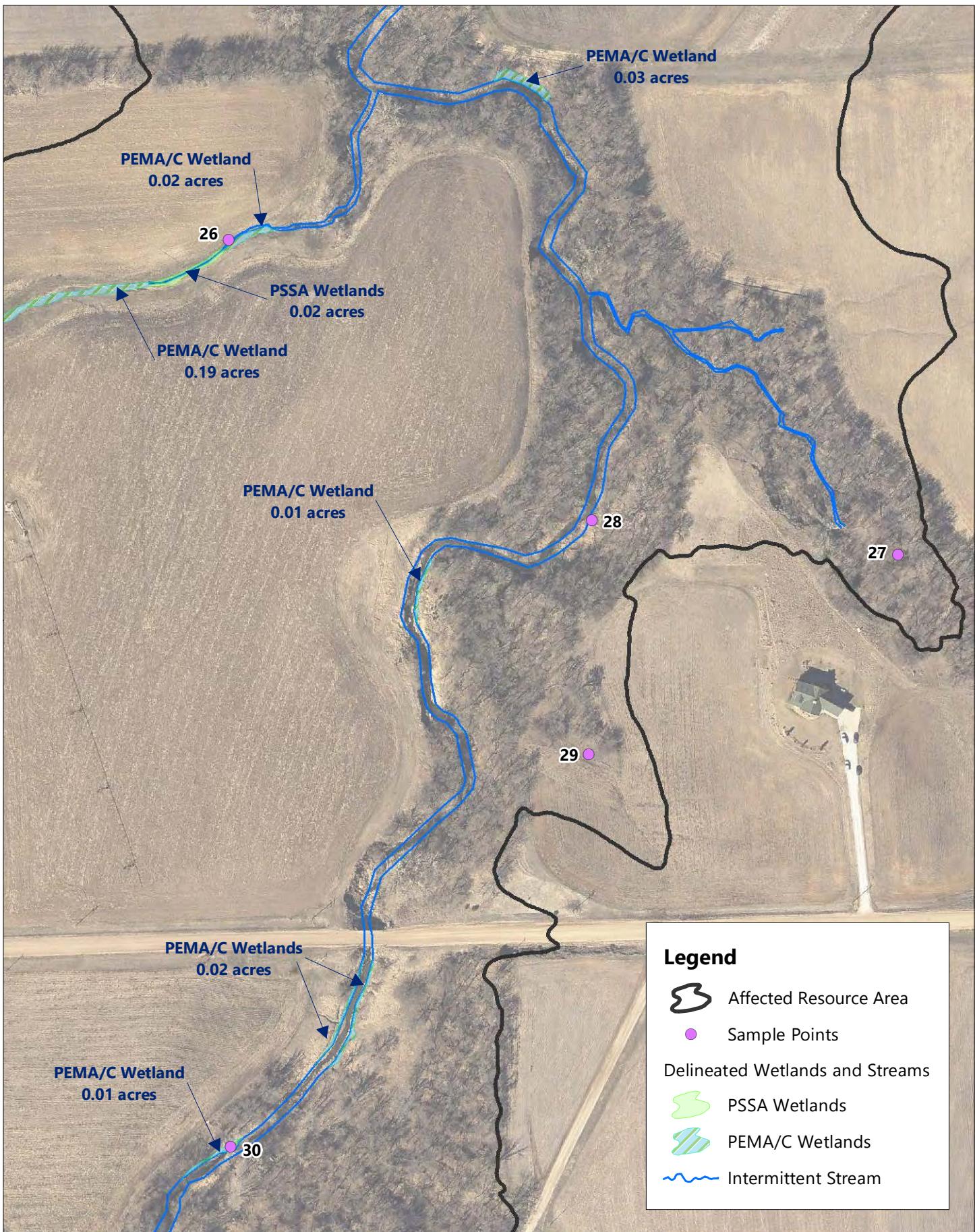
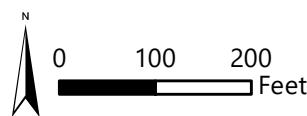


Figure C4.7E. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



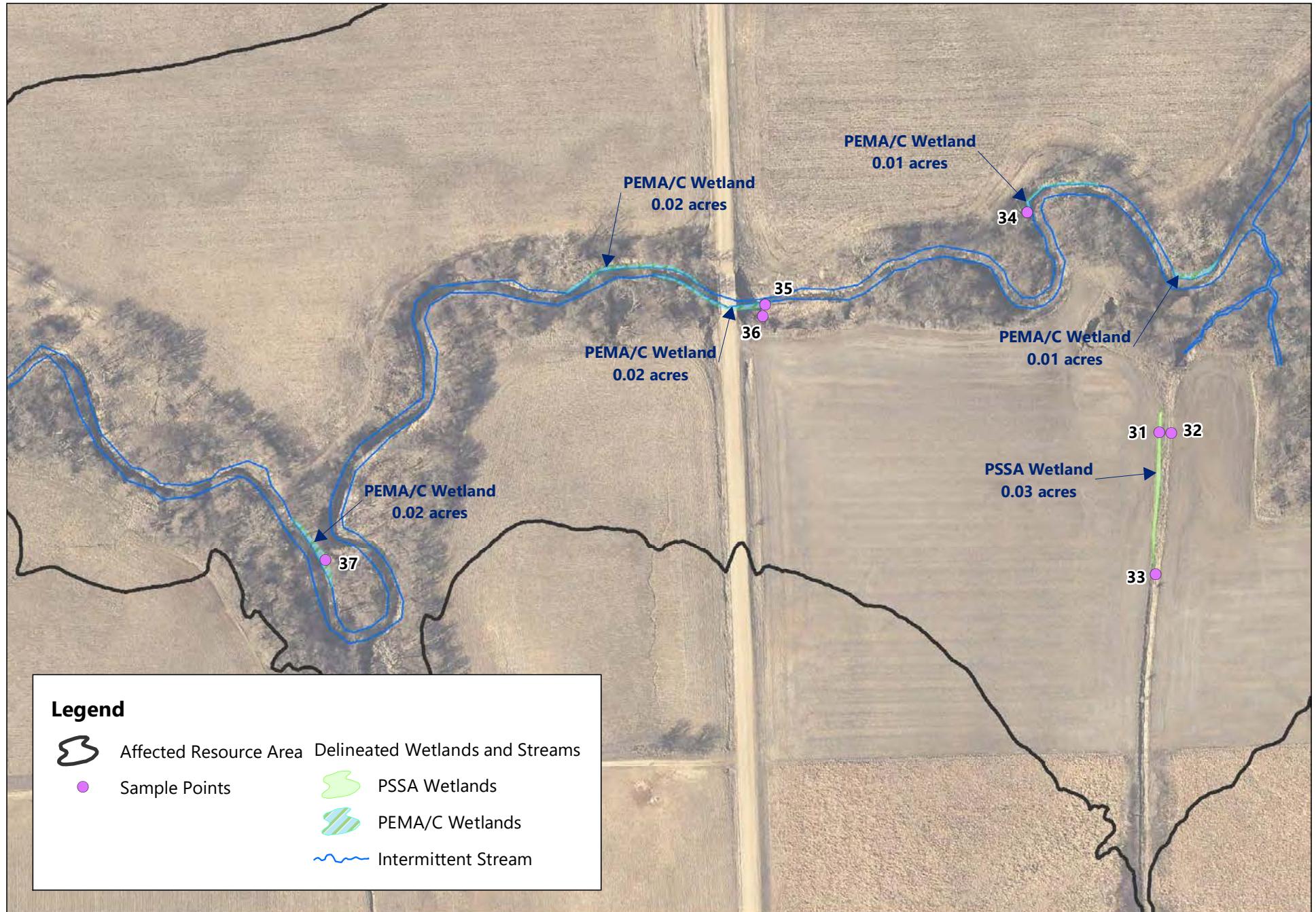


Figure C4.7F. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400 Feet



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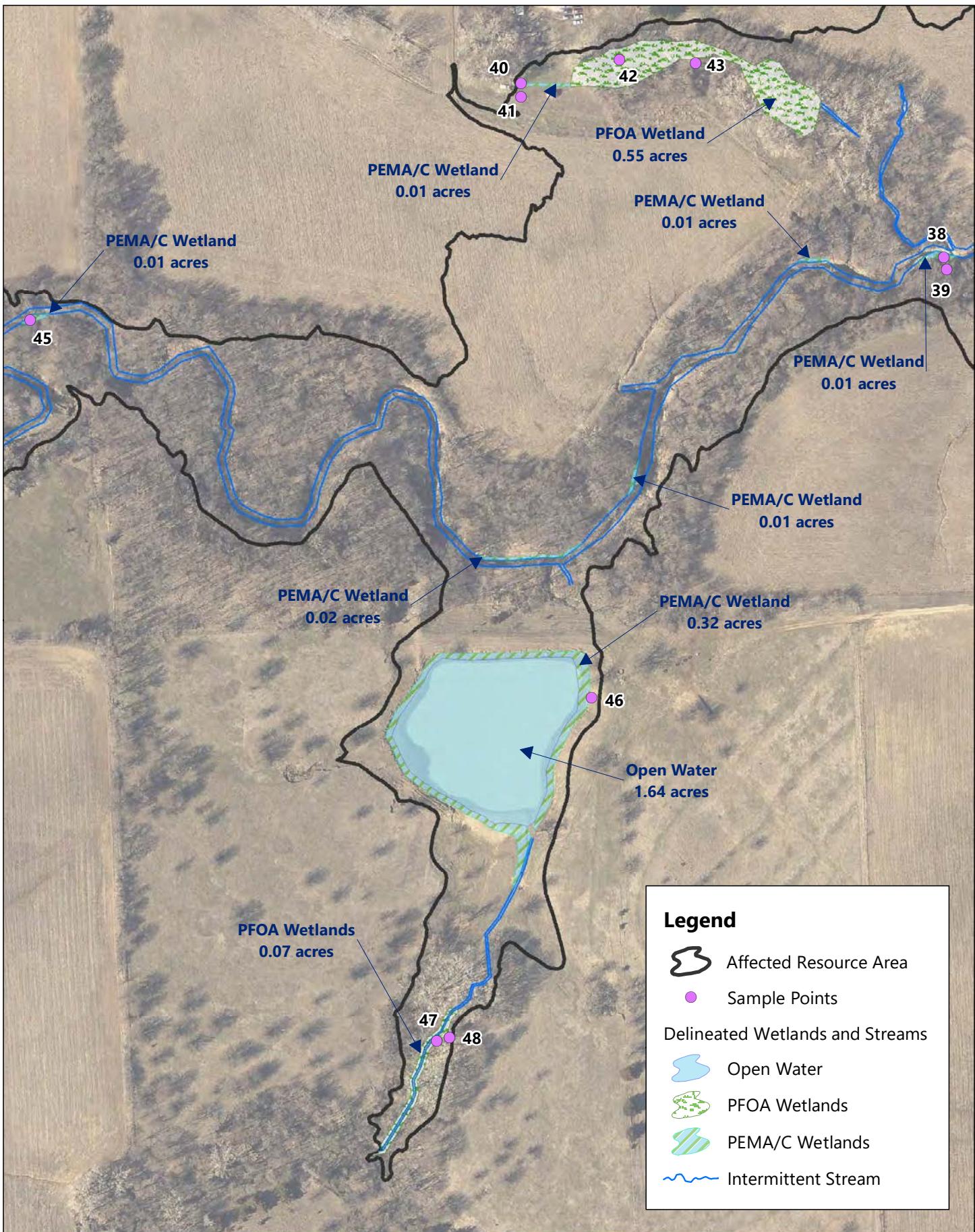


Figure C4.7G. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA

Natural Resources Conservation Service

Lower Platte North NRD





Figure C4.7H. Site 84 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 100 200 400 Feet

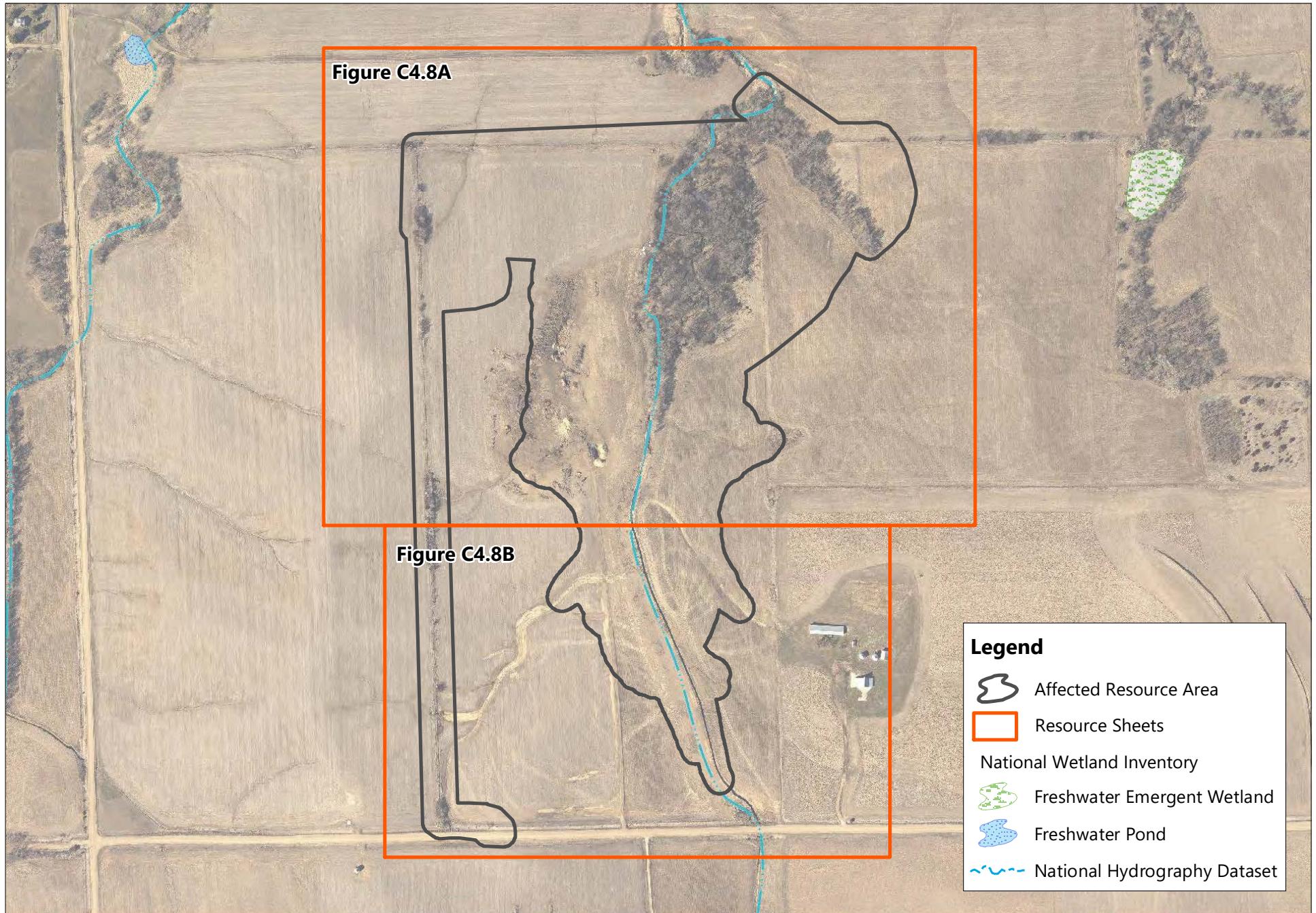
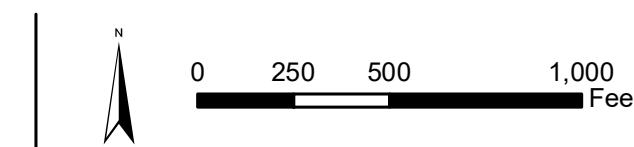


Figure C4.8. Site 85 Wetlands and Streams

Index Sheet

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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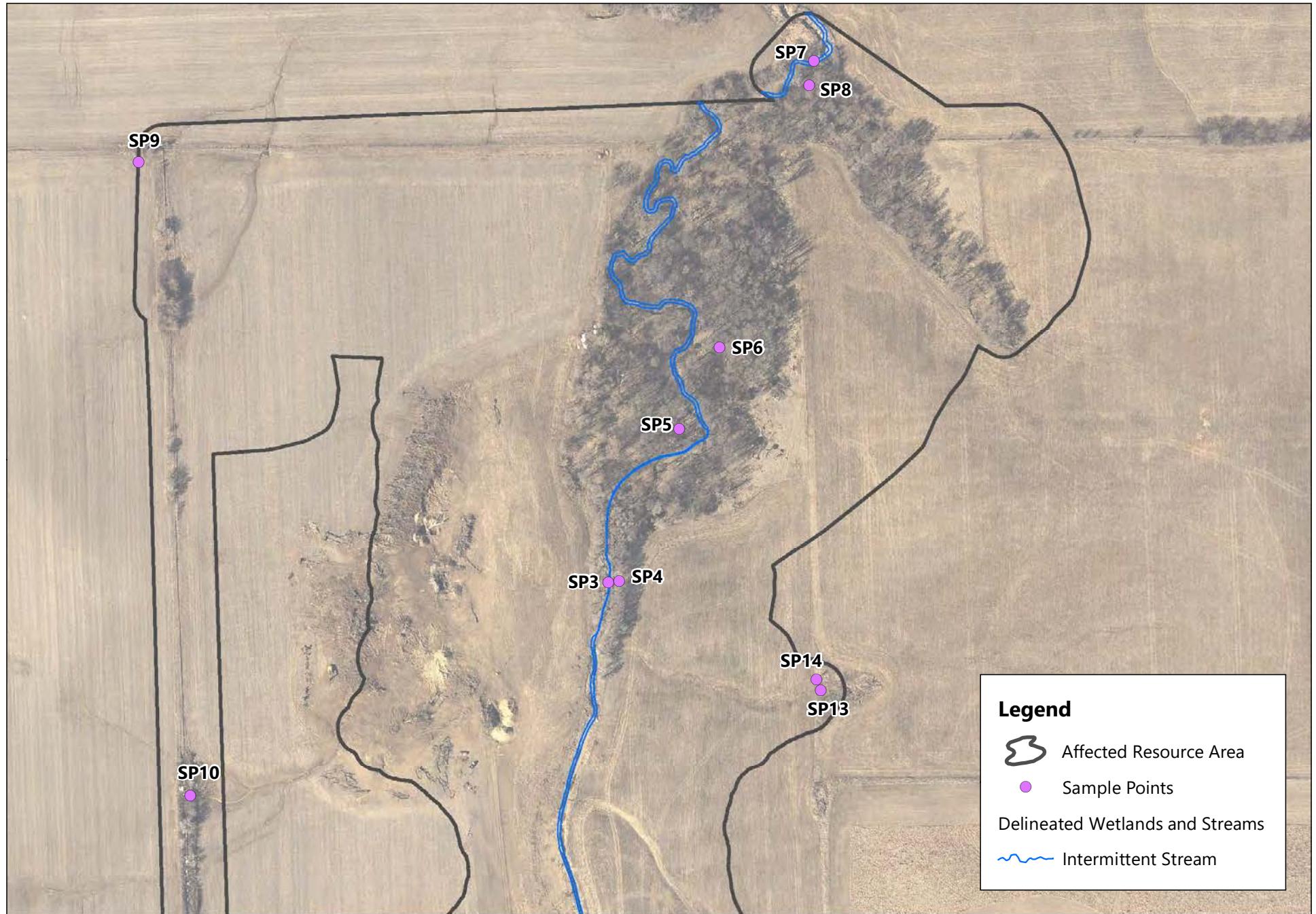


Figure C4.8A. Site 85 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 135 270 540 Feet



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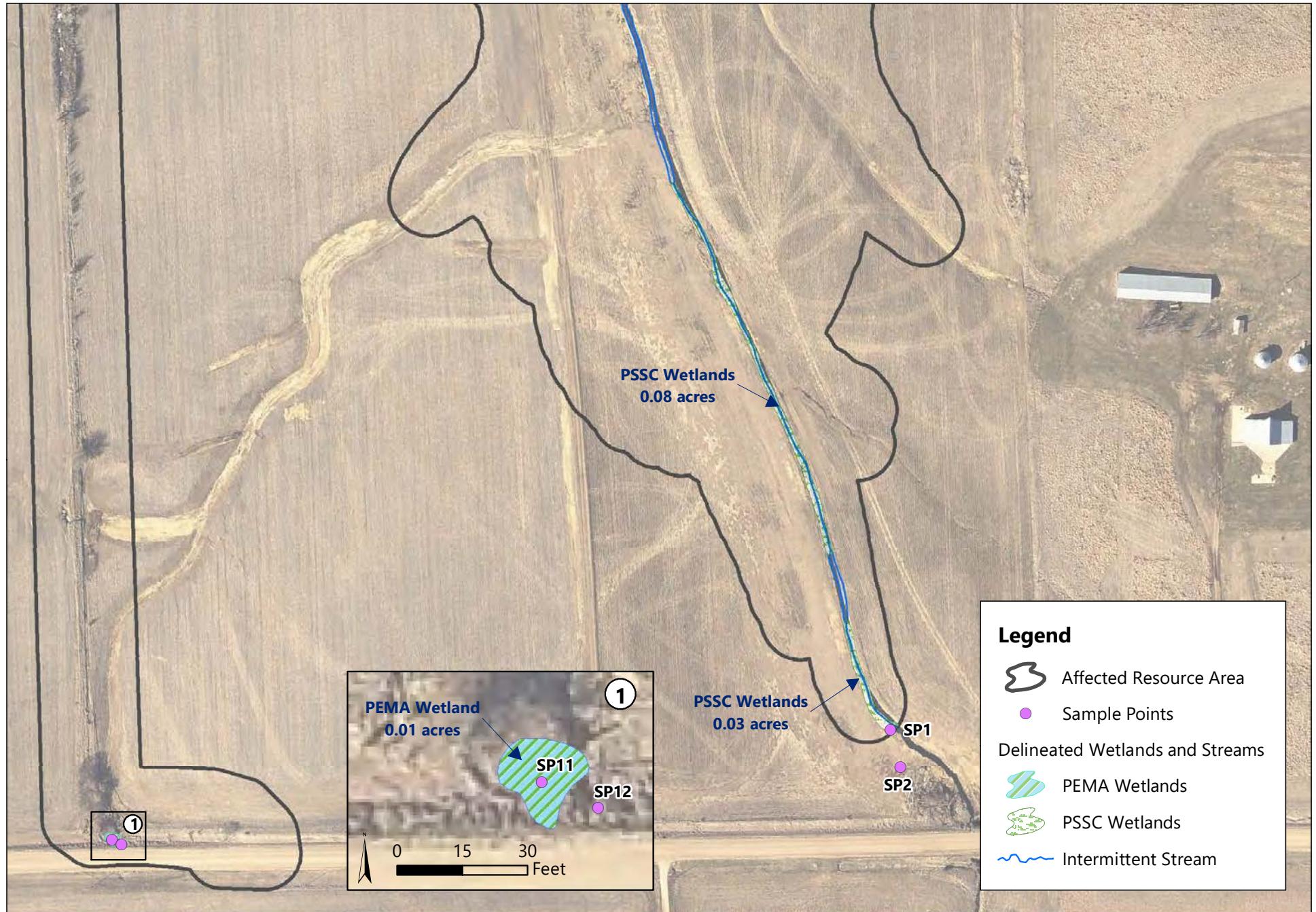


Figure C4.8B. Site 85 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



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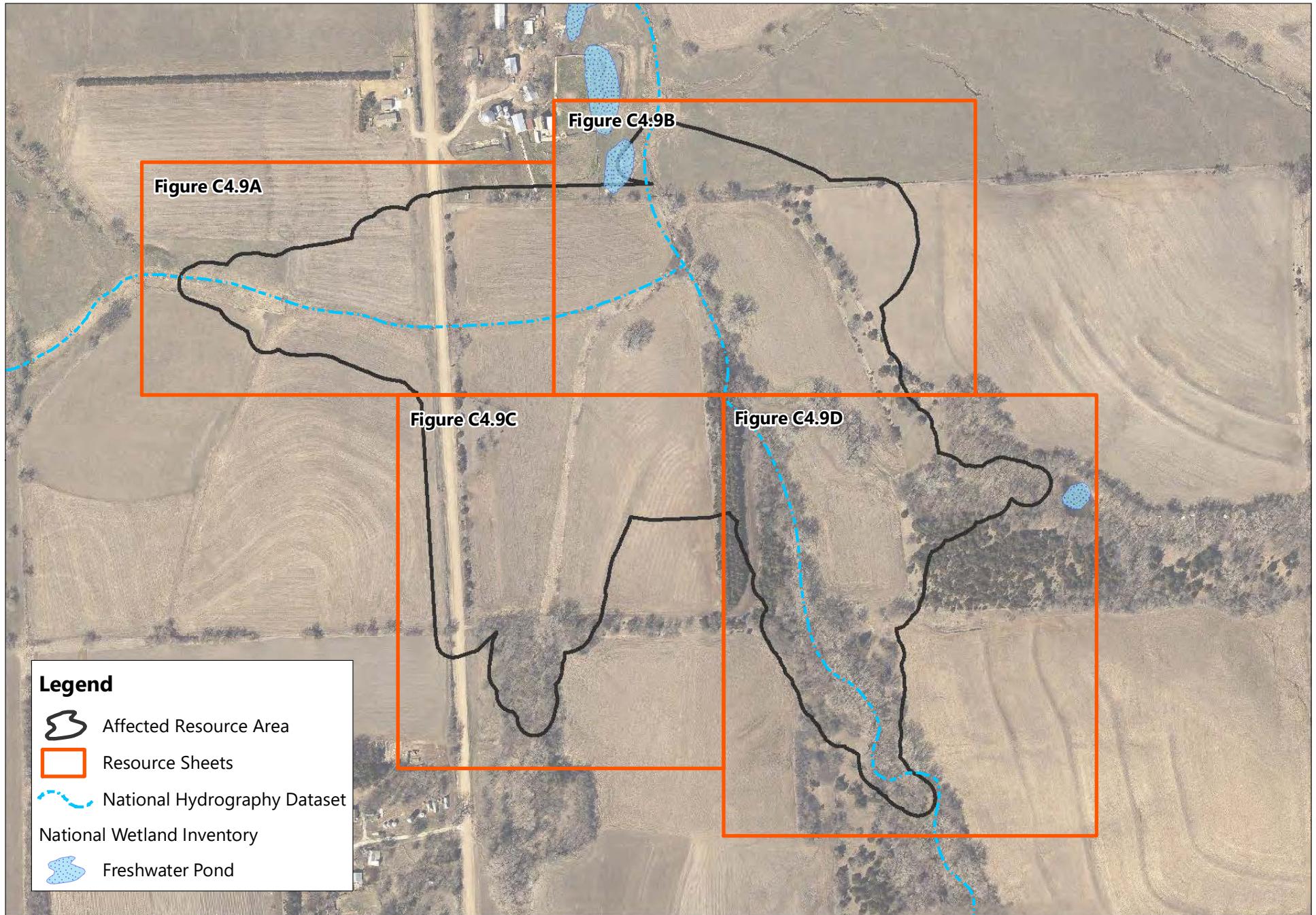


Figure C4.9. Site 86 Wetlands and Streams

Index Sheet

Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 200 400 800 Feet



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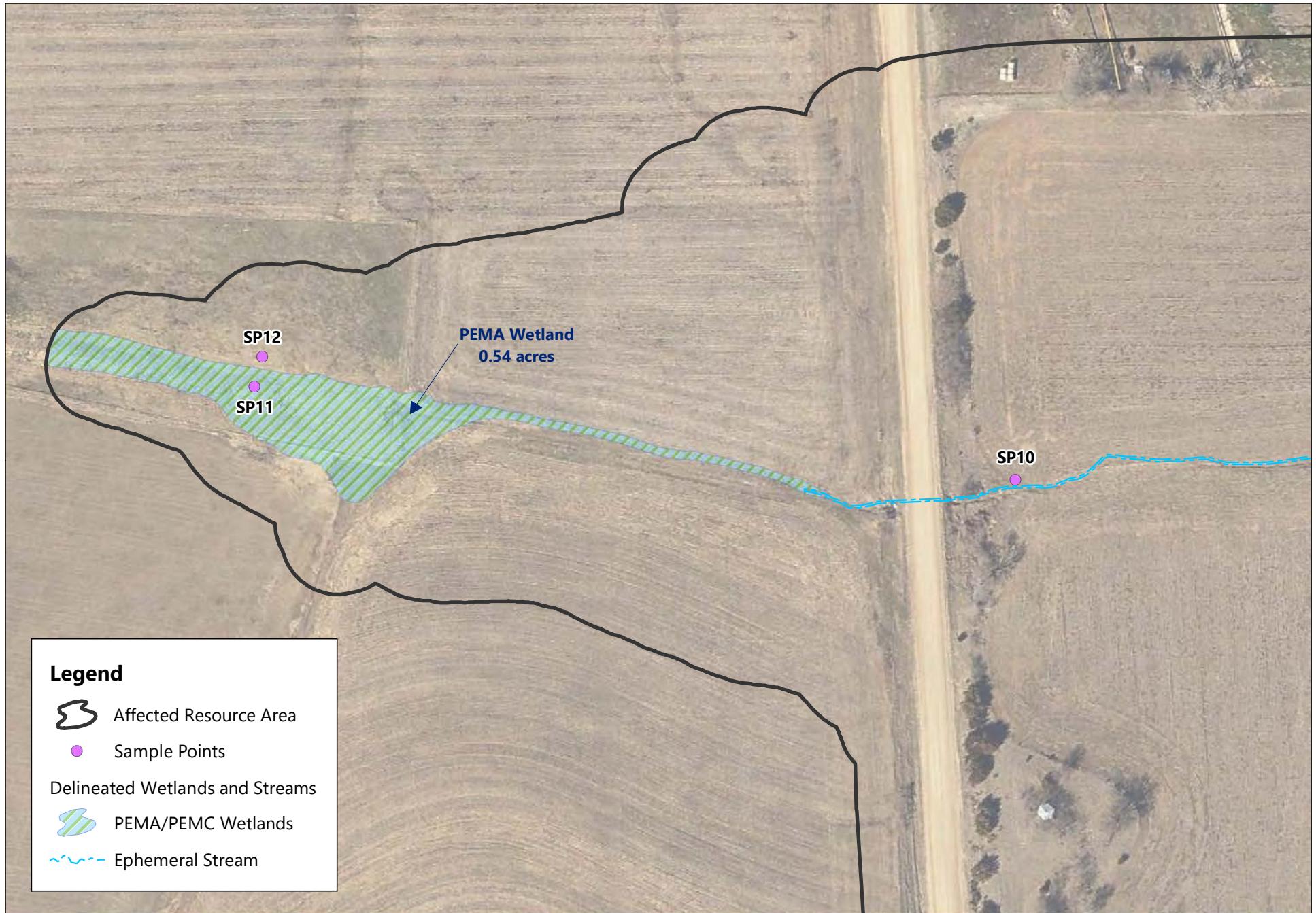


Figure C4.9A. Site 86 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 60 120 240 Feet



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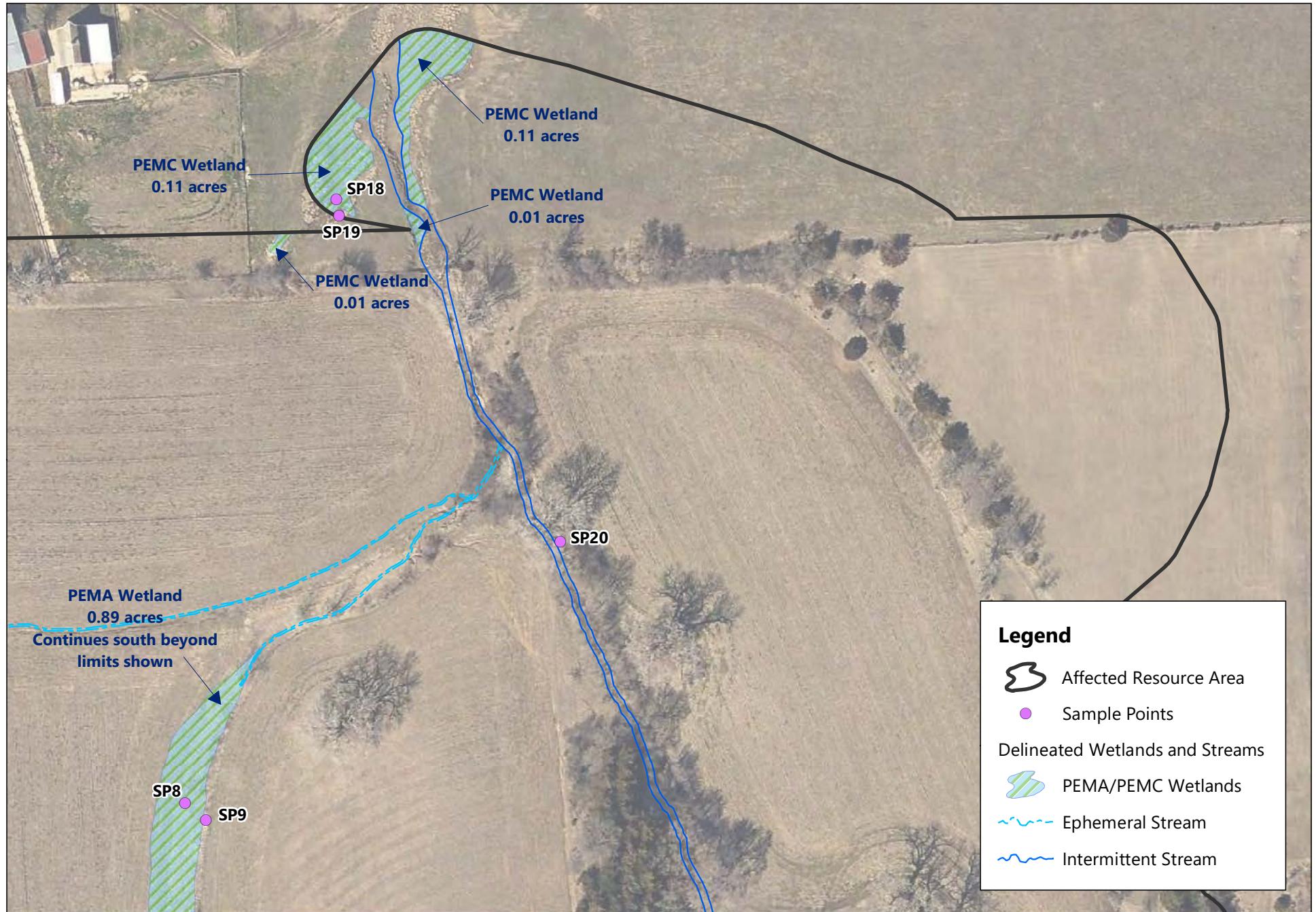


Figure C4.9B. Site 86 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 65 130 260 Feet



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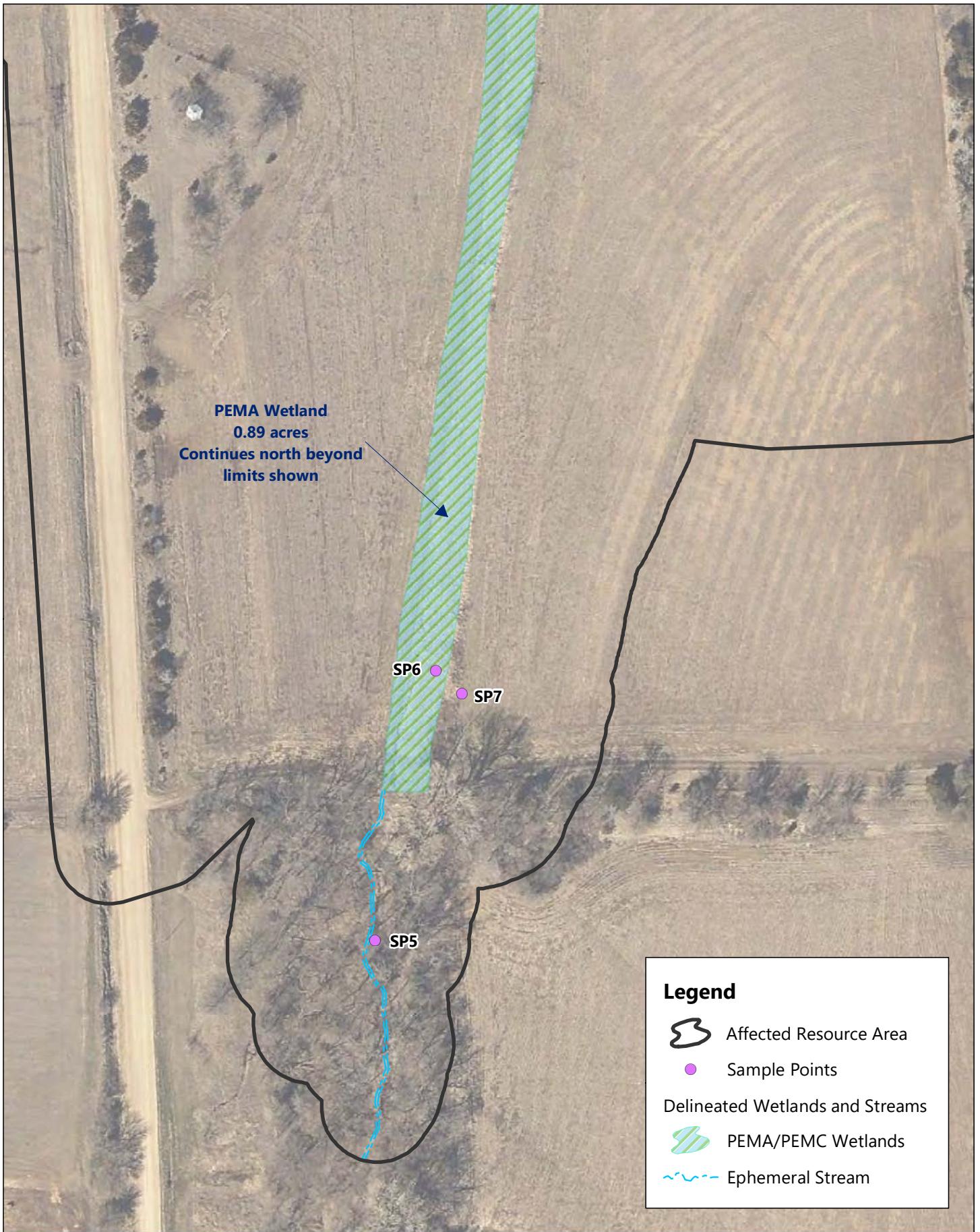


Figure C4.9C. Site 86 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



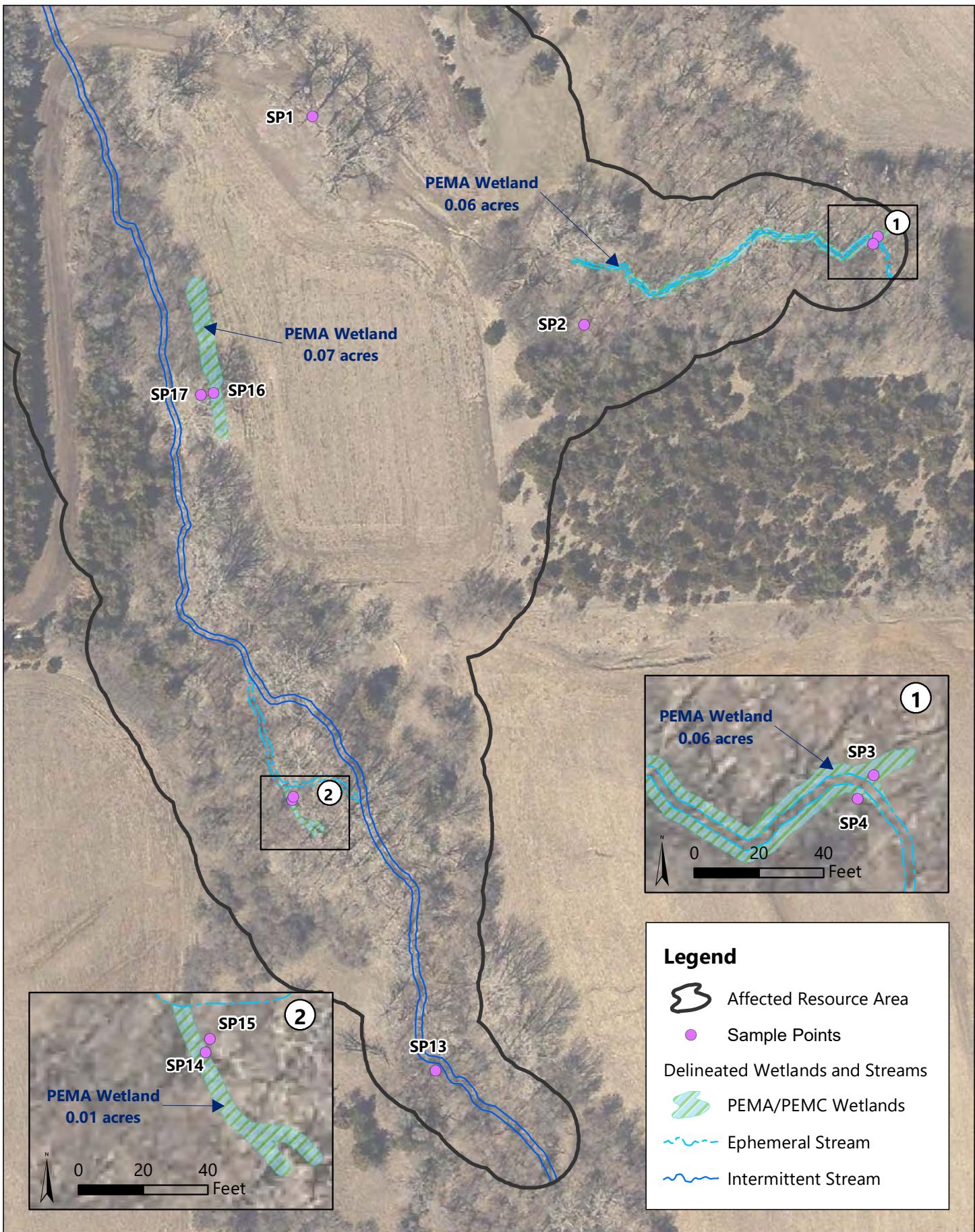
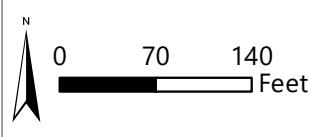


Figure C4.9D. Site 86 Wetlands and Streams

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



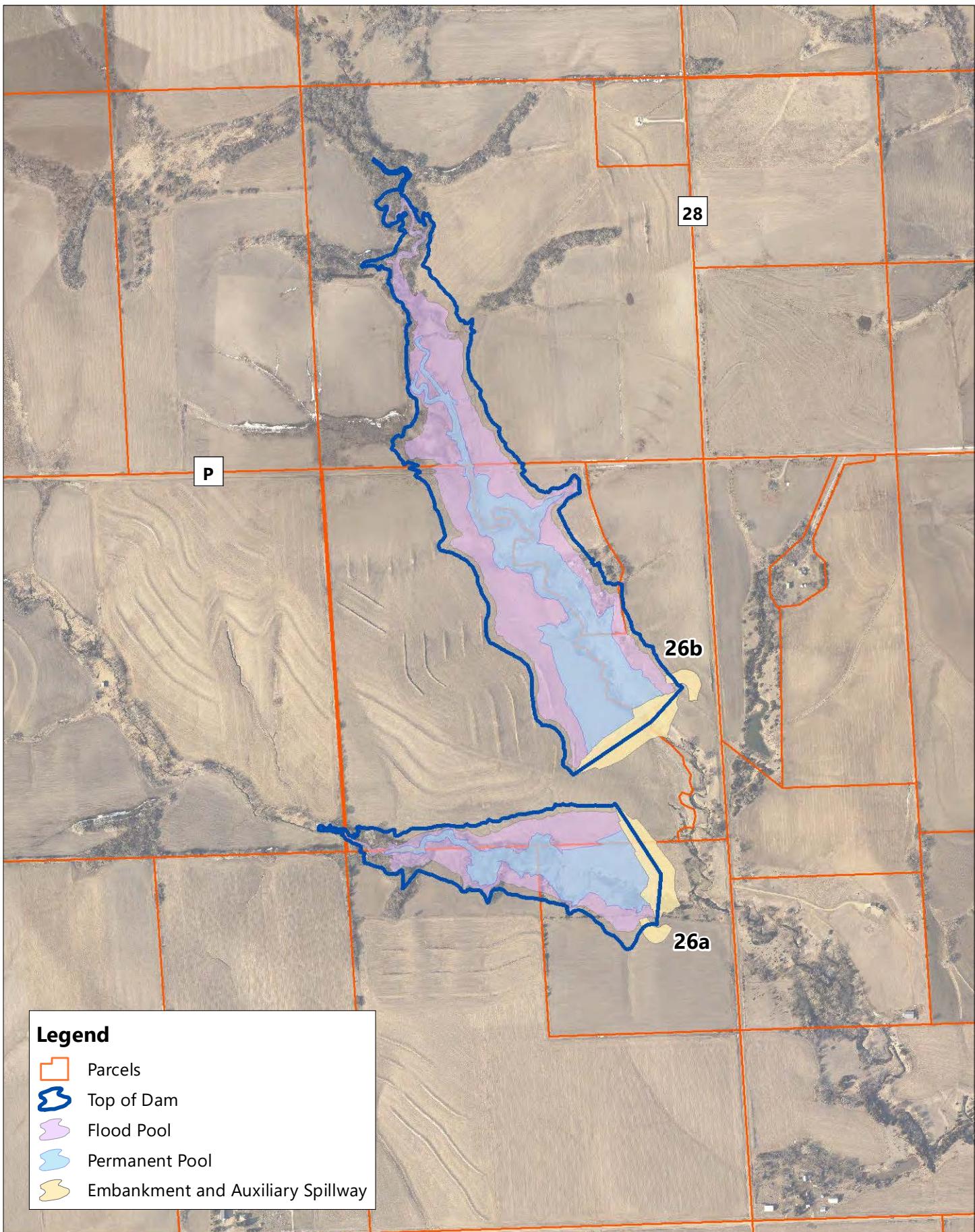


Figure C5.1. Sites 26a&b Project Extents

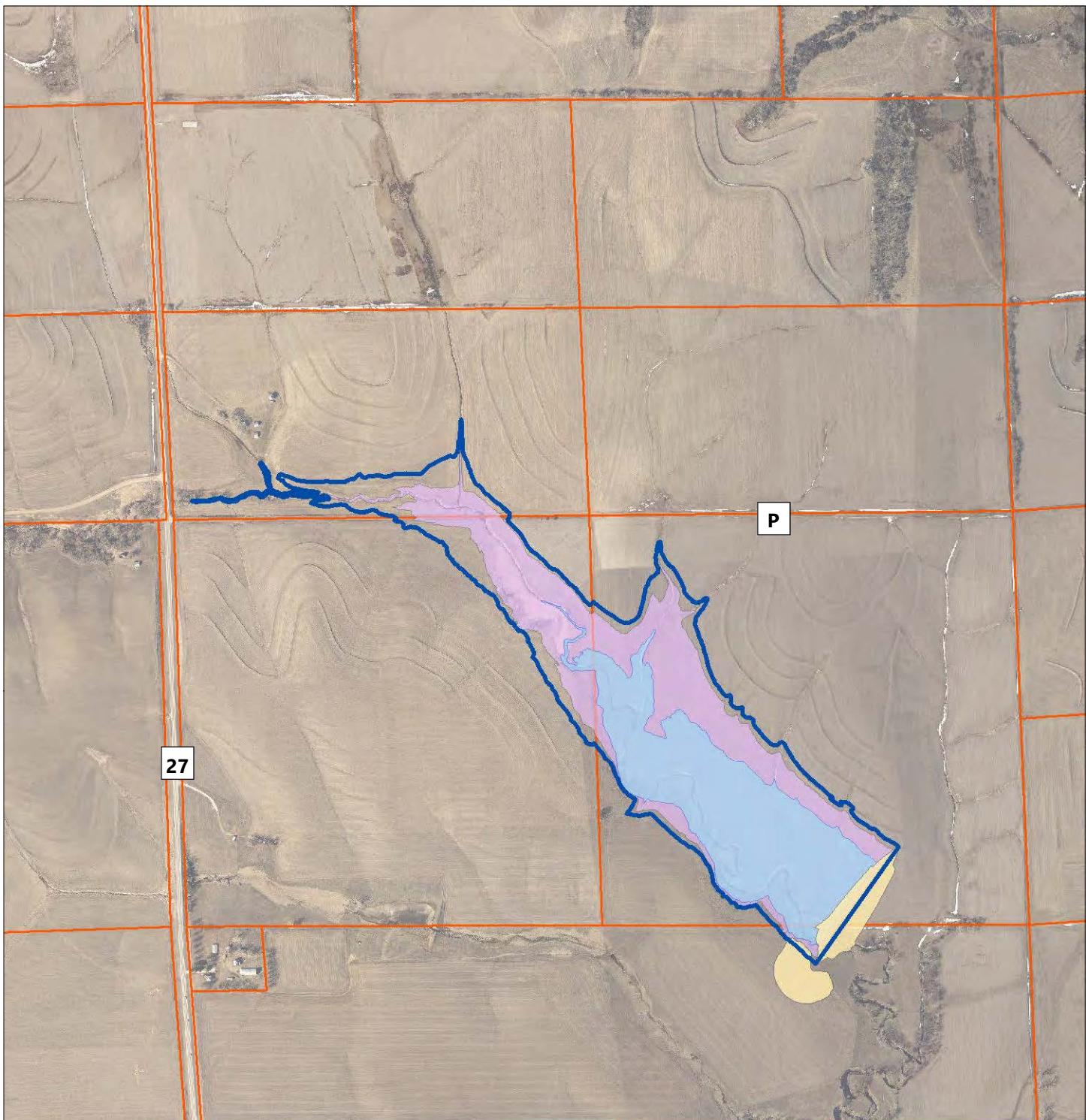
Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 450 900
Feet



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Legend

- Parcels
- Top of Dam
- Flood Pool
- Permanent Pool
- Embankment and Auxiliary Spillway

Figure C5.2. Site 27 Project Extents

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 460 920 Feet



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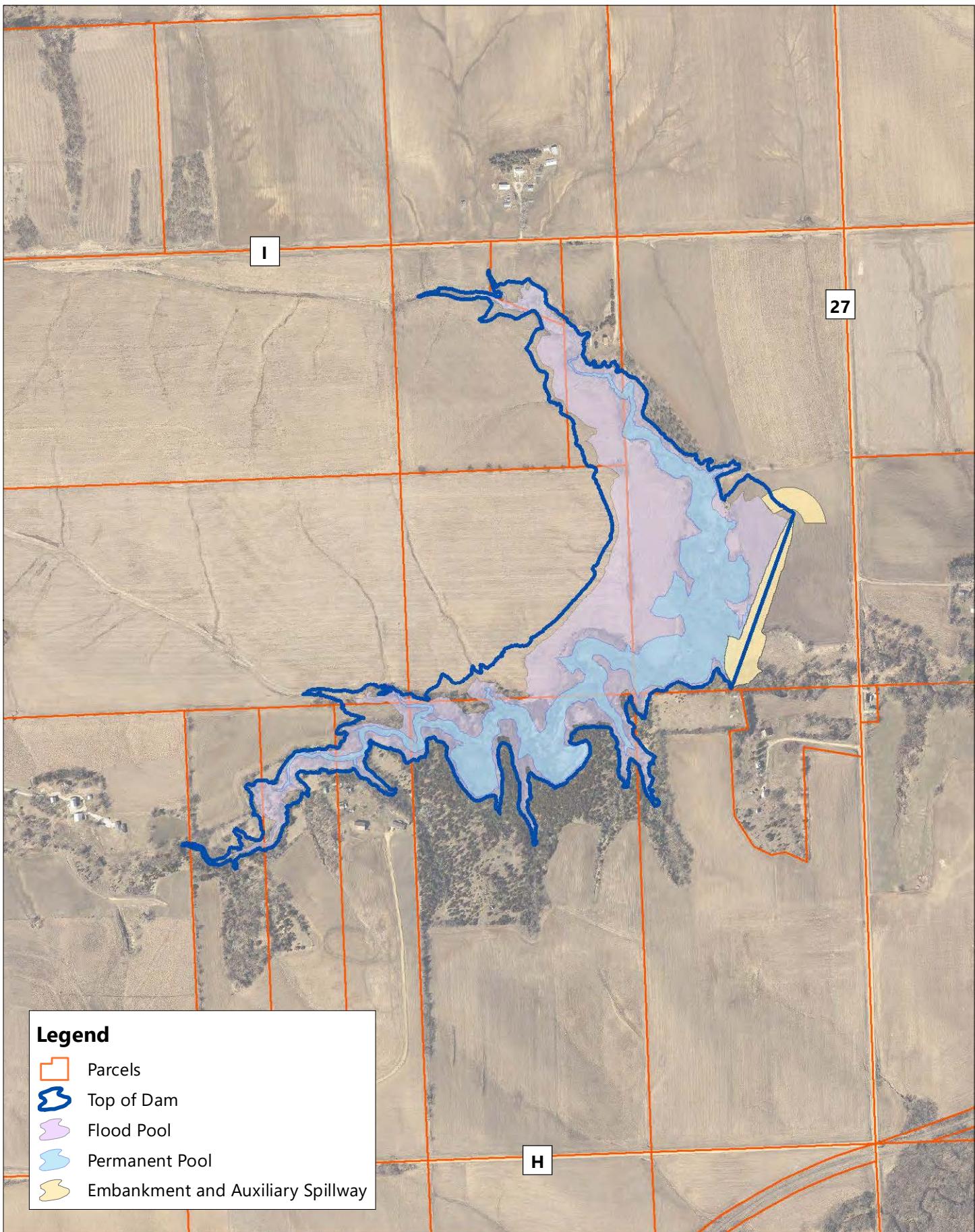


Figure C5.3. Site 55 Project Extents

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 375 750 Feet



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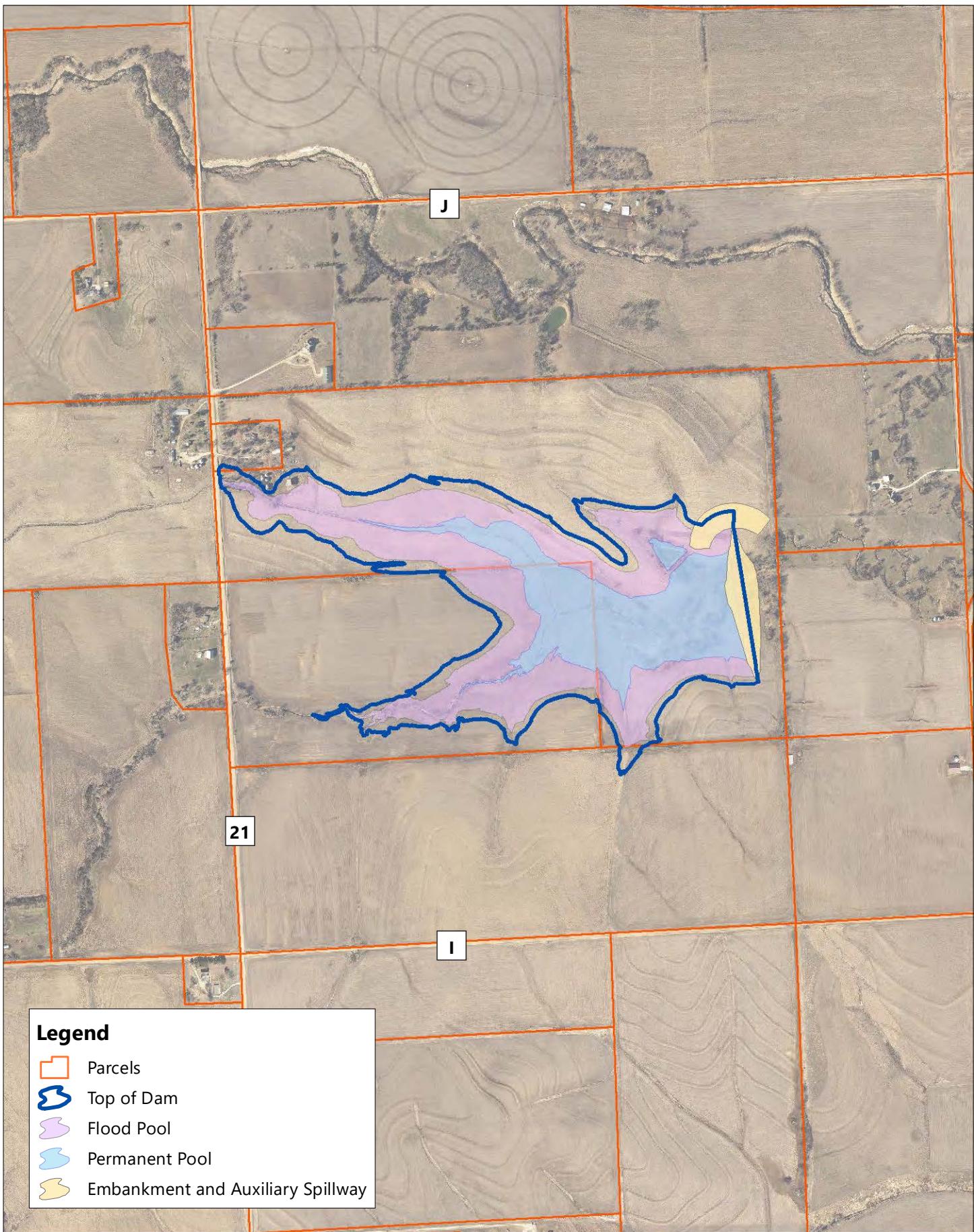


Figure C5.4. Site 66 Project Extents

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 460 920 Feet



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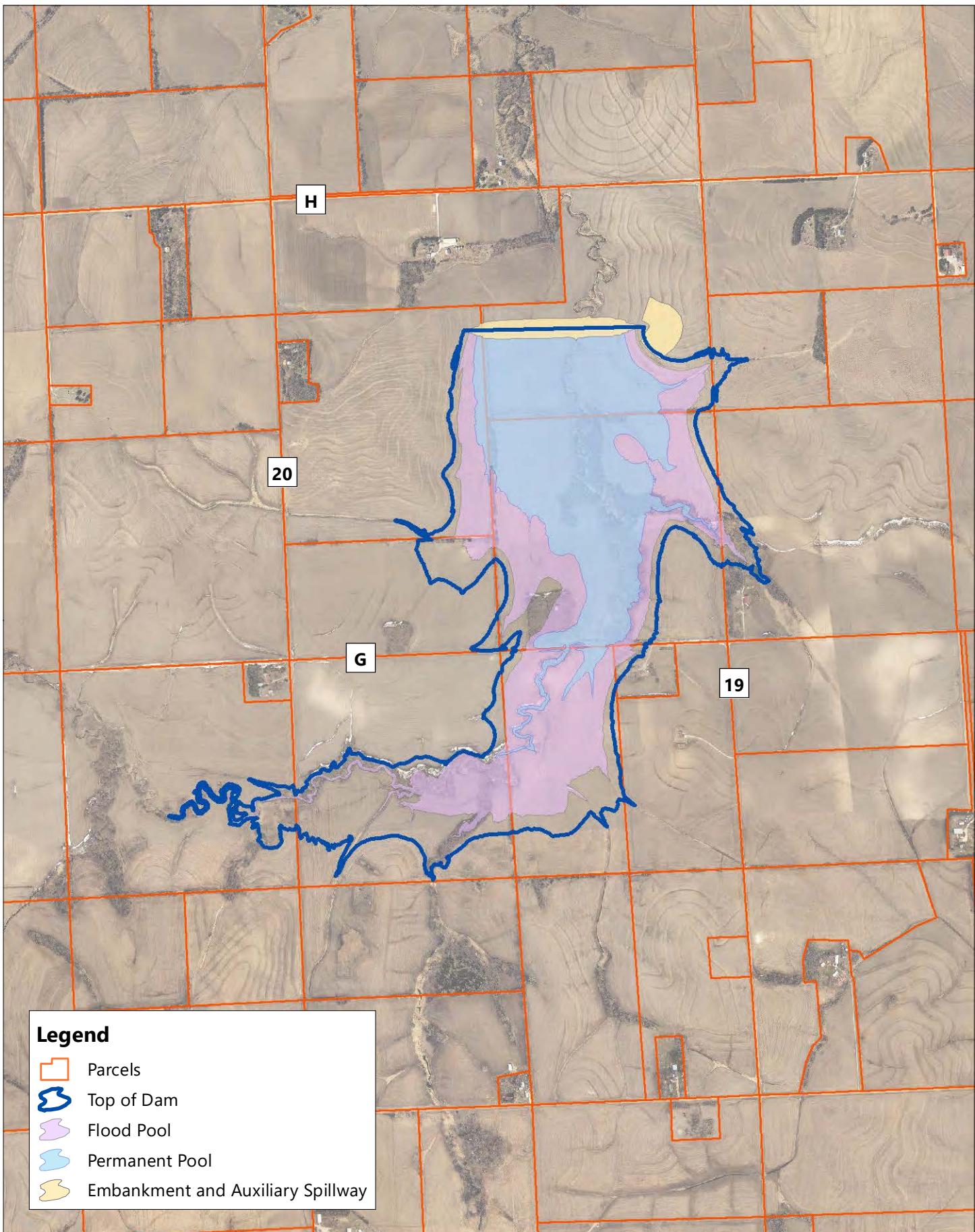


Figure C5.5. Site 77 Project Extents

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 750 1,500 Feet



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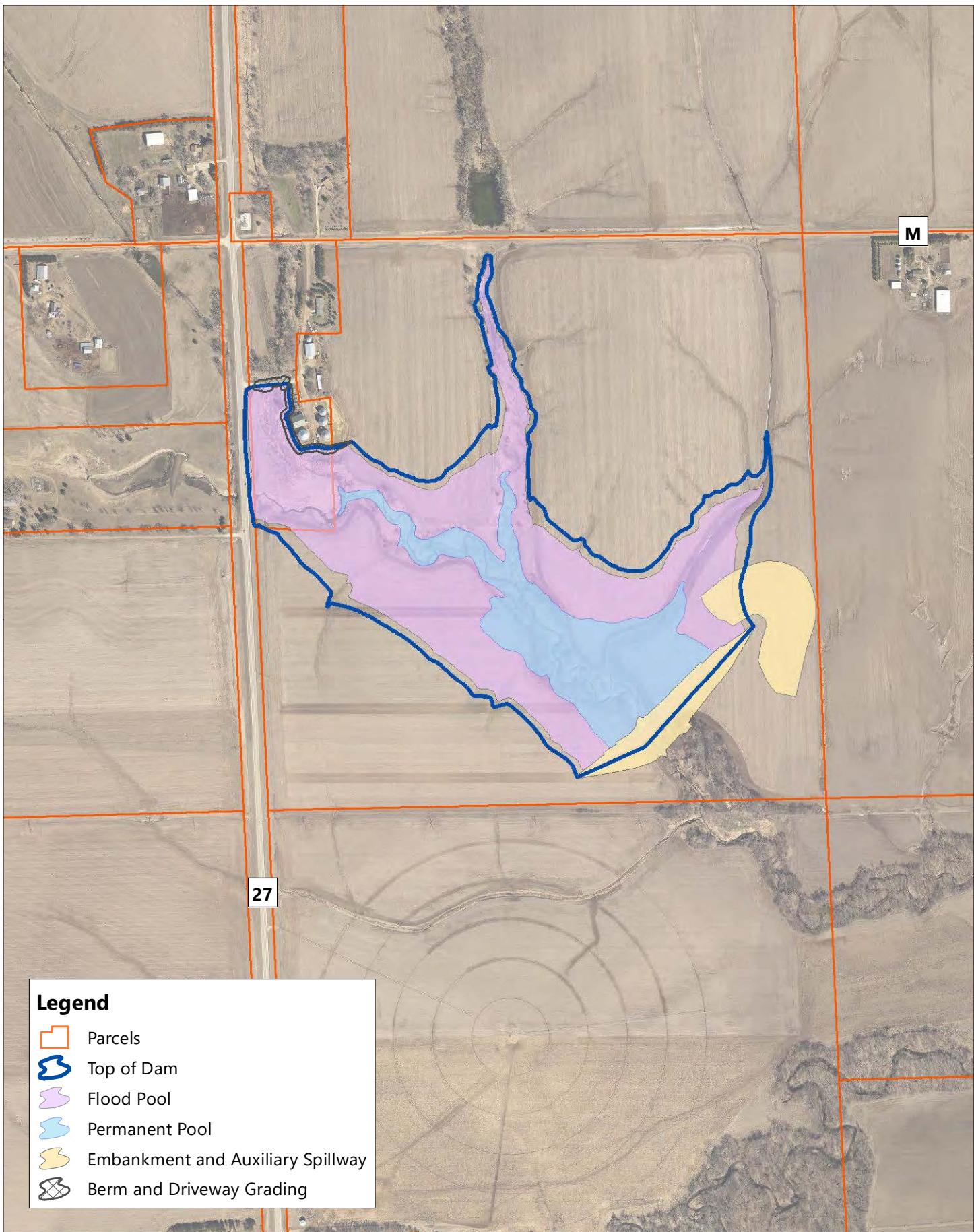


Figure C5.6. Site 82 Project Extents

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 300 600
Feet



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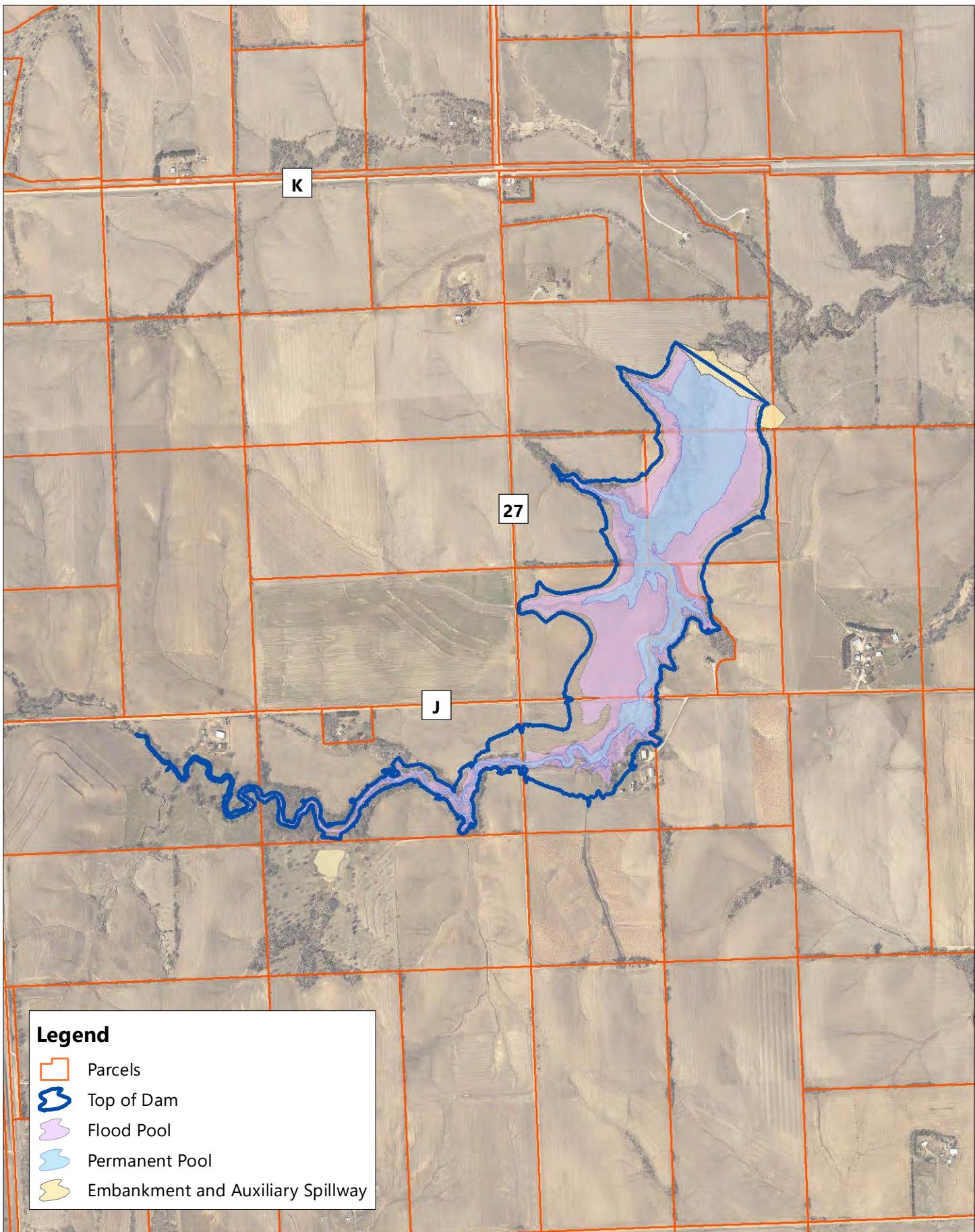


Figure C5.7. Site 84 Project Extents
Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 650 1,300 Feet



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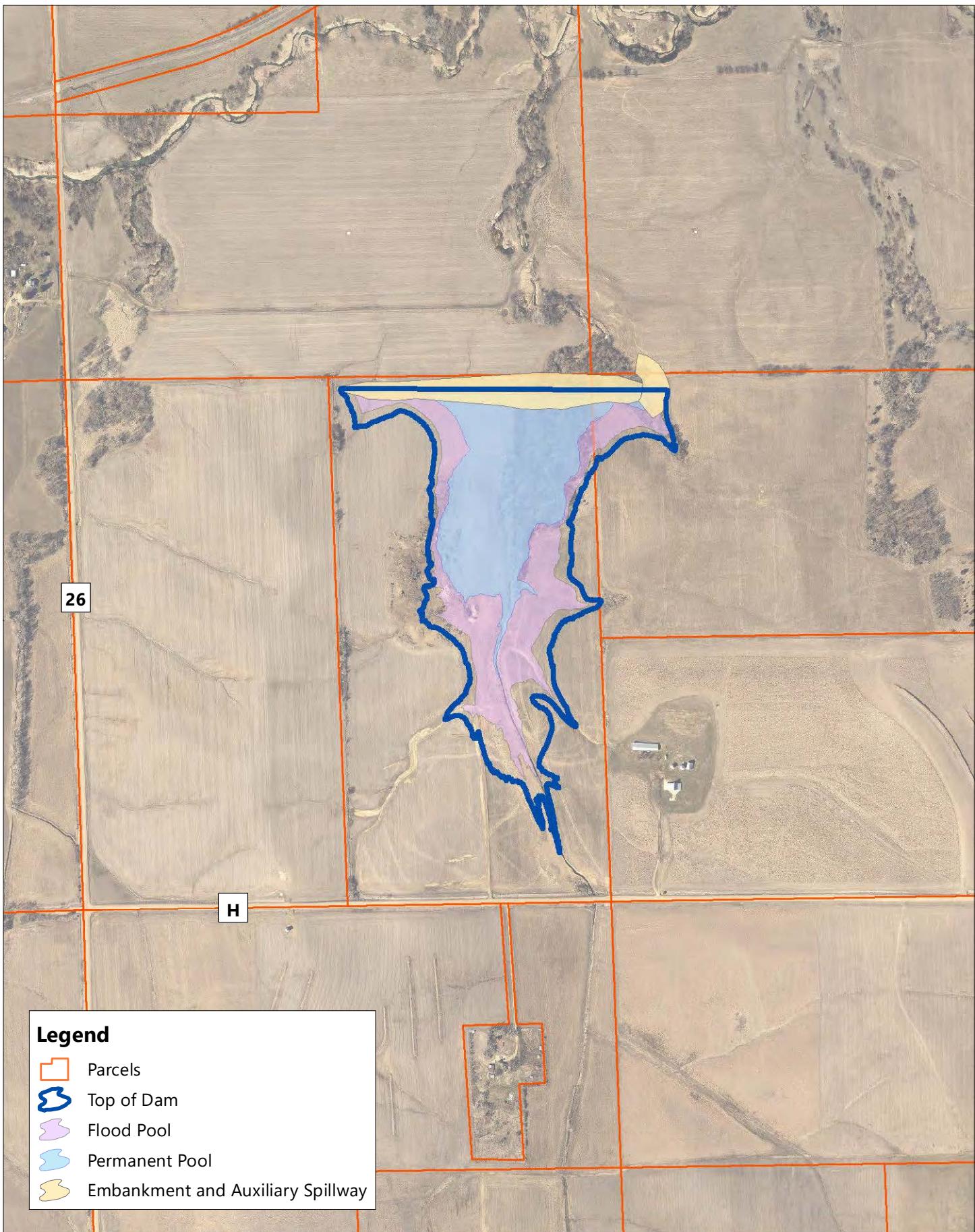


Figure C5.8. Site 85 Project Extents

Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



0 325 650 Feet



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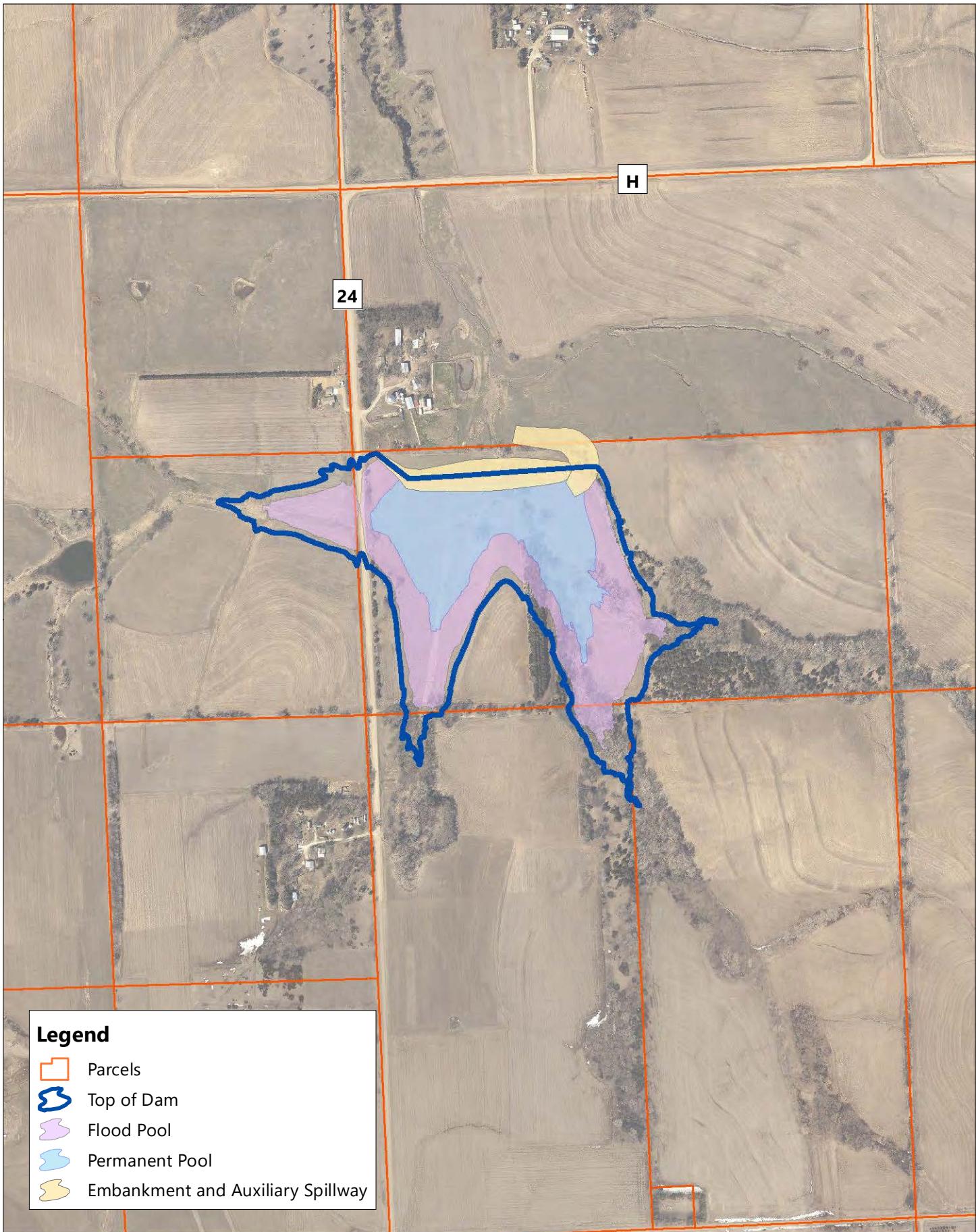


Figure C5.9. Site 86 Project Extents

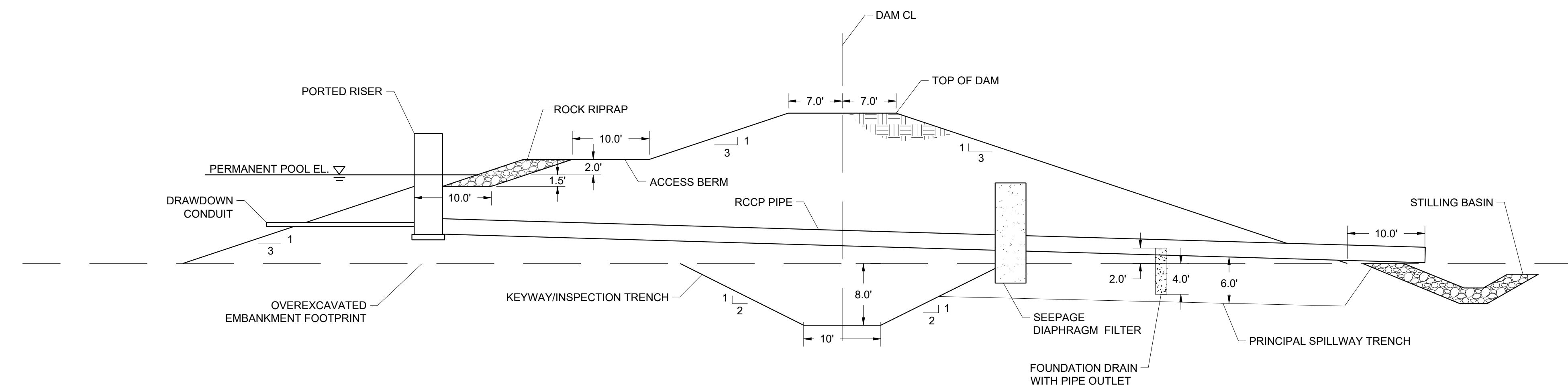
Upper Wahoo Creek Watershed Plan-EA
Natural Resources Conservation Service
Lower Platte North NRD



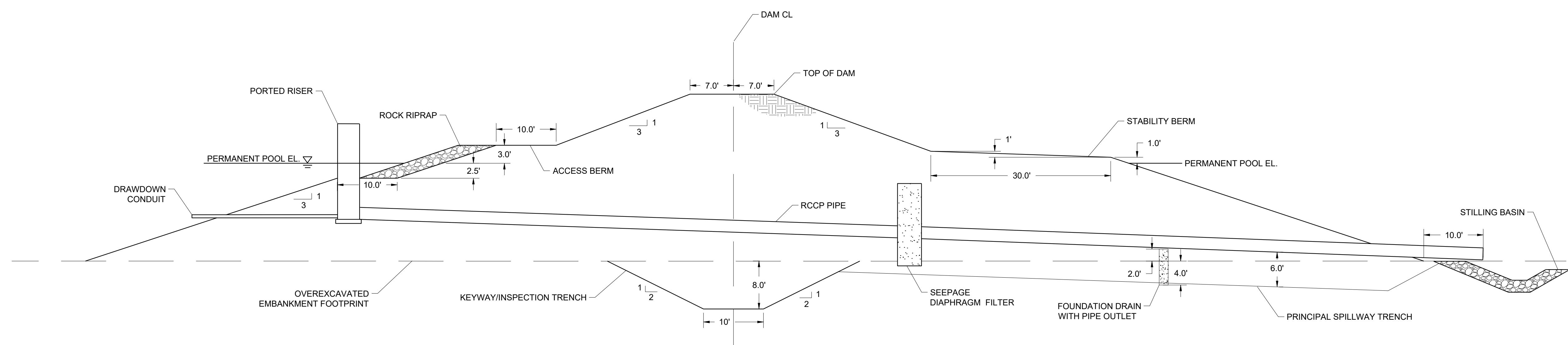
0 325 650
Feet



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TYPICAL DAM CROSS-SECTION: DAM HEIGHT \leq 35 FT



TYPICAL DAM CROSS-SECTION: DAM HEIGHT $>$ 35 FT

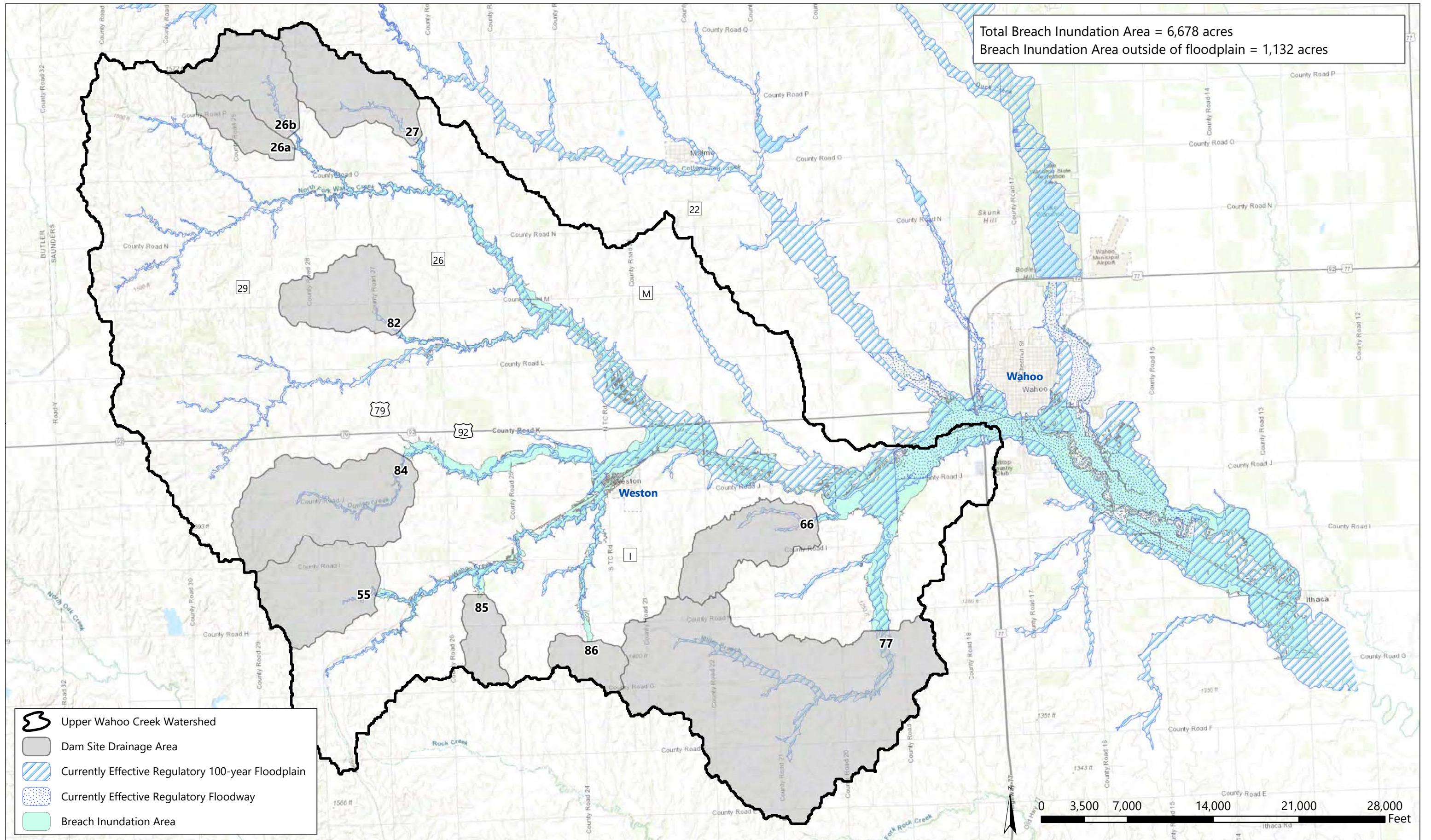


Figure C-7. Breach Inundation Map

Upper Wahoo Creek Watershed Plan-EA
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APPENDIX D – INVESTIGATION AND ANALYSIS REPORT

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D1.0 INTRODUCTION

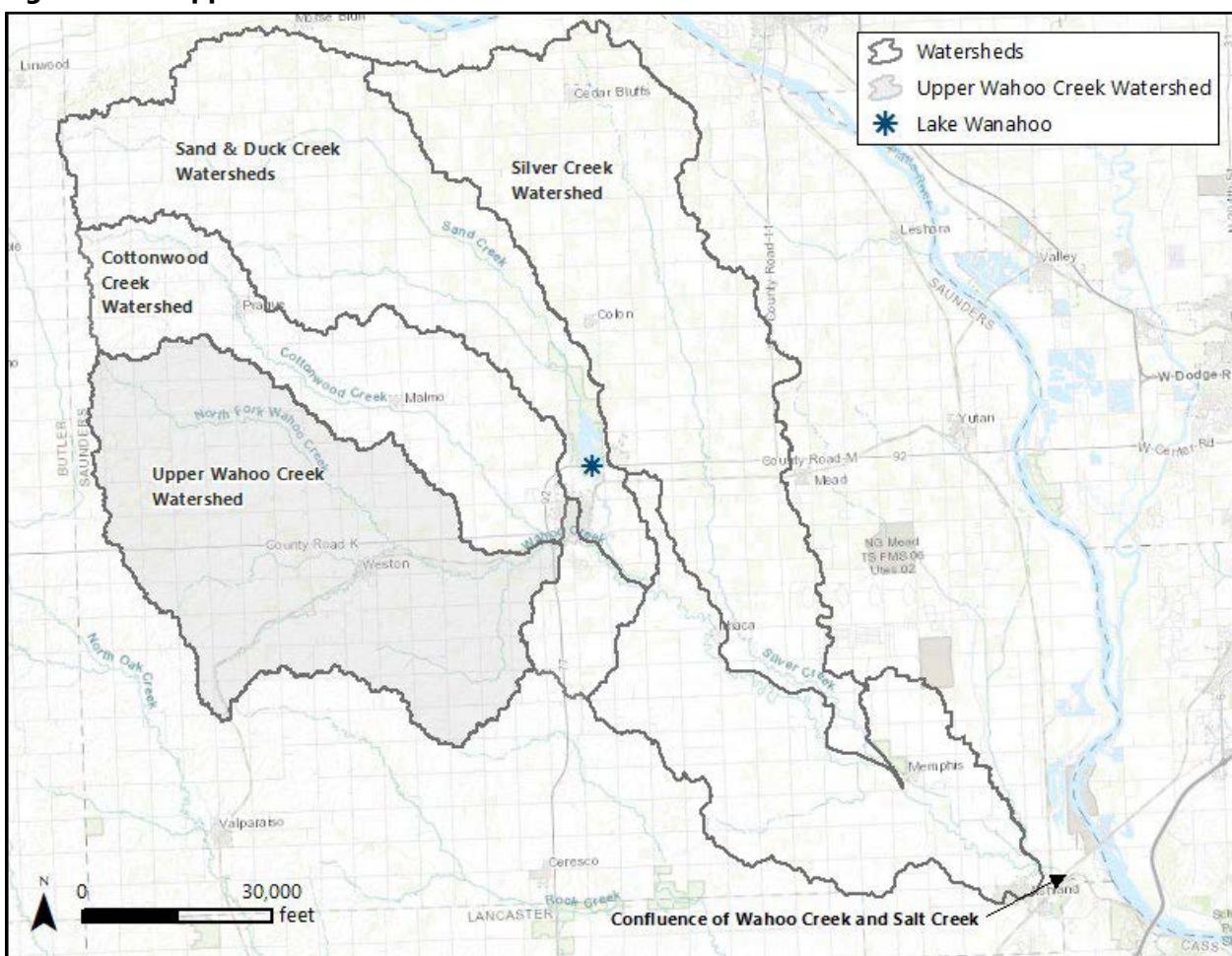
This appendix provides supporting information for the formulation, evaluation, and conclusions of this Plan-EA. Items of a routine nature are not included; however, citations are included throughout the Plan-EA and this Investigation and Analysis report for appropriate manuals, handbooks, research, and other references. USDA NRCS manuals and handbooks, state guidelines, and other reference documents were used to guide the planning of this project. These are referenced in Chapter 8.0 of the Plan-EA.

The NRCS planning staff and hired consultants worked with other federal, state, and local agencies, individual watershed residents, private professional services consultants, the Sponsor, and NRCS State and National staff specialists throughout the planning process. Interdisciplinary teams were used in the assessment and evaluation of present, Future Without Project, and Future With-Project conditions. This coordinated planning effort produced a forecasted Without Project condition that allowed for the consideration of several alternatives. Consideration of these alternatives led to the selection of a cost-effective alternative that was socially, politically, and economically acceptable.

D2.0 WATERSHED HYDROLOGIC MODELING

D2.1 Background

Wahoo Creek, upstream of its confluence with Salt Creek (see Figure D2-1), was modeled in HEC-HMS 3.5 for the USACE Section 206 Sand Creek Environmental Restoration Project (Restoration Project), here forward referred to as the Wanahoo Model. Earlier models developed by the USACE and NRCS (formerly SCS) were the basis of the more refined HEC-HMS model developed for the project. Eleven existing structures in the Cottonwood Creek watershed were included from the earlier SCS model and eight proposed dams in the Sand Creek watershed were added to the Wanahoo Model for the Restoration Project. These sites have now been constructed. After the construction of the Restoration Project, the Saunders County Flood Insurance Study (FIS) was updated to include discharges determined from the Wanahoo Model. In creating a model for the Restoration Project, the Upper Wahoo Creek watershed was largely unrefined as it did not pertain to design outside of the region of the previously designed projects. The Wanahoo Model was therefore not functional, nor was it intended to be used, for assessment of potential dam sites within the Upper Wahoo Creek watershed. Additionally, the storm events used to calibrate the Wanahoo Model were likely chosen to represent design storms for a high hazard structure, such as Lake Wanahoo, and would not be adequate to assess the intricacies of peak timing that occur in the more frequent events that cause the majority of the annualized flood damages and are important to this Plan-EA development effort.

Figure D2-1. Upper Wahoo Creek Watershed

D2.2 Methodology

A HEC-HMS model (hereafter referred to as the Wahoo Model) was developed and calibrated to improve the representation of more frequent flood events in the Upper Wahoo Creek watershed. This enabled the planning team to select potential dam site locations that offered the most benefits to flood damage reduction. The Cottonwood, Sand, and Duck Creek watersheds were rebuilt from the Wanahoo Model and adopt the previous naming schemes wherever possible. The Upper Wahoo Creek watershed was not imported from the Wanahoo Model due to the coarseness of the watershed delineation and was built using the methodology outlined in the following sections. Observations from flooding events occurring on 8/29/2007 and 5/7/2015 were used to calibrate the model's runoff volume, peak discharge, and timing of flood peak.

D2.2.1 Subbasins

Subbasin delineations were determined by computerized methods from a current 10-meter Digital Elevation Model (DEM). Subbasins were split at the existing dams included in the Wanahoo Model by referencing current aerials and the contributing areas were updated to reflect as-built conditions. The subbasins were also delineated at anticipated potential dam sites within the Upper Wahoo Creek watershed.

SCS curve numbers were determined from land use and hydrologic soil groups according to the procedure set forth in TR-55. The area-weighted average curve number within the subbasin was calculated and was refined during calibration for runoff volume for the selected storm events. National Hydrography Dataset (NHD) streamlines were used when determining stream lengths. The slopes are determined from a 2-meter DEM as the average slope over the reach with drops resulting from structural grade control removed. One purpose of this model is to assess timing for frequent events; therefore, the flow conveyed by the channel has more significance than would be typical in a floodplain model. If this model is repurposed to assess less frequent events, the hydrologic routing parameters should be assessed in more detail to confirm floodplain storage is not over-represented.

Eleven Cottonwood Creek and eight Sand Creek reservoirs were included in the Wanahoo Model. The Wahoo Model adopted the storage and discharge tables from the Wanahoo model. The 2007 calibration event preceded the construction of the eight Sand Creek reservoirs, so they have been excluded from the calibration model run; however, they are present in the 2015 calibration event. In the lower portion of the Cottonwood Creek watershed, four additional NRCS reservoirs with contributing areas of several hundred acres were identified and included in the model. Elevation-storage tables were developed from a 2-meter DEM for the volume above permanent pool.

D2.2.2 Precipitation

Next Generation Radar (NEXRAD) reflectivity was processed to determine the spatial and temporal precipitation distribution produced by the storms for calibration of the HEC-HMS model to gaged flows recorded during these storm events. The radar estimated storm total precipitation was adjusted to fit observed rainfall totals, and area weighted average incremental precipitation was resampled at ten-minute intervals for each subbasin. The resulting synthetic rain gauges were added to the model for each subbasin.

D2.2.3 Runoff Volume and Routing

Observed streamflow at Ithaca was used as the calibration target. The runoff volume target was met by adjusting the curve number to 97 percent of the spatially calculated value. The shape and peak of the hydrographs were driven by timing and floodplain attenuation. Muskingum-Cunge reach routings were used with eight-point cross sections. Reaches were classified into five channel and floodplain widths that are represented by the cross sections. The cross-section rating curves were verified to approximate the rating curve that has been observed at the Ithaca gauge and approximate channel capacity in the tributaries prior to incorporating them into the HEC-HMS model.

Additional modeling was included in the wide floodplain between Lake Wanahoo, City of Wahoo, and the Ithaca gauge. In this area, HEC-RAS 2D modeling developed by FYRA demonstrated separation of floodplain flows from channel flows during the less frequent events. Due to limitations within routing procedures in HEC-HMS, the physical behavior of the disconnected floodplain is modeled with a reach parallel to the channel with adjusted length and slope that routes the discharge that exceeds channel capacity. The nonlinear relationship of storage and discharge in the overbank has been represented by an elevation-area-discharge relationship that was determined from the USGS rating curves and the aforementioned HEC-RAS 2D model. Manning's "n-values" were increased significantly from the values presented in the Wanahoo Model to consistently reflect densely vegetated and meandering channels as observed during site investigations and in aerial imagery. The resulting reach routing calibration yields an

August 2007 storm hydrograph with peak discharge that is eleven percent lower and twenty four minutes earlier than the target as shown in Figure D2-2a. The calibration yields a May 2015 storm hydrograph with peak discharge that is seven percent lower and one hour and twenty four minutes later than the target as shown in Figure D2-2b. The hydrographs at Ithaca and Ashland shown in Figure D2-2a display the significant impact that floodplain attenuation exerts on flood events where the peak discharge of 14,000 cfs is reduced to nearly 3,000 cfs. The functional purpose of hydrologic modeling of Wahoo Creek between Ithaca and Ashland is to demonstrate that the reach routing assumptions are satisfactory so less detail was included on this portion of the model. The rising limb of the modeled hydrograph at Ashland is late to arrive because subbasin rainfall data on the lower tributaries to Wahoo Creek downstream of the Sand Creek confluence were not included in the analysis. The total runoff volume between Ithaca and Ashland, decreased in the downstream direction because of greater percolation losses than tributary inflows so the net effect of their omission appears to be balanced.

Figure D2-2a. August 2007 Calibration Hydrograph

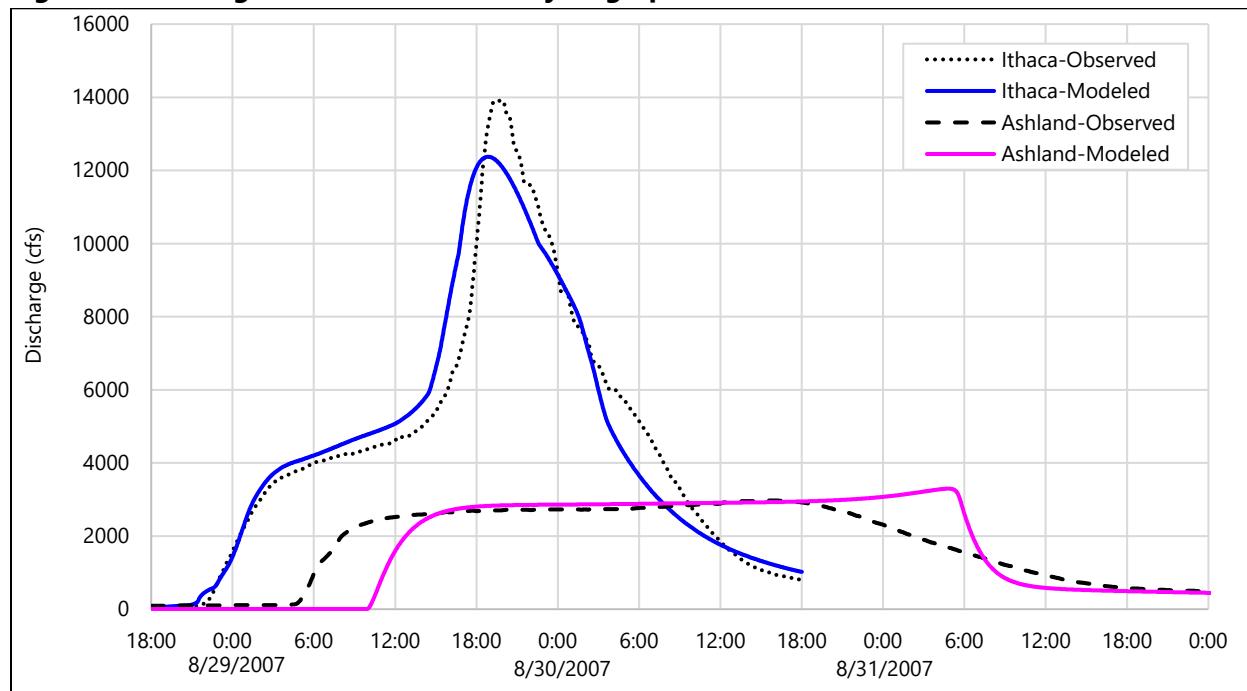
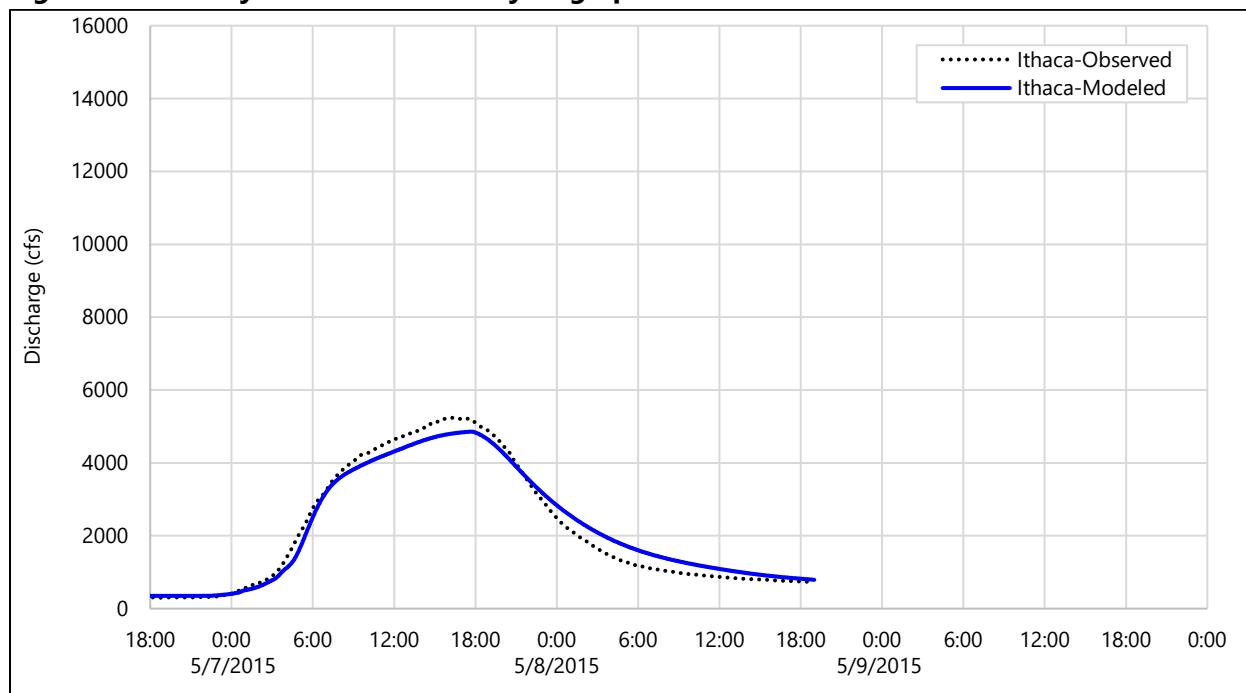


Figure D2-2b. May 2015 Calibration Hydrograph

D2.2.4 Hydrology

The generalized synthetic storm used to assess flood reductions due to potential dam sites during the site selection process was the one-day Atlas 14, 4th quartile, 90th percentile storm with a 200-square mile areal reduction factor, determined from Atlas 2. This temporal distribution was selected because it is the yielded the most conservative reservoir routing, and the areal reduction factor is applied based on the storm size encompassing the Upper Wahoo Creek watershed. Inherent consistency across all subbasins in rainfall rate and total depth, produced by the design storm, results in a hydrograph that is not biased towards any tributary. The resulting hydrograph does not represent the shape of a natural storm, because storm rainfall patterns are not uniform and will impact basins at different times as the storm traverses over a drainage area; even so, the design hydrograph represents averaging of natural storms so tributaries' influence on peak discharge can be distinguished.

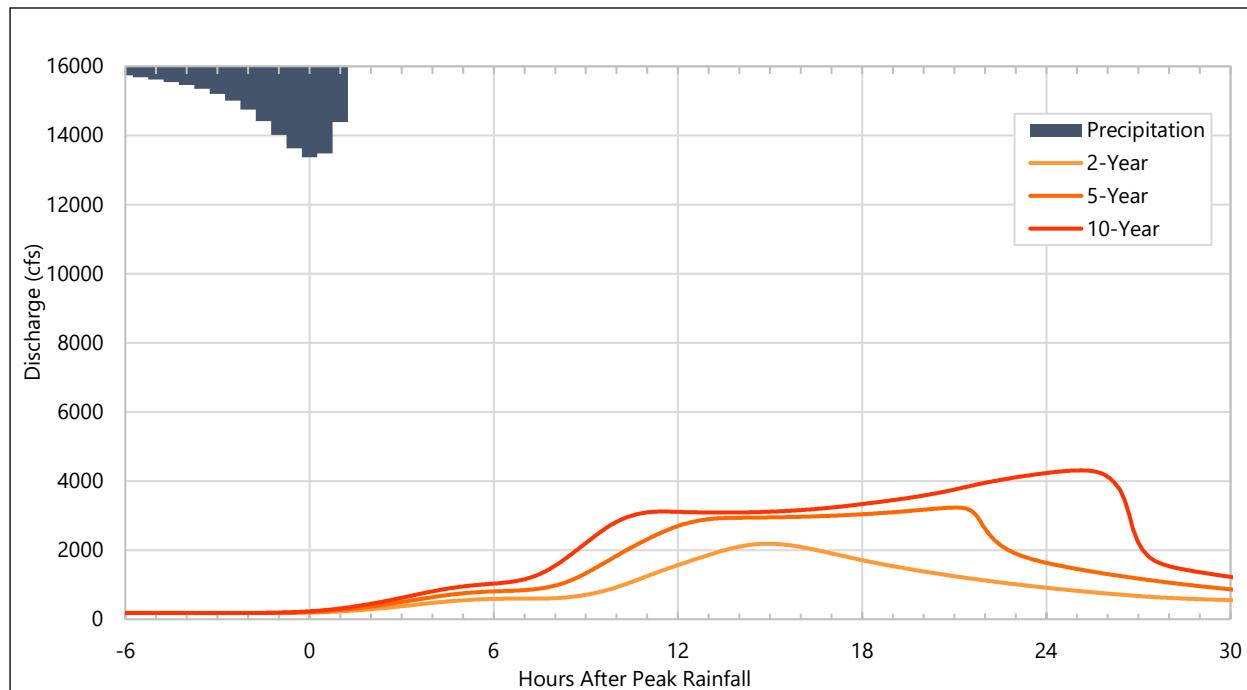
D2.2.5 Tributary Hydrograph Timing

Identifying potential sites that yield the most significant reduction to modeled peak discharge depends on hydrograph timing as well as the dam size, topography, and dam outlet works. An analysis of peak arrival time in the tributaries provided insight to where dam sites could best target reductions to the damage producing portions of the hydrograph at multiple locations along Wahoo Creek. In the Wahoo Creek watershed above Ithaca, there are three major tributaries: Sand, Cottonwood, and Wahoo Creek above the Cottonwood Creek confluence (see Figure D2-1).

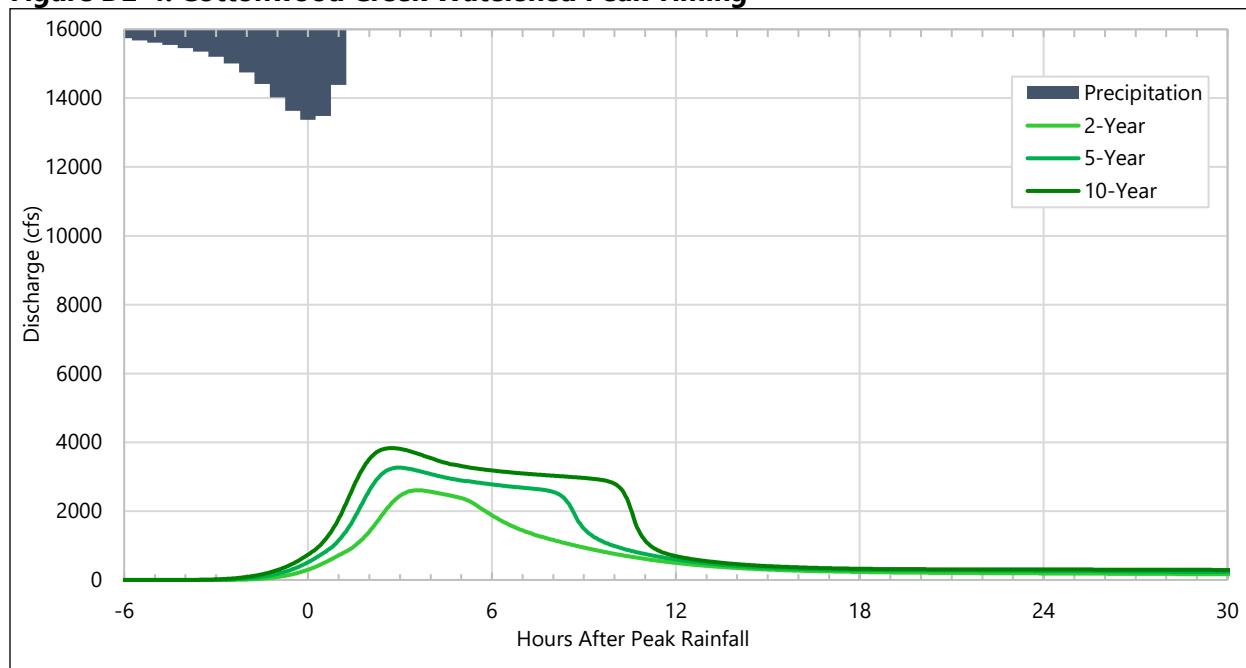
Sand Creek and its significant tributary Duck Creek join upstream of Lake Wanahoo, with Duck Creek's modeled peak flow preceding a more significant Sand Creek modeled peak by approximately five hours. Reservoir routing through Lake Wanahoo broadens the hydrograph and reduces the peak discharge to the floodplain between the lake and Wahoo Creek where additional storage in the floodplain lags the peak

discharge behind the rising limb of the hydrograph. Sand Creek peak discharge to Wahoo Creek occurs approximately 14, 20, and 24 hours after rainfall for the 2, 5, and 10-year, as shown in Figure D2-3. The rainfall depths vary by storm, so a unitless hyetograph is included in the figures to provide reference for time from peak rainfall intensity to peak discharge.

Figure D2-3. Sand Creek Watershed Peak Timing



Cottonwood Creek has no significant tributaries without flood control structures. The uncontrolled drainage areas are near to the stream and relatively evenly distributed along its length, thus the minor tributary peak discharges entering Cottonwood Creek tend to precede the arrival of the peak derived from minor tributaries upstream. Discharge to Wahoo Creek peaks approximately 2 hours after rainfall and remains high for 8 hours, as shown in Figure D2-4.

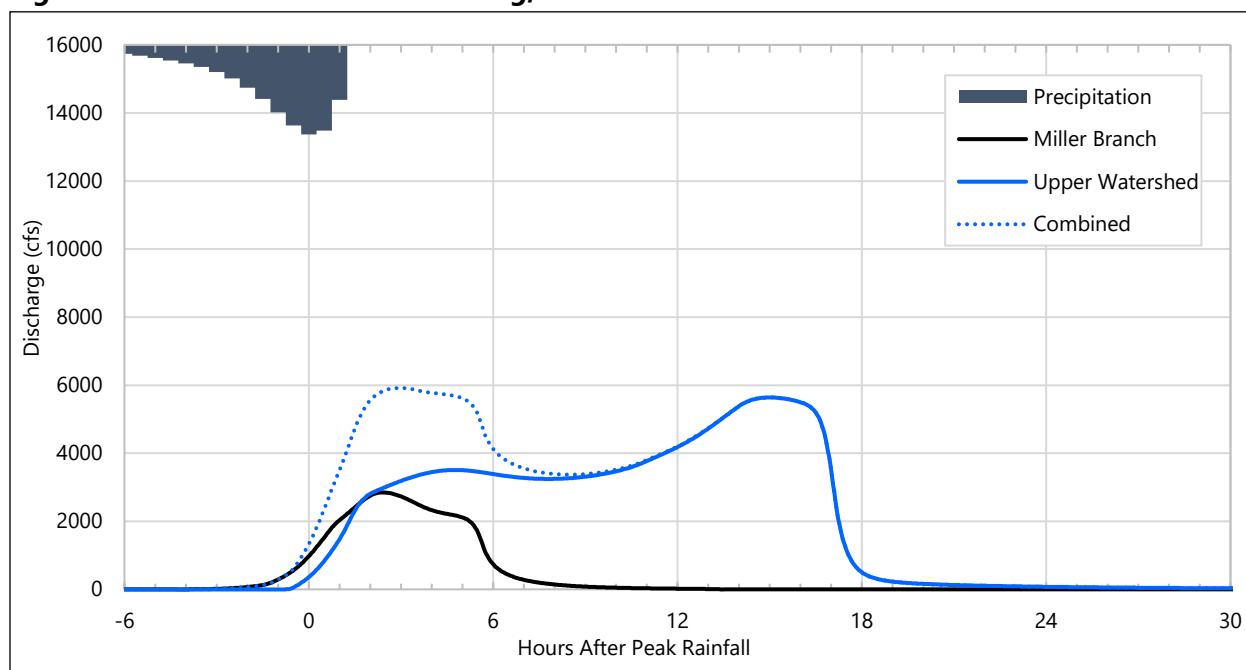
Figure D2-4. Cottonwood Creek Watershed Peak Timing

Wahoo Creek above Cottonwood Creek includes four significant tributaries: North Fork, North Fork's tributary, Wahoo Creek above North Fork, and Miller Branch.

North Fork and its significant tributary have a dendritic pattern of minor tributaries that result in many overlapping hydrographs with coinciding peaks but overlapping to a lesser degree east of Highway 79. The peak derived from these tributaries reaches Wahoo Creek approximately nine hours after rainfall.

Wahoo Creek above North Fork has two minor tributaries that enter on each bank. These tributaries have coinciding peaks that precede the peak derived from the milder sloped Wahoo Creek by approximately 3 hours. The peak derived from Wahoo Creek above North Fork reaches the confluence with North Fork about five hours after rainfall, four hours before the peak from North Fork. However, there is overlap of the rising and falling limbs of these hydrographs, which results in a combined hydrograph that does not have significant bias toward either tributary but with a much higher peak.

Miller branch and a left bank tributary to Wahoo Creek in the vicinity produce a peak in Wahoo Creek that precedes a secondary peak that is derived from the three significant tributaries upstream, as shown in Figure D2-5. These peaks occur 3 and 14 hours after rainfall, though in a natural storm it would be unlikely for both regions to receive equal rainfall which would reduce one of the peaks.

Figure D2-5. Miller Branch Peak Timing, 5-Year

The Wahoo Creek peak derived from the Miller Branch overlaps with peak discharge from Cottonwood Creek. The discharge of the combined peaks is greater than the discharge corresponding with the Wahoo Creek second peak, but assessment of potential sites takes both peaks into consideration independently, because a natural storm would be expected to bias one peak. The overlapping peaks are shown in Figure D2-6 and the combined hydrographs are shown in Figure D2-7.

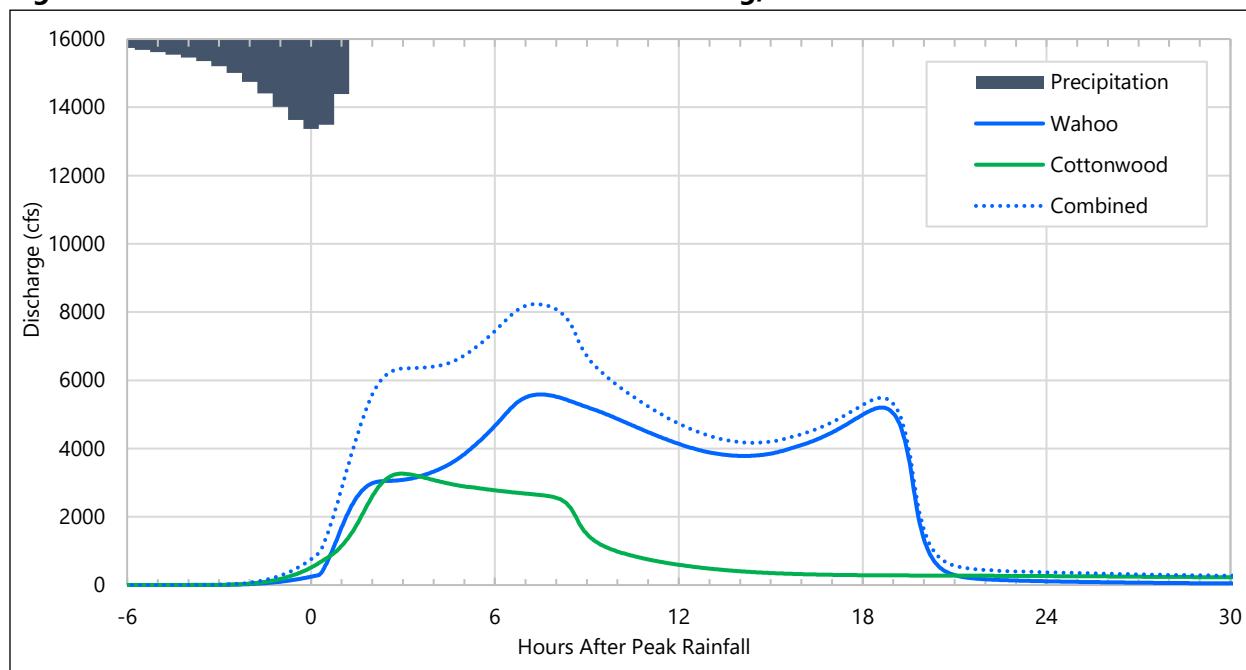
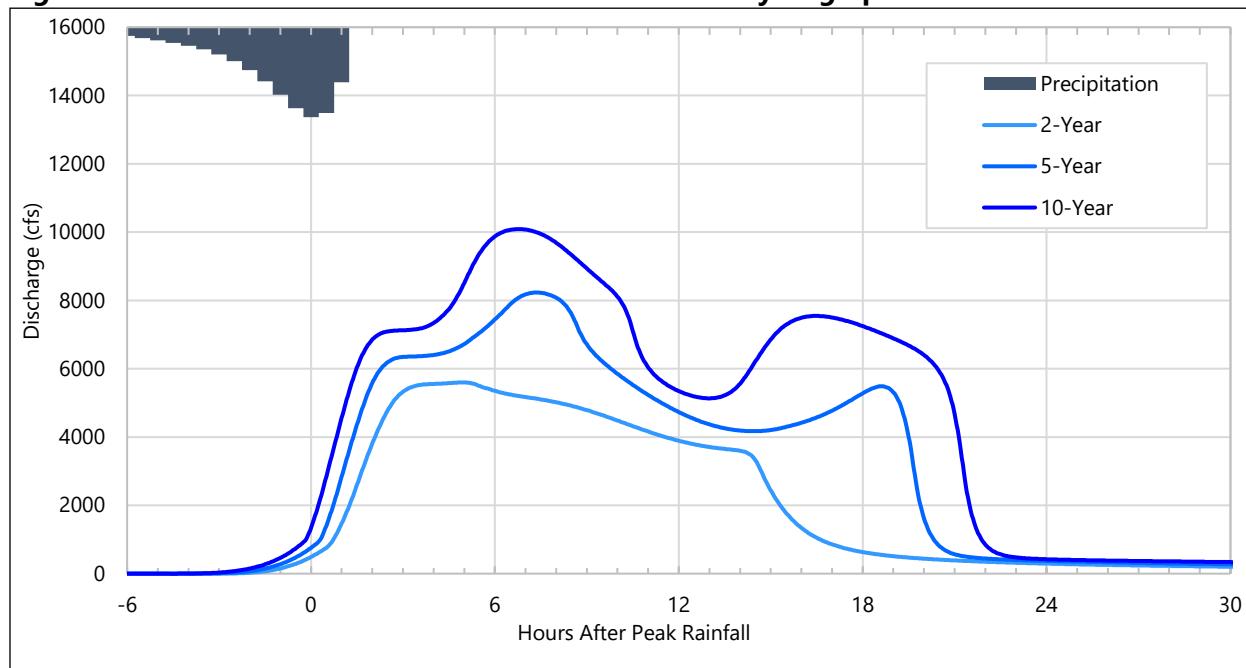
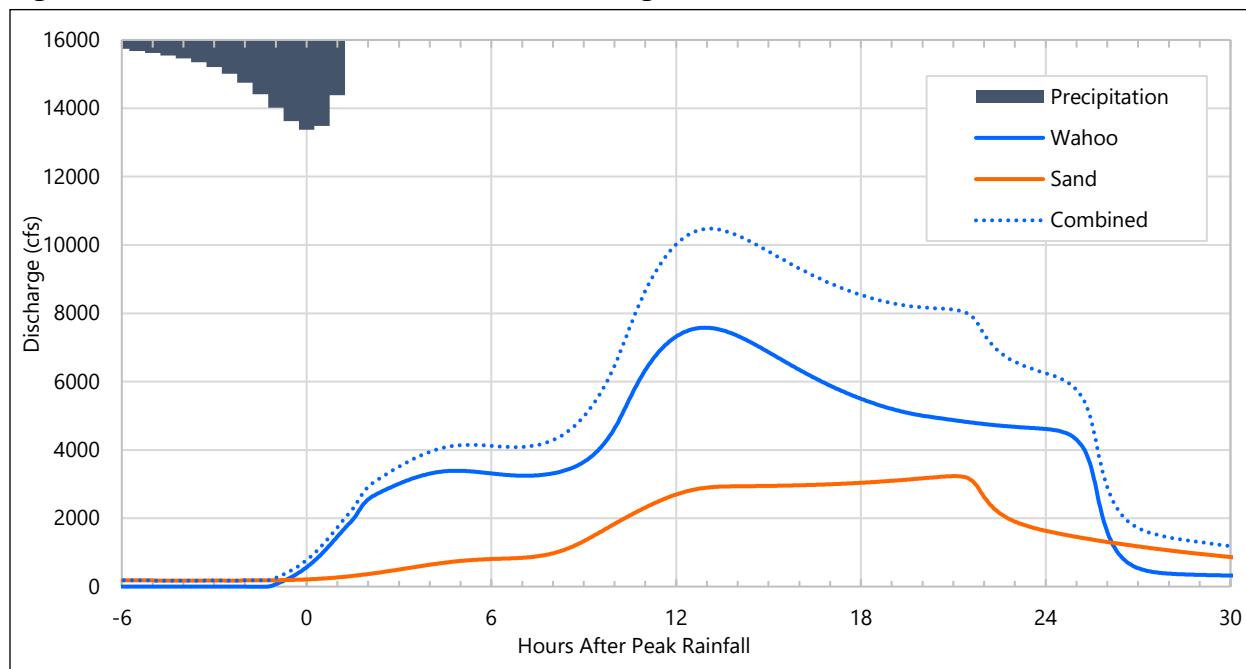
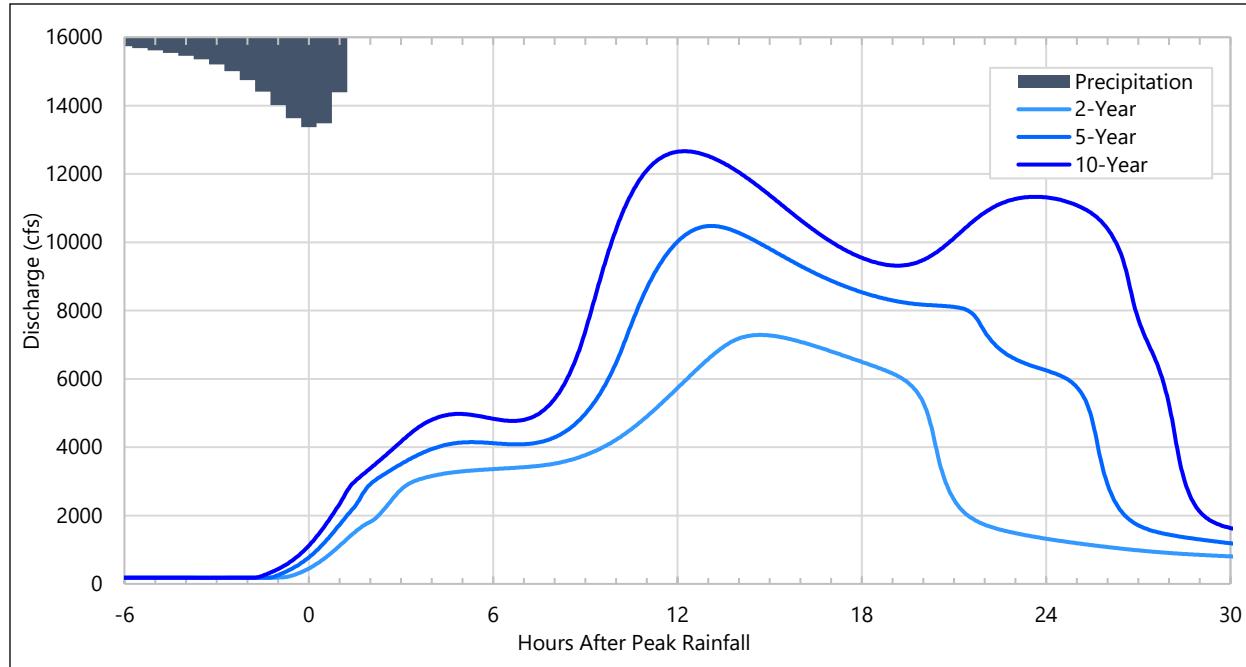
Figure D2-6. Wahoo and Cottonwood Creek Peak Timing, 5-Year

Figure D2-7. Wahoo and Cottonwood Creek Combined Hydrograph

To define a goal for volume detention, the timing of the peak discharge from Cottonwood and Wahoo Creeks were inspected in detail. While the combined Wahoo and Cottonwood Creek hydrograph is increasingly attenuated in the floodplain below Highway 77 for discharges greater than 3,000 cfs, discharges below this are primarily carried within the channel. The early peak from Cottonwood and Miller Branch, though initially high, has less volume than the second peak, so it is lagged into the second peak, but decreasingly with greater runoff volumes. Therefore, timing of the peak discharge is dependent on runoff volume and ranges from 12-23 hours after peak rainfall, as shown in Figure D2-8. This range includes the peak discharge of Sand Creek and consequentially, peak flow reductions below the confluence are attributable to volume of runoff which can be detained beyond that timeframe. The overlapping peaks are shown in Figure D2-8 and the combined hydrographs are shown in Figure D2-9. Considering these observations, maximizing the attenuation with ported risers and minimized principal spillway diameters to facilitate storage exceeding 24 hours was considered a primary goal.

Figure D2-8. Wahoo and Sand Creek Peak Timing, 5-Year**Figure D2-9. Wahoo and Sand Creek Combined Hydrograph**

The preferred alternative includes 10 sites that address peak flow reduction. Site identification and site-specific hydrology is included below in Section D3.0. Peak flow reductions at various storm events of the preferred alternative at two representative junction points included below in Table D2-1. The junction point locations are shown below in Figure D2-10.

Figure D2-10. Peak Flow Reduction at Representative Locations

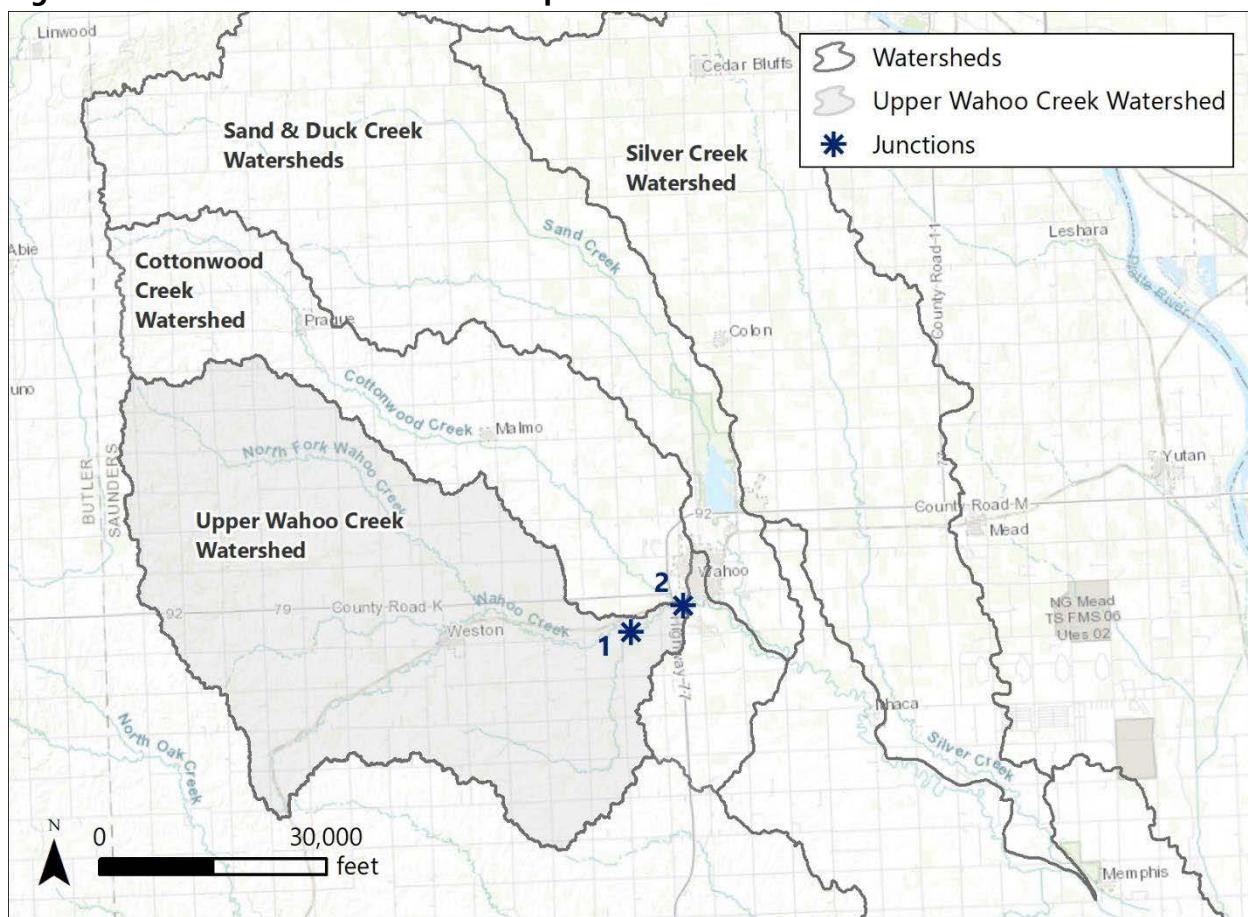


Table D2-1. Peak Flow Reductions¹

Storm Event	Miller Branch (Junction 1)			Wahoo and Cottonwood Creek (Junction 2)		
	Existing Peak Flow (cfs)	Preferred Alternative Peak Flow (cfs)	Peak Reduction	Existing Peak Flow (cfs)	Preferred Alternative Peak Flow (cfs)	Peak Reduction
2 year	4,500	3,200	29%	4,900	4,700	4%
5 year	5,700	4,400	23%	7,300	5,700	22%
10 year	7,200	6,000	17%	9,300	6,900	26%
25 year	10,200	8,300	19%	12,300	9,100	26%

¹Junction locations shown in Figure D2-10.



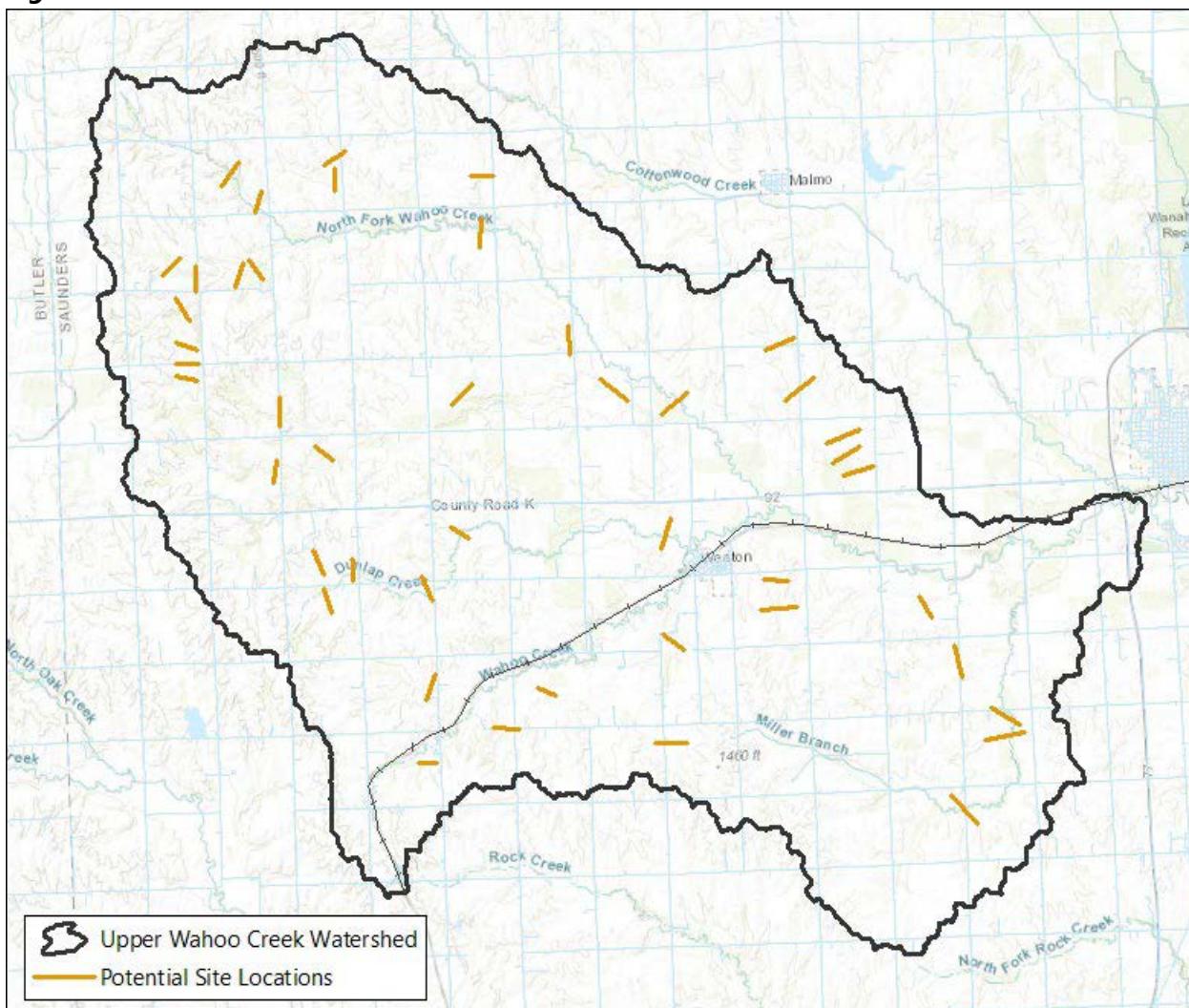
D3.0 The Preferred Alternative Design

The following section provides details on the design of the preferred alternative.

D3.1 Site Identification

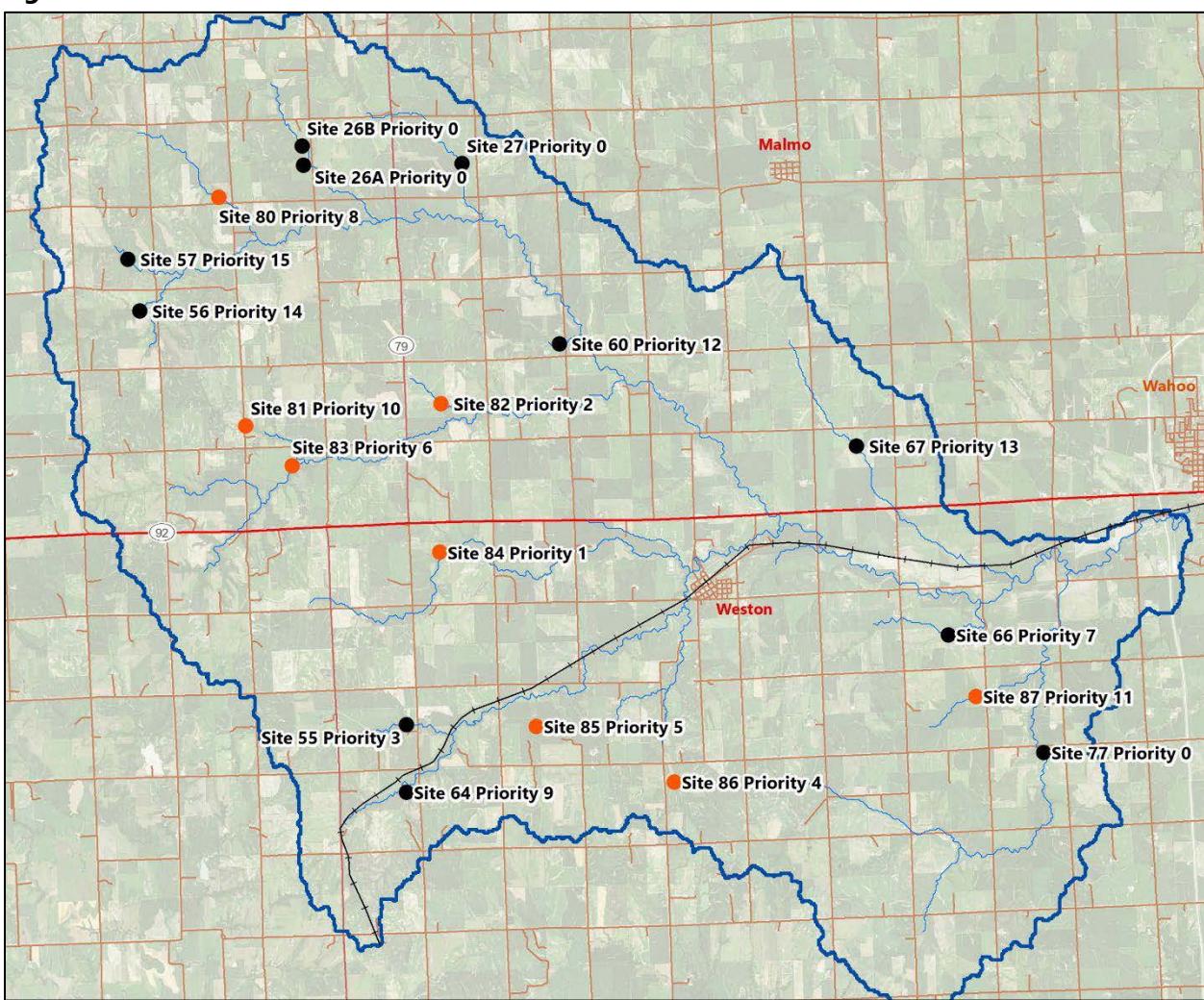
The dam locations identified in the 1998 Plan-EIS as well as new sites were considered during the site identification process. New sites were chosen based on an analysis of aerial photographs, publicly available information and GIS layers, field investigations, and speaking with members of the community. Existing infrastructure, including highways, railroads, major utilities, and homes and buildings, were all considered. Infrastructure within the potential footprint of the dam's embankment and top of dam limits were analyzed in addition to potential impacts downstream due to a potential dam failure. State of Nebraska dam hazard classification, and therefore design criteria, are based on the structure's size, proximity to cities or villages, and the consequences of dam failure, as outlined in the Classification of Dams publication produced by NeDNR Dam Safety Section (NeDNR, 2013). Significant or high hazard dams are required to be larger and would impact the economic viability of the project and were therefore avoided if possible.

Saunders County 1- and 6-year bridge replacement plans were analyzed as well to identify any locations where a structure placed upstream would allow for the aging bridge to be replaced by a culvert and therefore provide additional economic benefit. Existing sensitive resources were also considered when choosing potential site locations. Stream and woodland corridors, potential wetlands, and habitat for threatened and endangered species were identified and used in conjunction with the other data collected. Members of the community, elected officials of the LPNNRD, and members of the Saunders County Board of Supervisors were also invited to provide information on existing flooding issues throughout the Upper Wahoo Creek watershed at committee and board meetings facilitated by the Sponsor. A total of 45 floodwater retarding dam sites were originally identified as potential structure locations (Figure D3-1).

Figure D3-1. Potential Site Locations

D3.2 Site Prioritization

Sites that remained feasible were analyzed for the quantity of flood damage reduction (drainage area controlled and volume of storage) and for which peak they were helping to attenuate flood flows. These sites are shown in Figure D3-2 below. The two peak discharges (shown in the hydrographs in Chapter D2) were lowered in unison with the viable sites based on their influence on the peaks and prioritized. This is illustrated in Table D3-1 below.

Figure D3-2. Potential Site Locations with Priorities

Sites with a number less than 80 (shown as black dots) were originally identified in the 1998 Plan-EIS.

Table D3-1. Potential Site Information

Priority	Site	Drainage Area (Sq. Mi.)	Basin Average Percent Reduction in Peak Discharge	Basin Average Percent Reduction per Square Mile Controlled	Peak
1	27	2.1	-2.3%	-1.0%	Second
2	26a & 26b	2.5	-1.1%	-0.4%	Second
3	77	10.2	-11.2%	-1.1%	First
4	84	3.6	-7.7%	-2.0%	Second
5	82	2.0	-2.8%	-1.1%	Second
6	55	2.3	-2.0%	-0.9%	Second
7	86	0.7	-1.3%	-1.8%	Second
8	85	0.8	-1.1%	-1.5%	Second
9	83	4.9	-3.0%	-0.6%	Second
10	66	1.9	-1.2%	-0.7%	First
11	80	2.6	-0.5%	-0.2%	Second
12	64	0.6	-0.6%	-1.0%	Second
13	81	0.7	-0.5%	-0.7%	Second
14	87	1.6	-1.0%	-0.6%	First
15	60	1.0	-0.9%	-0.9%	Second
16	67	2.9	-2.4%	-0.8%	First
17	56	0.9	-0.2%	-0.2%	Second
18	57	1.3	-0.2%	-0.1%	Second

D3.3 Site Specific Hydrology

The structures were sized using hazard classifications outlined in NeDNR Classification of Dams (NeDNR, 2013) and design specifications described in NRCS Technical Release 60 (TR-60). A rainfall/runoff model using National Oceanic and Atmospheric Administration (NOAA) Atlas 14 precipitation values were used and the storm frequencies for the Principal Spillway Hydrographs (PSH), Auxiliary Spillway Hydrographs (SDH), and Freeboard Hydrographs (FBH) were determined according to the hazard and size specifications in TR-60. Atlas 14 temporal distributions were used in accordance with State of Nebraska requirements and were run with 24-hour storm durations at 90th percentile and 10th percentile distributions at each quartile since these percentile distributions are the most conservative with each containing the maximum intensity periods. The 90th percentile, 4th quartile Atlas 14 temporal distribution was the selected distribution for each site as it resulted in the most conservative elevations. Atlas 14 rainfall data were used to determine rainfall depths according to the storm frequency, and the Nebraska Statewide Probable Maximum Precipitation (PMP) Study (2008) rainfall data were used for the FBH.

The NRCS Water Resources Site Analysis Program (SITES) software is the State of Nebraska dam safety recommended program to hydraulically proportion the principal and auxiliary spillways and was therefore used to size the structures. To run the Atlas 14 distribution, a HEC-HMS model was developed to provide

the inflow hydrograph for input into the SITES program for each dam location. Drainage areas were divided into subbasins in HEC-HMS to represent basin runoff volumes and timing more accurately. Times of concentration and lag times for each drainage area was computed in accordance with the methodology in the NRCS TR-55 Urban Hydrology for Small Watersheds (TR-55) document. Curve numbers (CNS) were determined from land use and hydrologic soil group according to the procedure set forth in TR-55. Land uses were determined based on 2011 National Land Cover data and compared visually to aerials to ensure accuracy. Significant changes in land use within the Upper Wahoo Creek watershed have not recently occurred and are not expected in the coming decades. Muskingum-Cunge reach routings were used with eight-point cross sections. The 1-day/10-day storm distribution was modeled in SITES using precipitation data from NOAA's Technical Paper No. 40 and Technical Paper No. 49.

Permanent pool volumes were set at the 50-year sediment storage capacity. Existing contours generated from LiDAR data were used to arrive at a permanent pool and principal spillway elevation based on the required storage. Land use analysis was performed to ensure that meaningful land use changes had not occurred between the development of the 1998 Plan-EIS and this Plan-EA. The auxiliary spillway height was set from the PSH design storm and the SDH and FBH design storms were used to set the spillway width and top of dam elevation in accordance with TR-60 criteria. Auxiliary spillway and top of dam heights were rounded up to the near half-foot to be conservative.

Ported risers are included in the design where applicable to reduce the peak flood discharge within the watershed most effectively by retaining the more frequent flood events for longer periods of time, thereby attenuating frequent flood flows. The crest of the ported riser elevation was set and the port was sized to limit the discharge to below 20 cubic feet per second per square mile (csm) during the 10-year, 24-hour storm. This 20 csm value was selected after analyzing the standard pipe size discharges and what value would not provide a significant increase in the routed auxiliary spillway crest elevations. Ported risers are not included in the design of dam sites that need lower auxiliary spillway and/or top of dam elevations due to existing infrastructure or when the 20 csm discharge was greater than the principal spillway conduit would allow under the same storm. A 24-inch reinforced concrete pressure pipe (RCCP) was used for the principal spillway conduits for most sites. Larger diameters are required in some locations in order to lower auxiliary spillway and/or top of dam elevations (see Section D3.5 for site-specific design information). All sites are designed with vegetated auxiliary spillways and a 50-foot long crest section, excavated in natural ground. The auxiliary spillway has a minimum inside radius of 50-feet and widths vary by site to meet storage capacity requirements and to optimize fill and excavation volume ratios to reduce the cost of construction.

In March of 2019, NRCS issued Technical Report 210-60 – Earth Dams and Reservoirs (TR210-60), which was intended to update the 2005 version of TR-60. At the time of this release, the technical work for this Plan-EA was largely complete, and therefore, the Nebraska State office of NRCS was consulted about the need to update any design information that may be affected by the issuance of TR210-60. A review of the differences in the two documents yielded the decision between the Sponsor and the State NRCS technical specialists that following guidance presented in TR210-60 would not cause significant changes in the screening of alternatives from a technical, economic, or environmental impact standpoint. Minor changes in the design of individual sites will be assessed and included during final design.

D3.4 Dam Breach Analysis

A dam breach analysis was performed for dam hazard class protection according to the procedures outlined in the NRCS Technical Release 66 (TR-66) and TR-60. The peak discharge in the dam breach was determined according to TR-66 using the simplified attenuation-kinematic (Att-Kin) method. The breach hydrograph is embedded into the outflow hydrograph developed in HEC-HMS. The hydrographs were run through a 2-D, unsteady state hydraulic model without downstream tributary flows per state guidance in Classification of Dams. The breach analysis was performed to a level of detail to sufficiently confirm the hazard classification and restrict development downstream to protect the hazard classification of the proposed dams. Each dam in this Plan-EA was assigned a hazard class based on the criteria contained in the Classification of Dams by the NeDNR. There is one class (b), significant hazard potential dam at Site 77 due to potential impacts to downstream homes and roads and the remaining sites are all class (a), low hazard potential structures. The breach water surface elevation corresponds to whichever is higher, the 100-year flood routing elevation or the auxiliary spillway elevation. The breach inundation map, included in Appendix C, shows sudden dam breach flow for individual dam breaches.

D3.5 Site Specific Design Information

All sites were initially sized as low hazard dams with a 24-inch RCCP principal spillway and ported risers. The auxiliary spillway widths were set to optimize fill and excavation volume ratios to reduce construction costs and to set top of dam elevations that avoid existing infrastructure. Any deviation from this design, as well as other unique and site-specific design decisions, are described below. Cross sections are provided in Appendix C.

Site 26 was identified in the 1998 Plan-EIS with the embankment positioned at an angle over County Road 28, perpendicular to the unnamed tributary to North Fork Wahoo Creek. Updated LiDAR and additional analysis indicated that this alignment was not ideal due to the existing roadway and a tributary flowing southwest, under County Road 28, into the unnamed tributary to North Fork Wahoo Creek. Therefore, alternative alignments were analyzed. Options that included replacement of the existing bridge at County Road 28 were favored because it is currently impassable and will need to be replaced by Saunders County, thus providing a shared economic benefit. One option analyzed was a road dam at County Road 28. This option included a large embankment volume and footprint and therefore it was determined to be more cost effective and reduce stream impacts to construct two smaller dams upstream of County Road 28, which are currently referred to as Sites 26a and 26b. Only minimal loss is realized in the controlled drainage area (34-acres or a 2 percent loss compared to the original site location) because of the upstream shift and using two smaller structures.

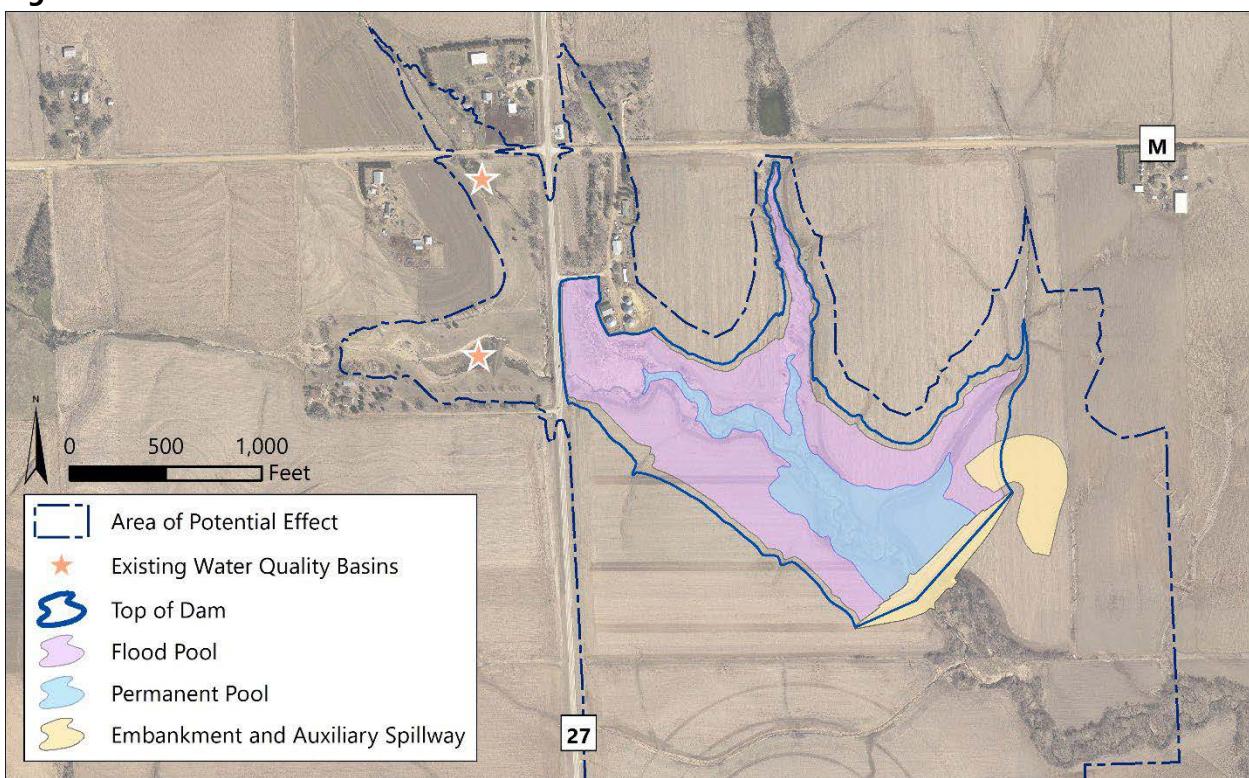
Site 27 was identified in the 1998 Plan-EIS. The originally identified embankment location was located over an existing buried NuStar Energy anhydrous ammonia pipeline. Costs to move the pipeline were quoted at over \$1 million. Consideration was given to moving the site downstream of the pipeline to increase the total controlled area and allow for additional flood damage reduction and water quality benefits. To do this, access berms with concrete culverts were preliminarily designed over the existing pipeline to ensure maintenance access for NuStar Energy. Upon review of this alternative, NuStar Energy informed the Sponsor that the berms would not be approved and therefore the site was moved upstream of the pipeline. The Site



27 location was optimized based on environmental constraints (predominantly stream impacts) and providing sufficient distance upstream of the pipeline.

Site 77 was part of the recommended plan in the 1998 Plan-EIS as a multipurpose structure, providing both NRCS and flood damage reduction benefits. Current preference of the public and the Sponsor is not to include public recreation at this site and therefore it is planned as a single purpose structure. Site 77 is a significant hazard structure due to the size and the potential impacts to downstream infrastructure identified during the breach analysis. Site 77 was designed without a ported riser and with a 72-inch RCCP principal spillway to keep the storage at the auxiliary spillway elevation below 2,500 acre-feet.

Site 82 was identified during the site identification process of this Plan-EA. The embankment location was optimized by avoiding existing irrigated land and power lines immediately downstream and by minimizing fill impacts to wetlands and streams. An existing barn, silos, and a driveway are present within the top of dam extents northwest of the embankment. A berm at elevation 1339 was designed to protect the silos and barn and the driveway was designed to be regraded to an elevation of 1339 to elevate it above the top of dam elevation. An existing culvert is located underneath the driveway and will be extended with the driveway grading. A minimum of 24-acre-feet of sediment will be excavated from the permanent pool to allow for the permanent pool to be set an elevation that meets the 50-year sediment storage requirements and ensures that the top of dam limits do not overtop the berm elevation. A 2.90-acre man-made wetland is located at the northern end of the permanent pool. To keep the wetland inundation impacts from the permanent pool less than 0.5-acres and thus enabling this site to fit within the constraints of a nationwide Section 404 permit from the USACE, the water will be drawn down to the elevation of 1325. Existing upstream water quality basins, shown in Figure D3-3 below, will be modified as determined during final design to reduce the inflow of sediment. Site 82 is designed without a ported riser and with a 54-inch RCCP principal spillway to ensure the top of dam elevation is below 1339.

Figure D3-3. Site 82

Sites 55, 66, 84, 85, and 86 did not require any unique design criteria.



D4.0 ECONOMICS

The following section provides details on costs and economic calculations.

D4.1 Costs

Engineer's estimates for each site have been developed to estimate the cost required to implement the recommended plan (Tables D4-1a – D4-5b). Construction costs are based on preliminary design quantities such as earthwork, excavation, seeding, and rock riprap. The unit costs used in the engineer's estimate are based on local knowledge and costs of previous flood risk reduction and watershed protection projects in the local area. Contingencies are included to allow for unforeseen expenses during construction and maintenance of items that do not have a life expectancy equivalent to the design life (for example, seeding and fencing) are included in the operations and maintenance costs.

Table D4-1a. Sites 26a and 26b Construction Cost Estimates

Item	Unit	Unit Cost	Site 26a		Site 26b	
			Quantity	Cost	Quantity	Cost
Mobilization	LS	10%	1	\$49,000	1	\$58,100
Tree Clearing	LS	\$15,000	1	\$15,000	1	\$15,000
Handling of Water	LS	\$15,000	1	\$15,000	1	\$15,000
SWPPP	LS	\$10,000	1	\$10,000	1	\$10,000
Dam Embankment	CY	\$2.90	63,500	\$184,200	85,000	\$246,500
Principal Spillway Pipe - 24" RCCP	FT	\$250	209	\$52,300	218	\$54,500
Trash Rack	LS	\$2,000	1	\$2,000	1	\$2,000
Drawdown Pipe - 18" PVC	FT	\$35	50	\$1,800	50	\$1,800
Valve	EA	\$9,500	1	\$9,500	1	\$9,500
Common Excavation	CY	\$3.70	22,600	\$83,600	24,900	\$92,100
Aggregate Fill	TN	\$38	500	\$19,000	500	\$19,000
Rock Riprap	TN	\$53	1,700	\$90,100	1,900	\$100,700
Seeding	AC	\$1,000	12	\$12,000	18	\$18,000
Fence	FT	\$5.00	2,800	\$14,000	3,000	\$15,000
Structural Concrete (Ported Riser)	CY	\$700	18	\$12,600	18	\$12,600
Non-Structural Concrete	CY	\$300	30	\$9,000	30	\$9,000
Subtotal				\$579,100		\$678,800
20% Contingency				\$115,800		\$135,800
Total				\$694,900		\$814,600

Table D4-1b. Sites 26a and 26b Land Rights/Easement Cost Estimates

			Site 26a		Site 26b	
Item	Unit	Unit Cost	Quantity	Cost	Quantity	Cost
Directly Impacted Area ¹	AC	\$7,500	18	\$138,500	33	\$247,500
Indirectly Impacted Area ²	AC	\$3,750	9	\$35,300	31	\$117,000
Land Rights Total				\$173,800		\$364,500

¹Includes the dam embankment, auxiliary spillway, and permanent pool area

²Includes area between the permanent pool area and the top of dam extents

Table D4-2a. Sites 27 and 55 Construction Cost Estimates

			Site 27		Site 55	
Item	Unit	Unit Cost	Quantity	Cost	Quantity	Cost
Mobilization	LS	10%	1	\$56,700	1	\$60,100
Tree Clearing	LS	\$15,000	1	\$15,000	1	\$15,000
Handling of Water	LS	\$15,000	1	\$15,000	1	\$15,000
SWPPP	LS	\$10,000	1	\$10,000	1	\$10,000
Dam Embankment	CY	\$2.90	78,500	\$227,700	94,750	\$274,800
Principal Spillway Pipe - 24" RCCP	FT	\$250	192	\$48,000	249	\$62,300
Trash Rack	LS	\$2,000	1	\$2,000	1	\$2,000
Drawdown Pipe - 18" PVC	FT	\$35	50	\$1,800	60	\$2,100
Valve	EA	\$9,500	1	\$9,500	1	\$9,500
Common Excavation	CY	\$3.70	28,700	\$106,200	20,165	\$74,600
Aggregate Fill	TN	\$38	500	\$19,000	500	\$19,000
Rock Riprap	TN	\$53	1,800	\$95,400	1,733	\$91,800
Seeding	AC	\$1,000	18	\$18,000	16	\$16,000
Fence	FT	\$5.00	3,400	\$17,000	4,000	\$20,000
Structural Concrete (Ported Riser)	CY	\$700	18	\$12,600	33	\$23,200
Non-Structural Concrete	CY	\$300	30	\$9,000	17	\$5,100
Subtotal				\$662,900		\$700,500
20% Contingency				\$132,600		\$140,100
Total				\$795,500		\$840,600

Table D4-2b. Sites 27 and 55 Land Rights/Easement Cost Estimates

			Site 27		Site 55	
Item	Unit	Unit Cost	Quantity	Cost	Quantity	Cost
Directly Impacted Area ¹	AC	\$7,500	42	\$316,500	28	\$210,000
Indirectly Impacted Area ²	AC	\$3,750	32	\$120,000	46	\$172,500
Land Rights Total				\$436,500		\$382,500

¹Includes the dam embankment, auxiliary spillway, and permanent pool area

²Includes area between the permanent pool area and the top of dam extents



Table D4-3a. Sites 66 and 84 Construction Cost Estimates

Item	Unit	Unit Cost	Site 66		Site 84	
			Quantity	Cost	Quantity	Cost
Mobilization	LS	10%	1	\$62,300	1	\$72,300
Tree Clearing	LS	\$15,000	1	\$15,000	1	\$15,000
Handling of Water	LS	\$15,000	1	\$15,000	1	\$15,000
SWPPP	LS	\$10,000	1	\$10,000	1	\$10,000
Dam Embankment	CY	\$2.90	110,000	\$319,000	127,375	\$369,400
Principal Spillway Pipe - 24" RCCP	FT	\$250	160	\$40,000	265	\$66,300
Trash Rack	LS	\$2,000	1	\$2,000	1	\$2,000
Drawdown Pipe - 18" PVC	FT	\$35	60	\$2,100	60	\$2,100
Valve	EA	\$9,500	1	\$9,500	1	\$9,500
Common Excavation	CY	\$3.70	17,077	\$63,200	21,785	\$80,600
Aggregate Fill	TN	\$38	500	\$19,000	500	\$19,000
Rock Riprap	TN	\$53	2,100	\$111,300	1,896	\$100,500
Seeding	AC	\$1,000	15	\$15,000	20	\$20,000
Fence	FT	\$5.00	3,800	\$19,000	4,000	\$20,000
Structural Concrete (Ported Riser)	CY	\$700	27	\$18,900	39	\$27,600
Non-Structural Concrete	CY	\$300	11	\$3,300	18	\$5,400
Subtotal				\$724,600		\$834,700
20% Contingency				\$144,900		\$166,900
Total				\$869,500		\$1,001,600

Table D4-3b. Sites 66 and 84 Land Rights/Easement Cost Estimates

Item	Unit	Unit Cost	Site 66		Site 84	
			Quantity	Cost	Quantity	Cost
Directly Impacted Area ¹	AC	\$7,500	55	\$412,500	52	\$390,000
Indirectly Impacted Area ²	AC	\$3,750	40	\$150,000	87	\$326,300
Land Rights Total				\$562,500		\$716,300

¹Includes the dam embankment, auxiliary spillway, and permanent pool area

²Includes area between the permanent pool are and the top of dam extents



Table D4-4a. Sites 77 and 82 Construction Cost Estimates

			Site 77		Site 82	
Item	Unit	Unit Cost	Quantity	Cost	Quantity	Cost
Mobilization	LS	10%	1	\$151,900	1	\$56,200
Tree Clearing	LS	\$15,000	1	\$15,000	1	\$15,000
Handling of Water	LS	\$15,000	1	\$15,000	1	\$15,000
SWPPP	LS	\$10,000	1	\$10,000	1	\$10,000
Earthen Fill	CY	\$2.90	237,500	\$688,800	61,500	\$178,400
Culvert Extension	FT	\$100.00	--	--	16	\$1,600
Principal Spillway Pipe - 24" RCCP	FT	\$250	--	--	--	--
Principal Spillway Pipe - 54" RCCP	FT	\$600	--	--	170	\$102,000
Principal Spillway Pipe - 72" RCCP	FT	\$750	266	\$199,500	--	--
Trash Rack	LS	\$2,000	1	\$2,000	1	\$2,000
Drawdown Pipe - 18" PVC	FT	\$35	50	\$1,800	50	\$1,800
Valve	EA	\$9,500	1	\$9,500	1	\$9,500
Common Excavation	CY	\$3.70	67,900	\$251,200	30,500	\$112,900
Aggregate Fill	TN	\$38	1,100	\$41,800	600	\$22,800
Rock Riprap	TN	\$53	3,600	\$190,800	1,400	\$74,200
Seeding	AC	\$1,000	77	\$77,000	16	\$16,000
Fence	FT	\$5.00	6,400	\$32,000	3,800	\$19,000
Structural Concrete (Non-ported Riser)	CY	\$700	18	\$12,600	18	\$12,600
Non-Structural Concrete	CY	\$300	40	\$12,000	30	\$9,000
Modification to Upstream Water Quality Basin(s)	LS	\$250,000	--	--	1	\$250,000
Subtotal				\$1,710,900		\$908,000
20% Contingency				\$342,200		\$181,600
Total				\$2,053,100		\$1,089,600



Table D4-4b. Sites 77 and 82 Land Rights/Easement Cost Estimates

			Site 77		Site 82	
Item	Unit	Unit Cost	Quantity	Cost	Quantity	Cost
Directly Impacted Area ¹	AC	\$7,500	165	\$1,237,500	25	\$186,800
Indirectly Impacted Area ²	AC	\$3,750	205	\$768,800	28	\$104,300
Land Rights Total				\$2,006,300		\$291,100

¹Includes the dam embankment, auxiliary spillway, and permanent pool area

²Includes area between the permanent pool area and the top of dam extents

Table D4-5a. Sites 85 and 86 Construction Cost Estimates

			Site 85		Site 86	
Item	Unit	Unit Cost	Quantity	Cost	Quantity	Cost
Mobilization	LS	10%	1	\$59,900	1	\$43,800
Tree Clearing	LS	\$15,000	1	\$15,000	1	\$15,000
Handling of Water	LS	\$15,000	1	\$15,000	1	\$15,000
SWPPP	LS	\$10,000	1	\$10,000	1	\$10,000
Dam Embankment	CY	\$2.90	107,500	\$311,800	75,000	\$217,500
Principal Spillway Pipe - 24" RCCP	FT	\$250	135	\$33,800	125	\$31,300
Trash Rack	LS	\$2,000	1	\$2,000	1	\$2,000
Drawdown Pipe - 18" PVC	FT	\$35	50	\$1,800	50	\$1,800
Valve	EA	\$9,500	1	\$9,500	1	\$9,500
Common Excavation	CY	\$3.70	19,641	\$72,700	13,526	\$50,000
Aggregate Fill	TN	\$38	500	\$19,000	500	\$19,000
Rock Riprap	TN	\$53	1,700	\$90,100	1,150	\$61,000
Seeding	AC	\$1,000	17	\$17,000	11	\$11,000
Fence	FT	\$5.00	4,200	\$21,000	3,900	\$19,500
Structural Concrete (Ported Riser)	CY	\$700	24	\$16,800	18	\$12,600
Non-Structural Concrete	CY	\$300	9	\$2,700	9	\$2,700
Subtotal				\$698,100		\$521,700
20% Contingency				\$139,600		\$104,300
Total				\$837,700		\$626,000



Table D4-5b. Sites 85 and 86 Land Rights/Easement Cost Estimates

Item	Unit	Unit Cost	Site 85		Site 86	
			Quantity	Cost	Quantity	Cost
Directly Impacted Area ¹	AC	\$7,500	19	\$142,500	18	\$135,000
Indirectly Impacted Area ²	AC	\$3,750	19	\$71,300	23	\$86,300
Land Rights Total				\$213,800		\$221,300

¹Includes the dam embankment, auxiliary spillway, and permanent pool area

²Includes area between the permanent pool area and the top of dam extents

Land values for required easements are based on previous land appraisals and current sale price of land. For land that falls within the permanent pool, embankment, and auxiliary spillway the price used is 100 percent of the appraised value. For land between the permanent pool and top of dam, 50 percent value is used. Mitigation costs are included at 5 percent of the construction cost and construction observation is based on local knowledge and experience. Final design and permitting costs for all 10 sites and construction observation costs for Sites 26a, 26b, and 27 are based on an existing agreement between the Sponsor and a consultant. Construction observation costs for the remaining sites are estimated at 10 percent of the engineer's estimate for construction. Project administration (split between the Sponsor and NRCS) is estimated at 10 percent of construction costs. Operation and maintenance costs are based on professional experience from similar structures and is included at 0.75 percent of the construction cost, not including mitigation. No replacement costs are included because the expected life equals or exceeds the length of the evaluation period. The Sponsor is responsible for 100 percent of the operation and maintenance costs for the planned life of the structure. Permitting costs are the responsibility of the Sponsor and are based on the anticipated permit requirements and similar projects in Nebraska. Agreements with landowners will be in place prior to construction to carry out farm conservation plans for not less than 50 percent of the land upstream of each structure. Existing conservation practices were determined using aerial surveys and local knowledge and costs to implement additional conservation, where necessary, were determined using engineering judgement. Total costs for these practices are estimated at \$30,800 and will are the responsibility of the Sponsor.

D4.2 Flood Damage Reduction Methodology

The following section provides details on the watershed-wide flood reduction economic calculations.

D4.2.1 Previous Methodology

In the past, USDA-NRCS assessed flood damage reduction benefits with a process that involved multiple USDA-NRCS developed computer programs. Hydrology was first prepared for the watershed using Technical Release-20 (TR-20) which developed discharges at appropriate nodes from which the maximum discharge of runoff was computed for a range of flows, usually 2-, 5-, 10-, 25-, 50- and 100-year event discharges were generated. Discharges were generated for both pre- and post-project conditions to evaluate the change in discharges within the watershed, as determined by the project alternatives being assessed.

Once hydrology was complete, TR-20 output was used as input for the Water Surface Profile 2 (WSP2) hydraulic program which used user-defined channel cross sections (made up of stage-discharge values defined by the user) to translate discharges into water surface elevations at cross sections developed

through the downstream (of project) stream network. The location and spacing of the cross sections were determined by identifying representative channel reaches that had similar hydraulic characteristics. WSP2 calculated the changes in the maximum water surface elevations at the cross sections and therefore determined the pre- and post-project conditions for each reach.

Once the hydraulic assessment was complete, the changes in water surface elevations were transposed onto land uses to calculate the change in pre- and post-project water depths for crops, structures, and other land uses. By assigning a land use to the hydraulic cross section, an economic model was developed to determine total changes in water surface elevations for a determined land use or specific structure such as a home, business type, and others. This translation of the hydraulic information into economic information comes from the defining of damage reaches within the ECON agricultural and URB1 economic computer programs. Damage reaches are defined by grouping similar land uses along lengths of stream, similar to how WSP2 defined similar hydraulic conditions along lengths of streams, but the two do not necessarily (or often) overlap. The ECON and URB1 programs then assess the pre- and post-project changes in water depths and compute damages to crops, pastures, structures, bridges, and others using a depth-damage curve. The information is then annualized using the return frequency of the different storms to create an average annual flood damage reduction benefit. This information is then used in the overall economic assessment, or benefit-cost analysis (BCA). The BCA is calculated for an alternative by comparing the annual benefits attributable to the flood damage reduction benefits to the costs.

D4.2.2 Current Methodology

Current modeling techniques and new technology allow for an updated process that mimics the original NRCS processes discussed above. Hydrology for the watershed was computed using a HEC-HMS (Version 4.3) model. Unlike TR-20, a variety of hydrologic methods can be used within the software (TR-20 defaults to the SCS Method) to prepare a better calibrated hydrologic model. A discussion of the hydrologic modeling decisions made can be found in Section D2.0 of this Appendix and the calibration effort is described in Section D2.2. Changes in hydrology pre-project and post-project were calculated for comparison purposes.

Hydraulic modeling was completed using the HEC-RAS (Version 5.0.7) software package. Like WSP2, HEC-RAS creates water surface profiles based on user-defined cross section locations and cross sections are cut using LiDAR or other user-defined input data. Unlike WSP2, the profiles are continuous and it is not necessary to develop hydraulic reaches of similar section types because HEC-RAS looks at every stream foot as a unique section.

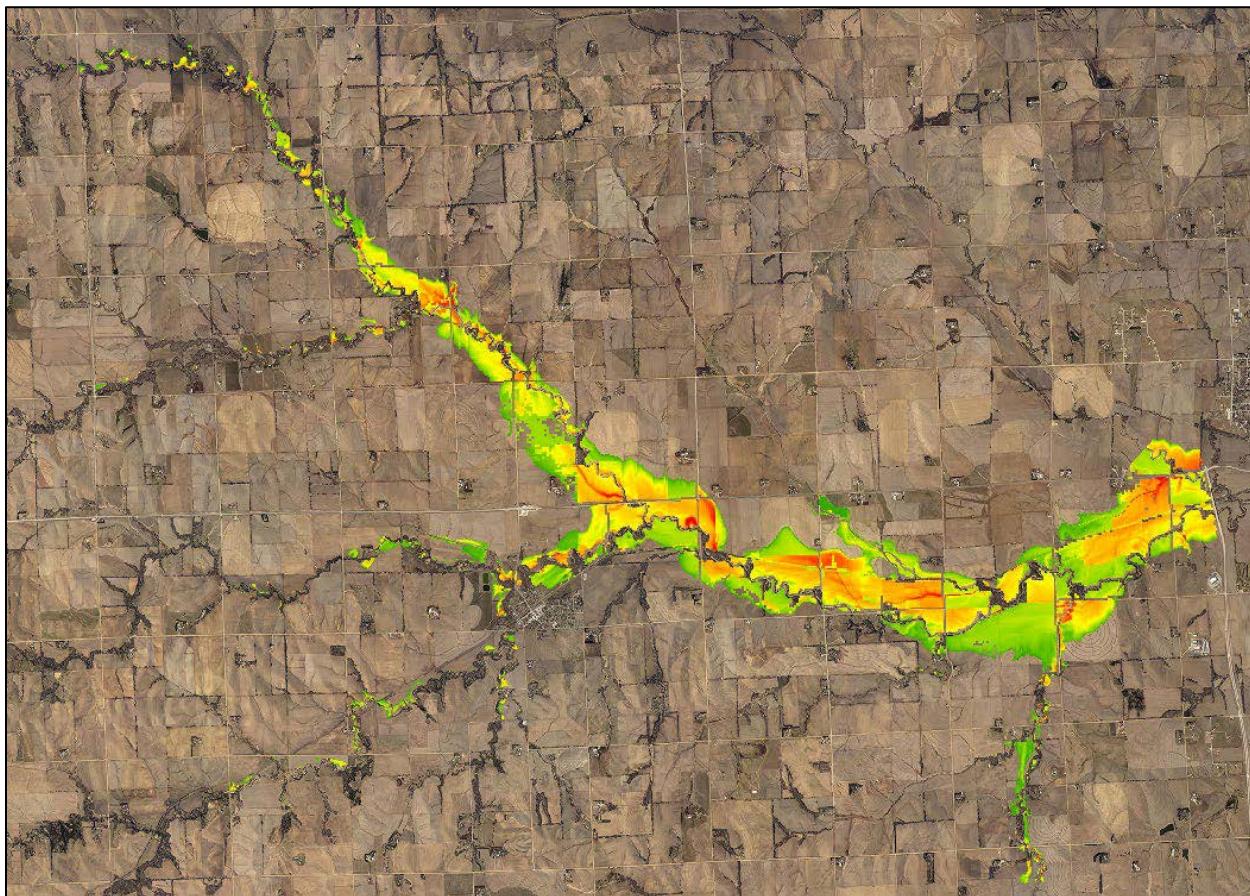
D4.2.2.1 Crop and Pasture

For the crop and pasture project economics, the process of comparing pre- and post-project water surface elevations is completed the same as in previous USDA-NRCS methods. However, instead of utilizing damage reaches, it is done with a tool developed in ArcMap (Version 10.6). The tool was developed using ArcMap's ModelBuilder application within the computer program, which allows the user to select multiple geoprocessing tools from the standard Arc Toolbox and arrange them in any order to create a workflow specific to the user's needs. Much like the previously described economics approach, land cover data and water depth data are used as inputs. Land cover data was derived from the most recent data within the CropScape – Cropland Data Layer website through the USDA. Water depth data was derived from the HEC-

RAS model outputs showing inundation depths. Additional geoprocessing was performed on these two datasets before combining them to obtain unique values for every land cover and water depth combination. The combined dataset is stored in a raster format which allows each cell within the raster to have a unique value.

The damage value is determined by using a base price for the crops, factoring in a percent damage factor (usually broken down by months or seasons), the seasonal flood distribution percent (broken down based on the same season/month used for the percent damage factors), and then summed for one depth interval to obtain a single damage value. This is repeated for each depth interval to obtain a depth-damage relationship for each crop. These relationships are joined with the combined landcover and depth raster and additional geoprocessing is performed. After additional geoprocessing, there is a raster that contains cells with damage/yield and a raster that contains cells with yield values. Further geoprocessing is performed to obtain resultant rasters. The resultant rasters contain damage values associated with each cell. The entire raster is summed to obtain a single damage value. This process is repeated for each event and then the results are annualized. This is performed for both pre- and post-project conditions. The results are then compared to compute the flood damage reduction benefit. This approach looks at damages in the watershed on a spatial level so that each area is considered. An example of this is shown below in Figure D4-1. Crop and pasture damages are shown below in Table D4-6.

Figure D4-1. Existing Flood Damages Upstream of Wahoo, NE¹



¹Image showing Pre-Project damages upstream of Wahoo for the 25-year event. Red colors showing higher damages and green colors showing lower damages.

Table D4-6. Annualized Crop and Pasture Damages

Damage Type	Without Project (\$)	With Project (\$)	Reduction (\$)
Crop and Pasture	\$1,277,700	\$975,200	\$302,500
Other Agriculture	\$127,800	\$97,500	\$30,300
Erosion and Sediment	\$115,000	\$87,800	\$27,200

D4.2.2.2 Urban

For the urban project economics, the process used is also similar to previous methods. To determine which structures would be inundated, geoprocessing was performed in the ArcMap computer program. Structure extent shapefiles and county parcels were used to establish structure locations and assign corresponding data to structures. Inundation extents, which are the same used in the crop and pasture analysis, were used to determine structure inundation depths. After the initial geoprocessing in ArcMap, information was transferred over to a spreadsheet where the damage calculations were performed. For each inundated structure, a parcel number is also attached. The structures are assigned assessed values based the Saunders County assessor website and structure type such as one-story residential, two-story residential, and non-residential as well as market values based on property sales in the area.

Depth-damage curves for structures and contents were taken from USACE HEC-FIA's computer software and *Economic Guidance Memorandum (EGM) 04-01, Generic Depth-Damage Relationships for Residential Structures with Basements* and therefore use types were selected to align with these. Structure and content damages are determined using the depth-damage curves and inundation depths and these are summed for all structures for each storm event. Damage results are then annualized for pre- and post-project conditions. Results are compared to compute flood damage reduction benefits, shown below in Table D4-7.

Table D4-7. Urban Damages and Benefits

Damage Type	Without Project (\$)	With Project (\$)	Reduction (\$)
Urban	\$310,700	\$209,600	\$101,100

D4.2.2.3 Road and Bridge

For the road and bridge project economics, a similar approach to the urban damages analysis was performed. Geoprocessing was performed on shapefiles, terrain, and water surface elevations. This data was transferred over to a spreadsheet where the damage calculations were performed. Previously calculated NRCS depth-damage curves for roads and bridges were used to assess damages based on bridge type and replacement values. Each bridge was assigned a bridge type that corresponds to a type aligning with these known depth-damage curves and depths were determined from the difference in bridge deck elevation and water surface elevation. Based on the bridge type and inundation depth, a structure damage can be identified for each storm event at each crossing. The damage results are then annualized for pre- and post-project conditions and the results are compared to compute the flood damage reduction benefit. Annualized road and bridge damages and benefits are shown below in Table D4-8.

**Table D4-8. Road and Bridge Damages and Benefits**

Damage Type	Without Project (\$)	With Project (\$)	Reduction (\$)
Road and Bridge	\$2,401,000	\$1,902,800	\$498,200

D4.3 Average Annual Equivalents

Average annual equivalents are determined over a 58-year period of analysis. The period of analysis includes the 8-year installation period plus the 50-year evaluation period. All benefits and costs were discounted from the year they were planned to incur to the beginning of the period of analysis by converting them to present value equivalents. When the present values were determined, they were amortized over the 58-year period of analysis to establish average annual equivalents.

The present value of the \$19,667,600 capital expenditure for the 10 dams is \$17,220,400 resulting in an average annual equivalent of \$564,800. The present values of the annual increments of O&M expenditures is \$1,853,000 and the present value of the benefits accrued over the 58-year analysis period is \$23,540,500. The average annual equivalents are \$772,100 and \$60,800, respectively. These values result in a benefit to cost ratio of 1.23 for the project. Economic tables, as outlined in the 2015 NWPM, are included in Chapter 7.0.



D5.0 AFFECTED ENVIRONMENT

D5.1 Sheet and Rill Erosion

Sheet and Rill erosion was calculated based on land capability class and land use. Land capability classes were determined from the web soil survey data for Saunders County. The 2011 United States Geological Survey (USGS) National Land Cover Dataset, and CALMIT and UNL irrigation data was used to find the watershed land use values. The sheet and rill erosion rates by capability class are from the 1998 Plan-EIS. The land uses, land capability classes, and sheet and rill erosion rates are shown below in Table D5-1.

Table D5-1. Land Use and Sheet and Rill Erosion Rates: Upper Wahoo Creek Watershed

		Cropland		Pastureland		Forest	Built-Up Land	Water/Other	Total
Land Capability Class		Non-Irrigated	Irrigated	Non-Irrigated	Irrigated				
1	Ac	723	101	138	1	26	63	7	1,059
	Tons/Ac	1.83	1.90	0.76	1.53	0.43	0.00	0.00	1.54
2w	Acres	3,602	1,571	657	12	225	318	3	6,388
	Tons/Ac	1.40	1.70	0.57	1.88	0.39	0.00	0.00	1.28
2e	Acres	10,799	397	2,517	15	196	815	5	14,744
	Tons/Ac	4.52	4.16	1.92	0.00	1.32	0.00	0.00	3.77
3e	Acres	16,745	767	4,299	16	246	1,194	6	23,273
	Tons/Ac	13.60	9.19	5.87	0.00	6.78	0.00	0.00	11.24
4e	Acres	5,999	1,914	4,480	38	403	512	2	13,348
	Tons/Ac	34.75	19.73	11.68	23.81	10.82	0.00	0.00	22.76
6w	Acres	623	27	880	7	896	80	3	2,516
	Tons/Ac	1.27	1.59	0.38	0.00	0.27	0.00	0.00	0.56
6e	Acres	42	0	96	0	21	14	3	176
	Tons/Ac	31.80	63.99	15.48	0.00	21.44	0.00	0.00	18.59
7e	Acres	160	3	512	0	705	60	8	1,448
	Tons/Ac	69.89	66.05	20.60	0.00	19.46	0.00	0.00	24.62
**	Acres	35	0	11	0	26	1	45	118
	Tons/Ac	0	0	0	0	0	0	0	0.0
Total	Acres	38,728	4,780	13,590	89	2,744	3,057	82	63,070
	Tons	504,684	49,567	95,241	929	20,797	0	0	671,219

**Other land capability class categories and miscellaneous areas

D5.2 Streambank and Gully Erosion

Visual observations were the primary basis of streambank and gully erosion estimates. Current aerial photos and LiDAR topographic data were used to trace current streambank limits in ArcMAP. Historical streambank limits were derived in the same manner with historical aerial imagery. The change in area determined from this evaluation was used with observed stream shape and average stream depths to calculate an estimated streambank erosion volume. This volume was converted to weight using a typical clay soil unit weight.



Factoring this volume of soil loss over the time between the historical and current aerials generated an annual streambank erosion rate.

Gully erosion was split into ephemeral gullies and permanent gullies. Permanent gully erosion was estimated in the same manner as streambank erosion. This accounts for the soil erosion in gullies that are not yet large enough to be considered a stream. The gullies are too large for tillage equipment to repair annually.

Ephemeral gullies were accounted for by assuming an annual depth of erosion in visually observable ephemeral gullies. This accounts for small gullies that are in tilled fields which are filled in each year through tillage operations then reform as ephemeral gullies during storm events annually.

The streambank and gully erosion rates are shown below in Table D5-2.

Table D5-2. Streambank and Gully Erosion Estimates

Dam Site	Drainage Area (sq. mi.)	Annual Erosion Totals (Ton/Yr)	
		Channel/Streambank	Ephemeral and Gully
26a	0.8	40	470
26b	1.8	80	1,040
27	2.1	100	1,260
55	2.3	90	1,340
66	1.9	70	1,110
77	10.2	460	6,070
82	2	120	1,160
84	3.6	160	2,150
85	0.8	30	450
86	0.7	30	420
All Dams	26.1	1,180	15,470
Entire Watershed	164	7,490	97,500

Note: Values rounded to the nearest 10 tons/year

D5.3 Sediment Delivery

Erosion quantities were combined with appropriate delivery ratios and knowledge of local materials, terrains, and conditions to generate sediment yields. Sheet and rill erosion have a low sediment delivery efficiency because overland runoff leaves much material behind as depositions on fields, at field boundaries, in road ditches, and other obstacles. An estimated 29 percent of sheet and rill erosion produced annually moves through the stream system. Ephemeral gully erosion is somewhat more efficient at sediment delivery, due to the close proximity to flow channels with an estimated 65 percent delivery rate. Streambank erosion is much more efficiently delivered, due to the greater carrying capacity of channelized flow with an estimated 90 percent delivery rate.

The streambank and gully sedimentation rates are shown below in Table D5-3.

**Table D5-3. Streambank and Gully Sedimentation Estimates**

Dam	Drainage Area (sq. mi.)	Annual Sedimentation Totals (Ton/Yr)	
		Channel/Streambank	Ephemeral and Gully
26a	0.8	30	300
26b	1.8	70	680
27	2.1	90	820
55	2.3	80	870
66	1.9	60	720
77	10.2	410	3,940
82	2	110	750
84	3.6	140	1,400
85	0.8	30	290
86	0.7	20	270
All Dams	26.1	1,040	10,050
Entire Watershed	164	6,740	63,370

D5.4 Consumptive Use Calculations

The headwaters of Dunlap, North Fork Wahoo, and Wahoo Creeks are located near the west edge of Saunders County. These creeks flow in the easterly direction. Dunlap Creek flows into Wahoo Creek west of Weston as does North Fork Wahoo Creek closer to Weston. Wahoo Creek continues onto its junction with Salt Creek just east of the city of Ashland. Salt Creek drains into the Platte River at the east edge of Saunders County. Dunlap Creek, North Fork Wahoo Creek, and the upper reach of Wahoo Creek are intermittent streams. The lower reach of Wahoo Creek is a perennial stream.

United States Geological Service (USGS) stream gauge #0680400 at Ithaca, Nebraska is located on Wahoo Creek downstream of the Upper Wahoo Creek watershed. The drainage area at this gauge is 273 square miles of which 5 square miles is probably noncontributing. The drainage area of the Upper Wahoo Creek watershed is 98 square miles. The drainage area of Salt Creek at Ashland just above its junction with the Platte River is 1,640 square miles of which 52 square miles probably is noncontributing. The drainage area of the Platte River at the junction with Salt Creek is 85,370 square miles of which 14,370 square miles is probably noncontributing.

The purpose of the 10 proposed structures is to provide flood damage reduction within the Upper Wahoo Creek watershed. Together they control 26 square miles. The structures would be designed so that each pool can be drawn down to at least 15 acre-feet as required by state law. They can be operated with a permanent pool and all additional inflow would flow-through the structure to the Platte River. The accumulative net depletions (February through July) for each structure is less than the bench mark of 25 acre-feet and are contained in Table D5-4. Tables for the monthly estimated evapotranspiration for each structure area prior to construction and post construction filling are contained in Appendix E.

**Table D5-4. Consumptive Use Summary Table**

Site	Net Depletions ¹	Change in Annual Evapotranspiration (acre-feet)
26a	1.8	1.7 accretion
26b	3.4	3.9 accretion
27	7.9	83.7 depletion
55	2.6	18.3 accretion
66	4.7	6.9 accretion
77	23.6	14.2 accretion
82	7.4	6.3 depletion
84	4.3	76.0 accretion
85	1.9	6.3 accretion
86	2.6	1.6 accretion

¹This is the accumulative Net depletion in acre feet for February through July. Accretions are not included.

The maximum volume of water that could be stored at the permanent pool elevation over the proposed 50-year life and the evaporation rate for the pool area of each proposed structure in acre-feet per year and cubic feet per second is contained below in Table D5-5.

Table D5-5. Consumptive Use Summary Table

Site	Pool (acre-feet)	Pool Evaporation Rate (ac-ft/yr)	Pool Evaporation Rate (cfs)
26a	71.9	27.5	0.04
26b	159.0	53.6	0.07
27	181.4	152.7	0.21
55	184.7	61.7	0.09
66	179.2	101.5	0.14
77	674.0	335.0	0.46
82	162.0	80.2	0.11
84	325.9	331.8	0.46
85	77.7	47.7	0.07
86	59.4	46.3	0.06

APPENDIX E – OTHER SUPPORTING INFORMATION



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Additional Included Information

NE-CPA-52

USFWS Letter

Monthly Evapotranspiration Tables

Saunders County Zoning Regulations

City of Wahoo Zoning Regulations



E1.0 INTRODUCTION

This appendix provides additional information related to the Upper Wahoo Creek Watershed Plan-EA.

E2.0 AFFECTED ENVIRONMENT WITHIN THE AFFECTED RESOURCE AREAS

This section provides detailed information about the existing environmental resources and conditions within the 10 affected resource areas. The extents of the Project affected resource areas are shown in Figures C1.1-C1.9, Appendix C. Additional information on the following resources can be found in Chapter 3.0 of the Plan-EA.

E2.1 Prime and Unique Farmlands

Prime farmland and farmland of statewide importance was found within the affected resource areas was determined using the USDA, NRCS web soil survey, for Saunders County (NE155). There are approximately 1,520-acres of prime and unique and farmland of statewide importance within the affected resource areas. The NRCS soil map unit symbols within the affected resource areas that are prime farmland or farmland of statewide importance are listed in Table E2-1 below. Please see figures C2.1-C2.9, Appendix C for figures of the soil map unit symbols within each affected resource area.

Table E2-1. Prime Farmland and Farmland of Statewide Importance within Affected Resource Areas

Map Unit Symbol	Map unit name	Rating	Area (acres)
7049	Kenridge silty clay loam, occasionally flooded	All areas are prime farmland	61
7230	Judson silt loam, 0 to 2 percent slopes	All areas are prime farmland	23
7231	Judson silt loam, 2 to 6 percent slopes	All areas are prime farmland	374
7646	Yutan, eroded-Judson complex, 6 to 11 percent slopes	Farmland of statewide importance	527
7647	Yutan, eroded-Aksarben silty clay loams, 2 to 6 percent slopes	All areas are prime farmland	122
7750	Nodaway silt loam, occasionally flooded	All areas are prime farmland	368
8125	Pohocco silty clay loam, 6 to 11 percent slopes, eroded	Farmland of statewide importance	39

Source: USDA. Web Soil Survey. Saunders County, Nebraska (NE155). Last updated: September 2018.

E2.2 Streams

Streams within the affected resource areas were assessed between June 2018 and September 2018. The ordinary high water mark (OHWM), which is federally defined as "that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas" (33 CFR 328.3(e)), was recorded for all streams during the site visits. Figures with the delineated streams from these investigations are provided in Figures C4.1-C4.9, Appendix C and descriptions of the streams for each affected resource area are included below.



Site 26

The Site 26 field assessment took place in July 2018 and the results are shown in Figure C4.1, Appendix C. An unnamed intermittent stream (Channel 1) flows from northwest to southeast through the affected resource area for approximately 12,500-feet. Channel 1 is highly incised and is experiencing severe erosion. Continual degradation and widening have resulted in channel isolation from the floodplain, which has led to poor in-stream habitat for faunal diversity. The channel has sheer slopes from mass wasting and some vegetated channel benches and side slopes dominated by *Phalaris arundinacea* (reed canary grass) are located on the downstream portion of stream. Intermittent streams, with similar geomorphology and characteristics as Channel 1, flow into Channel 1 from the east. Four ephemeral channels flow into Channel 1. These channels are narrow and connected to the floodplain. Channel 1 has a narrow, unprotected grass buffer with some trees along the right bank.

An intermittent channel (Channel 2) flows from northwest to southeast, south of Channel 1, with the confluence of Channel 1 and Channel 2 in the southeast portion of the affected resource area. Channel 2 is degrading and widening, with no floodplain connectivity. The channel is severely eroding with high and sheer channel banks throughout the stream. A 70-foot long, ephemeral channel is the only tributary to Channel 2 within the affected resource area. An unprotected treed buffer borders the center stretch of Channel 2 and a grassed buffer borders the downstream portion of Channel 2.

Site 27

The Site 27 field assessment took place in August 2018 and the results are shown in Figure C4.2, Appendix C. An unnamed intermittent stream (Channel 1) flows through the affected resource area in the southeast direction for approximately 11,200-feet. The channel is degrading and varies in width between approximately 7- and 10-feet and is 3-feet deep at the OHWM. Four intermittent tributaries to Channel 1 are located within the affected resource area with similar channel characteristics and geomorphology. Low channel benches are predominant throughout the streams. The top of banks and benches are vegetated with *Phalaris arundinacea* (reed canary grass), *Bromus inermis* (smooth brome), *Leersia oryzoides* (rice cutgrass), and *Persicaria lapathifolia* (pale smartweed). The majority of stream length is without a buffer and has crops planted to the edge of the channel banks. A narrow, unprotected treed and grassed buffer borders the stream near the southern edge of the affected resource area. Some bank erosion is present at this part of the stream, especially near channel bends.

Site 55

The Site 55 field assessment took place in August 2018 and the results are shown in Figure C4.3, Appendix C. Two main unnamed intermittent streams flow through the affected resource area. The northern intermittent stream (Channel 1) flows in the east and southern direction for approximately 4,000-feet within the affected resource area. Channel 1 is degrading and widening with severely disrupted sediment dynamics. The channel is experiencing severe erosion with shear channel side slopes and no floodplain connection.

The southern stream (Channel 2) flows from west to east for approximately 8,000-feet within the affected resource area. The channel is degrading and widening and has some toe erosion, mass wasting, and slumping throughout the stream. Channel benches are located throughout and are dominated by *Persicaria lapathifolium* (pale smartweed), *Leersia oryzoides* (rice cutgrass), and *Phalaris arundinacea* (reed canary grass). The tributaries to Channel 2 are also intermittent and are degrading. These channels have low



channel benches with poor in-stream habitat. An unprotected forested buffer borders most of the stream lengths within the affected resource area and is dominated by *Quercus macrocarpa* (Bur oak) and *Ulmus americana* (American elm) trees.

Site 66

The Site 66 field assessment took place in July 2018 and the results are shown in Figure C4.4, Appendix C. An unnamed intermittent stream flows east though the affected resource area for approximately 6,000-feet. This channel is degrading with low vegetated channel benches dominated by *Phalaris arundinacea* (reed canary grass). Starting at approximately 2,500-feet downstream from the northwest corner of the affected resource area, the channel width at the OHWM widens from 6-feet to 25-feet and the channel bench vegetation consists primarily of *Cannabis sativa* (marijuana) and *Ambrosia trifida* (great ragweed). The stream at this location appears to have been recently disturbed and was likely excavated sometime between 2017 and 2018 based on a review of historical aerial images. The disturbed portion of the channel is approximately 1,000-feet long and ends at a culvert. Downstream of the culvert, the stream is degrading, widening, and experiencing severe erosion.

An unnamed intermittent stream is a tributary to the channel and flows northeast for 2,300-feet within the affected resource area. The channel is degrading and is approximately 5-feet wide at the OHWM. The top of banks are vegetated and are dominated by *Bromus inermis* (smooth brome) and *Gleditsia triacanthos* (honey-locust). Downstream of the confluence of the two streams, the channel is degrading and widening with no connection to the floodplain. Toe erosion is evident. An unprotected grassed stream buffer with some forested areas are present on the easternmost 1,700-feet of stream within the affected resource area. For the remaining and majority of the streams within the affected resource area, the land is farmed to the top of the channel banks.

Site 77

The Site 77 field assessment took place in September 2018 and the results are shown in Figure C4.5, Appendix C. Miller Branch, a perennial stream, flows through the affected resource area in the eastern and northern direction within the affected resource area. The most upstream portion of Miller Branch within the affected resource area is degrading and has grassed channel side slopes. Towards the center of the stream, the channel is widening and degrading and with some minor erosion and sloped low benches. The downstream portion of Miller Branch within the affected resource area is degrading and widening, resulting in disconnection from the floodplain. The stream at this part has relatively steep and vegetated side slopes and small low-flow channel benches. Approximately half of the stream has an unprotected forested buffer and crops are planted up to the edge of the channel bank for the remaining stream segments. The treed buffers consist predominantly of *Populus deltoides* (eastern cottonwood) and *Fraxinus pennsylvanica* (green ash).

Ephemeral tributaries to Miller Branch within the affected resource area are degrading with low channel benches. Narrow, unprotected treed buffers border two of the ephemeral streams. A degrading ephemeral tributary flows east through the cropland and is approximately 3-feet wide and 2-feet deep at the OHWM. The channel does not have a riparian buffer but some *Salix sp.* (willow) are found along the channel benches. A degrading ephemeral channel flows west that varies in width between 2.5- to 10-feet and with sloped



channel banks. A narrow, ephemeral tributary flows north in the southern portion of the affected resource area and has a small buffer between the emergent vegetation on the channel banks and planted crops.

Site 82

The Site 82 field assessment took place in July 2018 and the results are shown in Figure C4.6, Appendix C. An intermittent stream (Channel 1) flows through the affected resource area in the southeast direction. It is a degrading stream with low flow benches dominated by *Phalaris arundinacea* (reed canary grass) and *Echinochloa crus-galli* (barnyard grass). Erosion is present on the downstream portion of Channel 1. A dense, unprotected treed buffer borders Channel 1 along the southern portion of the affected resource area.

Three degrading intermittent tributaries to Channel 1 flow south with low channel benches dominated by *Phalaris arundinacea* (reed canary grass) and *Echinochloa crus-galli* (barnyard grass). A degrading intermittent stream flows southwest and is approximately 3-feet wide and 1-foot deep, with channel benches dominated by *Equisetum hyemale* (rough horsetail). Crops are planted up to the edge of this channel's banks. A degrading ephemeral tributary to Channel 1 flows east along the southern portion of the affected resource area, with crops also planted to the top of banks. The ephemeral channel becomes highly incised and is actively degrading and widening beginning approximately 250-feet upstream of its confluence with Channel 1.

Site 84

The Site 84 field assessment took place in August 2018 and the results are shown in Figure C4.7, Appendix C. An intermittent stream, known as Dunlap Creek, flows in the northeast direction and several intermittent tributaries to Dunlap Creek are located within Site 84's affected resource area. Dunlap Creek is degrading and widening with no connection to the floodplain. It is experiencing severe erosion with slumping, mass wasting, and toe erosion occurring throughout the channel resulting in poor in-stream habitat. The channel has both sheer and vegetated banks that vary from 15- to 25-feet tall. Channel benches and vegetated bank slopes are located periodically throughout the channel and are dominated by *Phalaris arundinacea* (reed canary grass). The tributaries to Dunlap Creek are degrading and widening and are also experiencing severe erosion. An unprotected treed buffer borders the majority of Dunlap Creek and its tributaries.

Site 85

The Site 85 field assessment took place in July 2018 and the results are shown in Figure C4.8, Appendix C. One unnamed intermittent stream flows through the affected resource area in the north direction. The upstream portion of the stream is degrading and widening, with many low channel benches that appear to have been recently sloughed off. The channel erosion becomes more severe downstream and the channel is experiencing more degradation and widening. Two knickpoints being held at-grade with large tree debris are located on the northern end of the affected resource area within the channel. An unprotected treed buffer, dominated by *Ulmus pumila* (siberian elm), borders the northern half of the stream and crops are planted to the top of the channel banks on the southern half of the stream.

Site 86

The Site 86 field assessment took place in July of 2018 and the results are shown in Figure C4.9, Appendix C. One unnamed intermittent stream runs through the affected resource area in the north direction. This channel is degrading with wide and low vegetated channel benches. The intermittent channel is

approximately 6- to 7-feet wide and 1.5-feet deep at the OHWM. Near the southern end of the affected resource area, an ephemeral channel with similar characteristics breaks off from the intermittent stream and rejoins it after 220-feet. An unprotected riparian buffer borders the southern portion of the intermittent channel and is dominated by *Ulmus americana* (american elm), *Celtis occidentalis* (hackberry), and *Juglans nigra* (black walnut).

An ephemeral degrading tributary to the intermittent stream flows east. The channel is approximately 2-feet wide and 1-foot deep with no surface water during the site visit. Another ephemeral channel with similar characteristics joins the ephemeral channel before emptying into the intermittent stream. An ephemeral channel is located at the downstream end of a pond for approximately 400-feet with wide, vegetated channel benches.

E2.3 Wetlands

Wetland investigations were conducted for the affected resource areas between June and September of 2018 and the results are summarized below. Figures from these investigations are provided in Appendix C. Descriptions of the wetland investigation results for each affected resource area and wetland summary tables (Tables 2-2 through 2-10) are included below.

Site 26

At the time of the wetland delineation conducted for Sites 26a and 26b (referred to as Site 26 due to a shared affected resource area) in July 2018, the land use was predominantly agricultural. The results from the wetland delineation are summarized in Table 2-2 below and shown in Figure C4.1, Appendix C. Two main intermittent channels, a northern and a southern, flow through the affected resource area in the southeast direction and merge near the southeast corner of the affected resource area. These channels are highly incised and experiencing severe erosion. Wetlands are located on benches within the intermittent channels and along ephemeral tributaries to the intermittent channels.

Several bench wetlands with Cowardin classification of palustrine emergent temporarily/seasonally flooded (PEMA/C) are located along the northern intermittent channel, that flows in the southern direction. The vegetation for these wetlands consists primarily of *Phalaris arundinacea* (reed canary grass) and some *Persicaria lapathifolia* (pale smartweed). Some low channel bench wetlands with vegetation consisting of *Persicaria lapathifolia* (pale smartweed), *Leersia oryzoides* (rice cutgrass), and *Phalaris arundinacea* (reed canary grass) are located within the ephemeral streams that flow into the northern intermittent channel. A 0.48-acre PEMA/C wetland is also present in a sloped field between an ephemeral channel tributary and the intermittent stream and consists entirely of *Phalaris arundinacea* (reed canary grass). PEMA/C and palustrine scrub-shrub temporarily flooded (PSSA) wetlands are located along a ditch that flows southwest into the intermittent stream. These wetlands are dominated by *Leersia oryzoides* (rice cutgrass) and *Phalaris arundinacea* (reed canary grass). A small earthen dam with a 0.97-acre permanent pool is on an eastern tributary to the intermittent stream and PEMA/C wetlands are located around the permanent pool.

PEMA/C, PSSA and palustrine forested temporarily flooded (PFOA) wetlands are located on both channel banks in the northwest corner of the southern intermittent channel. These wetlands are dominated by *Salix amygdaloides* (peachleaf willow) and *Echinochloa crus-galli* (barnyard grass). Just downstream of these wetlands, a farmed wetland drains into the intermittent stream that had saturation visible on aerial imagery and hydric soils. Riverine PEMA/C wetlands are located on low channel benches on the downstream end

of the southern intermittent stream. These wetlands are dominated by *Phalaris arundinacea* (reed canary grass). A sloped PEMA/C wetland is connected to these wetlands and is located below a natural spring.

Table E2-2. Site 26 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA/C	3.36	Riverine
PEMA/C	0.05	Sloped
PFOA	1.81	Riverine
PSSA	0.24	Riverine

¹PEMA/C = Palustrine emergent temporarily/seasonally flooded

PFOA = Palustrine forested temporarily flooded

PSSA = Palustrine scrub-shrub temporarily flooded

Site 27

A wetland delineation for Site 27 took place in August 2018. The results are summarized in Table 2-3 below and shown in Figure C4.2, Appendix C. An intermittent stream flows through the affected resource area in the east/southeast direction and has three intermittent tributaries. Most of the wetlands on this Site are PEMC riverine wetlands located along the intermittent streams and some PEMA depressional wetlands are located within grasslands and farmlands.

There are 1.28-acres of PEMC riverine wetlands located both above and below the streams' OHWMS. The stream channel banks are generally vegetated with low vegetated channel benches located throughout the affected resource area. An unprotected treed stream buffer borders the stream in the southern portion of the affected resource area where the stream is highly incised and actively degrading. Vegetation for the riverine wetlands consist primarily of *Bidens cernua* (burr-marigold), *Leersia oryzoides* (rice cut grass), *Echinochloa crus-galli* (barnyard grass), *Persicaria lapathifolia* (pale smartweed), and *Phalaris arundinacea* (reed canary grass).

Six depressional PEMA wetlands were identified within the affected resource area. One of the depressional wetlands is a 0.51-acre wetland within an open grassland with dominant vegetation consisting of *Phalaris arundinacea* (reed canary grass). The remaining three are located within current or previously farmed fields with vegetation consisting of *Phalaris arundinacea* (reed canary grass), *Panicum virgatum* (wand panic grass), *Amaranthus tuberculatus* (rough-fruit amaranth) and *Equisetum arvense* (field horsetail).

Table E2-3. Site 27 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA	0.62	Depressional
PEMC	1.27	Riverine

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

Site 55

A wetland delineation for Site 55 took place in August 2018 and the results of the wetland delineation are summarized in Table 2-4 below and Figure C4.3, Appendix C. Two main intermittent streams flow through



the Site 55 affected resource area. One stream flows from southwest to northeast (Channel 1) and one stream flows from north to south (Channel 2). Stream widening and bank failures have led to the creation of sparse PEM/C wetlands along low-flow benches of Channel 1 and its tributaries. The vegetative community of these wetlands consists of *Phalaris arundinacea* (reed canary grass), *Persicaria Lapathifolia* (pale smartweed), and *Leersia oryzoides* (rice cutgrass). Two farmed PEM/C wetlands that exhibit wetness signatures on aerial imagery are located near the tree line north of Channel 1.

The downstream portion of Channel 2 has shear banks with high channel slopes, not suitable for wetland formation. Rock riprap is present near the upstream end of this stream to protect the upstream channel from a large progressing headcut. Stream 2 has low channel benches upstream of the riprap with wetlands present on both sides of the stream for approximately 700-feet. These are PFOA and PEM/C riverine wetlands and are dominated by *Phalaris arundinacea* (reed canary grass), *Populus deltoides* (eastern cottonwood), and *Salix amygdaloides* (peachleaf willow).

Table E2-4. Site 55 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA/C	0.58	Riverine
PEMA/C	0.22	Depressional
PFOA	0.03	Riverine

¹PEMA/C = Palustrine emergent temporarily/seasonally flooded

PFOA = Palustrine forested temporarily flooded

Site 66

A wetland delineation for Site 66 took place in July 2018 and the affected resource area is predominantly agricultural. The results from the wetland delineation are summarized in Table 2-5 below and shown in Figure C4.4, Appendix C. Two intermittent streams run through the affected resource area and do not support wetlands. One channel has wide, sparsely vegetated channel slopes and the other stream is narrow with steep channels. One PEMC wetland is located at the confluence of these two streams and is dominated by *Echinochloa crus-galli* (barnyard grass). Three farmed wetlands are located in the northwest portion of the affected resource area and exhibit secondary indicators such as saturation visible on aerial imagery, geomorphic position, and surface soil cracks.

A large grassed area borders the stream in the eastern portion of the affected resource area. Five PEM/C wetlands are present in slight depressions within this grassed area and are dominated by *Phalaris arundinacea* (reed canary grass). A pond supporting lacustrine fringe wetlands is located north of the stream on the eastern portion of the affected resource area.

Table E2-5. Site 66 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA	0.5	Depressional
PEMC	0.04	Lacustrine Fringe
PEMC	0.01	Riverine

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

Site 77

A wetland delineation for Site 77 took place in September 2018 and the results from the wetland delineation are summarized in Table 2-6 below and Figure C4.5, Appendix C. A perennial stream exhibiting active degradation and widening flows through the affected resource area in the north/northeastern direction. No wetlands are located along this perennial stream.

Riverine wetlands are located on channel benches and banks of ephemeral tributaries to the perennial stream. In the northeastern portion of the affected resource area, PEMA wetlands are located along the banks of ephemeral channels with vegetation dominated by *Phalaris arundinacea*. Two PSSA wetlands and one PEMA wetland are located on the high channel banks of an ephemeral channel on the southern portion of the affected resource area that consist of *Salix sp.* (willow) saplings, *Phalaris arundinacea* (reed canary grass), and *Equisetum hyemale* (rough horsetail).

Two farmed wetlands are located in the northern portion of the affected resource area in fields of *Glycine max* (soybeans), that had stunted plants and visible saturation on aerial imagery. PEMA and PEMC wetlands are also present in vegetated swales within farm fields with vegetation consisting primarily of *Bidens cernua* (nodding beggartick), *Echinchloa crus-galli* (barnyard grass), *Panicum dichotomiflorum* (panicgrass), and *Phalaris arundinacea* (reed canary grass).

A 0.28-acre palustrine forested seasonally flooded (PFOC) wetland is located within a large depression adjacent to the perennial channel. Surface water was present throughout the wetland and was dominated by *Salix nigra* (black willow), *Salix amygdaloides* (peachleaf willow), and *Phalaris arundinacea* (reed canary grass). The wetland drains into an ephemeral channel that flows for approximately 150-feet before joining the perennial channel. A smaller wetland depression is located south of the PFOC wetland, in what appears to be an old oxbow. This wetland consists primarily of *Phalaris arundinacea* (reed canary grass).

A 0.21-acre pond is located on the most eastern portion of the affected resource area and PEMA lacustrine fringe wetlands surround the pond. The pond fringe wetlands consist primarily of *Phalaris arundinacea* (reed canary grass) and *Populus deltoides* (cottonwood). A PEMC wetland is within a depression downstream of the pond. This wetland is dominated by *Phalaris arundinacea* (reed canary grass) and surface water was present during the site visit.

Table E2-6. Site 77 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA	0.79	Depressional
PEMA	0.04	Lacustrine Fringe
PEMA	0.24	Riverine
PEMC	0.35	Depressional
PEMC	0.01	Riverine
PFOC	0.28	Depressional
PSSA	0.06	Riverine
PFOC	0.06	Riverine

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

PFOC = Palustrine forested seasonally flooded

PSSA = Palustrine scrub-shrub temporarily flooded

**Site 82**

A wetland investigation was conducted for Site 82 in July 2018 and the land use was predominantly agricultural. The results are summarized in Table 2-7 below and Figure C4.6, Appendix C. An intermittent stream flows through the affected resource area from northwest to southeast and three small channel bench wetlands are located on the downstream portion of the stream, near the southeastern edge of the affected resource area. These wetlands are located on slumped off channel benches, created from channel widening and bank failures and are dominated *Phalaris arundinacea* (reed canary grass) and *Echinochloa crus-galli* (barnyard grass). Small PEMA wetlands, with similar vegetation, are located on low benches along the tributaries to the intermittent stream.

A small dam is located on the northwest portion of the main tributary and two PEMC wetlands are located along the pond fringe, which consist of *Phalaris arundinacea* (reed canary grass). Upstream of the pond is a PEMA wetland within a vegetated swale. Another PEMA wetland, which consists of *Typha angustifolia* (narrowleaf cattail) and *Phalaris arundinacea* (reed canary grass), is located at the dam's principal spillway outlet. A 2.90-acre PEMA wetland is located downstream of this dam and east of Highway 79 that runs through the affected resource area. This is a man-made wetland created when the land was excavated within the last 10-years. The main intermittent stream as well as a tributary run through this wetland, which consists entirely of *Typha latifolia* (bulrush). Two small PFOA wetlands are located on the northern edge of the wetland dominated by *Salix sp.* (willow) and *Phalaris arundinacea* (reed canary grass).

A 0.30-acre pond is located on the northwest tributary within the affected resource area and a PEMC wetland is supported along the pond fringe. Near the southeastern portion of the affected resource area, northeast of the main channel, are two PEMC wetlands located within a relic oxbow. The wetlands meander and have various hummocks with standing water present during the site visit. These wetlands are dominated by *Phalaris arundinacea* (reed canary grass). *Salix sp.* (willows) and *Celtis occidentalis* (hackberry) trees are located upland of the wetlands.

Table E2-7. Site 82 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA	0.10	Depressional
PEMA	3.42	Riverine
PEMC	0.32	Depressional
PEMC	0.79	Lacustrine Fringe
PFOA	0.22	Riverine

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

PFOA = Palustrine forested temporarily flooded

Site 84

A wetland delineation for Site 84 took place in August 2018 and the results are summarized in Table 2-8 below and Figure C4.7, Appendix C. The land use within the affected resource area is predominantly agricultural and one intermittent stream, known as Dunlap Creek, flows through the affected resource area. PFOA and PEMA/C bench wetlands are located along Dunlap creek. Channel widening and bank failures have led to the creation of these wetlands, which are now supporting a vegetation community of *Persicaria lapathifolia* (pale smartweed), *Echinochloa crus-galli* (barnyard grass), *Phalaris arundinacea* (reed canary



grass), *Leersia oryzoides* (rice cutgrass), and *Ulmus americana* (american elm). PEMA/C, PFOA, and PSSA bench wetlands are also located along tributaries to Dunlap Creek and are dominated by *Phalaris arundinacea* (reed canary grass), *Persicaria pensylvanica* (pennsylvania smartweed), *Persicaria lapathifolia* (pale smartweed) and *Salix amygdaloides* (peachleaf willow).

Two PEMA/C wetlands are located within farmed areas that exhibit wetness signatures on aerial images and had wetland soil hydrology. One of the farmed wetlands is located within a corn field and drains into a PEMA/C wetland and the other is in a highly eroded area within an alfalfa field. Wetlands are within three drainage swales within the agricultural land. One of these drainage swales is located near the northwestern portion of the affected resource area and consists of one PEMA/C and one PFOA wetland, and are dominated by *Typha angustifolia* (narrowleaf cattail), *Helianthus grosseserratus* (sawtooth sunflower), and *Salix sp.* (willow). A PEMA/C wetland and a PSSA wetland are located within the other two swales and are dominated by *Persicaria pensylvanica* (pennsylvania smartweed) and *Salix amygdaloides* (peachleaf willow) respectively.

A small dam is located near the southern portion of the affected resource area and a fringe wetland borders the permanent pool. This wetland is dominated by *Persicaria pensylvanica* (pennsylvania smartweed). A depressional PFOA wetland is located within a forested area upstream of a tributary to Dunlap Creek. This wetland is approximately 0.55-acres in size, had surface water present during the wetland delineation, and has vegetation consisting primarily of *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (american elm), and *Leersia oryzoides* (rice cutgrass).

Table E2-8. Site 84 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA/C	0.42	Depressional
PEMA/C	0.32	Lacustrine Fringe
PEMA/C	0.40	Riverine
PFOA	0.64	Depressional
PFOA	0.14	Riverine
PSSA	0.03	Depressional
PSSA	0.02	Riverine

¹PEMA/C = Palustrine emergent temporarily/seasonally flooded

PFOA = Palustrine forested temporarily flooded

PSSA = Palustrine scrub-shrub temporarily flooded

Site 85

A wetland delineation for Site 85 took place in July 2018 and the results are summarized in Table 2-9 below and Figure C4.8, Appendix C. One intermittent stream flows north through the affected resource area. PSSC wetlands are located along low channel benches on the southern end of the stream. These wetlands are dominated by *Salix amygdaloides* (peachleaf willow) and *Phalaris arundinacea* (reed canary grass). A PEMA depressional wetland is located at the southwest corner of the affected resource area with a vegetation community dominated by *Echinocloa crus-galli* (barnyard grass). The northern portion of the stream has an unprotected forested buffer, which consists of *Ulmus pumila* (Siberian elm), *Celtis occidentalis* (common hackberry), and *Phalaris arundinacea* (reed canary grass). No wetlands are present within the forested area.



Table E2-9. Site 85 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PSSC	0.11	Riverine
PEMA	0.01	Depressional

¹PEMA = Palustrine emergent temporarily flooded

PSSC = Palustrine scrub-shrub seasonally flooded

Site 86

A wetland delineation for Site 86 took place in July 2018 and the results are summarized in Table 2-10 below and Figure C4.9, Appendix C. An intermittent stream flows from south to north through the affected resource area and two PEMC riverine wetlands are located along channel banks at the northern end of the channel. A depressional PEMC wetland with surface water present during the site visit is located west of the two riverine wetlands and consists of *Persicaria hydropiper* (mild water-pepper) and *Phalaris arundinacea* (reed canary grass). On the southern end of the intermittent stream, an ephemeral channel splits off from the intermittent channel for approximately 220-feet. A PEMA depressional wetland is located within a swale near the southern end of the affected resource area with vegetation dominated by *Leersia virginica* (white cutgrass).

An ephemeral channel flows north on the western side of the intermittent channel. Approximately 350-feet downstream from the south end of the affected resource area, the ephemeral channel becomes a swale for approximately 1,000-feet. This swale consists of a 0.89-acre PEMA depressional wetland dominated by *Phalaris arundinacea* (reed canary grass) with some *Salix amygdaloidea* (peachleaf willow) saplings. A 0.54-acre depressional PEMC wetland is located on the northwestern edge of the affected resource area and consists of *Scirpus atrovirens* (dark green bulrush) and *Phalaris arundinacea* (reed canary grass).

Table E2-10. Site 86 Wetlands within the Affected Resource Area

Cowardin ¹ Wetland Classification	Area (ac)	Hydrogeomorphic Classification
PEMA	1.51	Depressional
PEMA	0.06	Riverine
PEMC	0.12	Depressional
PEMC	0.12	Riverine

¹PEMA = Palustrine emergent temporarily flooded

PEMC = Palustrine emergent seasonally flooded

E2.4 Cultural and Historic Properties

A cultural resource inventory of the APE for Structures 26 and 27 was conducted by NRCS archeologists in May 2018 (Mackling 2018). A cultural resource inventory of the APE of Structures 55, 66, 77, 82, 84, 85, and 86 was completed by Buried Past Consulting, LLC. in November 2018-January 2019 (Bevitt and Bevitt 2019). Both inventories were conducted by professional archeologists who meet the Secretary of Interior's Standards for Archeology and Historic Preservation and included background research, pedestrian inventory, and shovel tests. A total of 1,973 acres were inventoried, and 20 cultural resource sites were identified. Cultural resources recorded within the APE include isolated stone artifacts, a bridge, a barn, a wooden latrine, a corncrib, late 19th century farmsteads, and historic artifact scatters (glass, metal, and

wood). Results of those surveys are summarized in Table E2-11. Requests for copies of the cultural resource inventory reports may be submitted to the Nebraska State Historic Preservation Office (hn.hp@nebraska.gov).

In accordance with 36 CFR 800.4 and 36 CFR 60.4, sites within the project APE were evaluated to determine eligibility for inclusion in the National Register of Historic Places (NRHP). Eighteen of the sites were determined to not meet any of the criteria for NRHP eligibility. Two of the sites were determined to be eligible for the NRHP under Criteria A and C (Criterion A: association with Czech immigrant settlement of Nebraska; Criterion C: association with early Czech-American settlement construction patterns). One of the historic properties is a late 19th century farmstead containing a house, a barn, a chicken coop, a corn crib, modern metal grain bins, three wooden sheds, a concrete-block garage, and an extensive artifact scatter of glass, plastic, and metal debris and farm equipment. The other historic property is also a late 19th century farmstead containing a barn, a wooden corn crib, modern metal grain bins, a historic farmhouse, a modern residence, and several outbuildings. The Nebraska State Historic Preservation Office concurred with these determinations of eligibility in letters received January 16, 2019, December 13, 2019, and August 9, 2021 (Appendix A).

Table E2-11. Cultural Resources within the APE

Structure	Site	Site Type	NRHP Determination of Eligibility
26	25SD141	Farmstead	Not Eligible
	25SD142	Wooden bridge	Not Eligible
27	25SD102	Farmstead	Not Eligible
55	25SD117	Two bifacial stone tools	Not Eligible
	25SD215	Farmstead	Not Eligible
66	25SD113	Isolated fragment of white crockery	Not Eligible
	25SD114	Artifact scatter – glass, metal, wood	Not Eligible
	25SD140	Windmill	Not Eligible
	25SD216	Farmstead	Eligible
77	25SD105	Isolated fragment of white porcelain	Not Eligible
	25SD106	Three fragments of white ironstone	Not Eligible
	25SD107	Isolated retouched chert flake	Not Eligible
	25SD108	Isolated chert flake	Not Eligible
	25SD132	Farmstead	Not Eligible
	25SD133	Farmstead	Not Eligible
	25SD134	Wooden structure (latrine)	Not Eligible
	25SD217	Farmstead	Not Eligible
82	No cultural resources identified	N/A	N/A
84	25SD219	Farmstead	Eligible
	25SD220	Isolated ground stone tool (mano)	Not Eligible
85	No cultural resources identified	N/A	N/A



Structure	Site	Site Type	NRHP Determination of Eligibility
86	25SD221	Wooden corn crib	Not Eligible

E2.5 Environmental Justice

Although this project will provide many benefits, it is important to ensure any negative human health and/or environmental impacts are not disproportionately carried by minorities or low-income populations. The affected resource areas and downstream potential breach paths are located in Saunders County, Nebraska, United States within the 2010 Census Tracts 9682, 9683, and 9684 (Project tracts). To determine if minorities or low-income populations would potentially experience disproportionately high negative impacts, the demographics of the Project are first analyzed. Table 2-13 shows the percentage of minorities within the Project tracts compared to the percentages within Saunders County, the state of Nebraska, and the United States from 2010 Census data (USCB 2018). As shown in Table E2-12, the percentage of minorities within the Project tracts are significantly lower than the percentages within Nebraska and the United States. Tract 9683 has a slightly higher percent minority population than the rest of Saunders County, but it is still well below the State and Country minority population percentages. Due to the low percentage of minority populations within the Project area, this Project will not disproportionately impact minority groups.

Table E2-12. 2010 Census Demographic Data

Category	Tract 9682	Tract 9683	Tract 9684	Saunders County	Nebraska	United States
Percent Minority	1.8%	5.0%	2.1%	2.9%	13.9%	27.6%

Source: United States Census Bureau. 2010 Census.

The affected resource areas are located within block groups 311559682001, 311559682002, and 311559682003 on the Environmental Protection Agency's (EPA) Environmental Justice Screening and Mapping Tool (EJ Screen). EJ Screen results are similar to those listed above, with 2 to 3-percent within the minority population and 12 to 31-percent low income (defined as income less than two times the poverty level). The demographic index (a combination of percent minority and percent low-income) varies between 7 and 14-percent within the affected resource area, which is in the 8th to 41st percentile for the state of Nebraska.

U.S. Department of Agriculture Natural Resources Conservation Service		NE-CPA-52 9/2013	A. Client Name: Lower Platte North Natural Resources District														
ENVIRONMENTAL EVALUATION WORKSHEET		B. Conservation Plan ID # (as applicable): Program Authority (optional): PL 83-566 (WFPO, RCPP)															
D. Client's Objective(s) (purpose): To provide flood damage reduction to agricultural and urban lands within the Wahoo Creek subwatershed and below the confluence of Sand Creek and Wahoo Creek within the Wahoo Creek Watershed		C. Identification # (farm, tract, field #, etc. as required): The following Section, Township, Ranges in Saunders County: S15 T14 R05; S10 T15 R05; S13 T15 R05; S23 T14 R05; S13 T14 R05; S30 T14 R07; S36 T15 R05; S03 T14 R05; S12 T14 R05; S19 T14 R06; S29 T14 R06															
E. Need for Action: Flood damage reduction is needed in agricultural and urban lands within the Wahoo Creek watershed that experience flood damage from frequent precipitation events.	H. Alternatives <table border="1" style="width: 100%;"> <thead> <tr> <th>No Action</th> <th>✓ if RMS</th> <th>Alternative 1</th> <th>✓ if RMS</th> <th>Alternative 2</th> <th>✓ if RMS</th> </tr> </thead> <tbody> <tr> <td>No action</td> <td></td> <td>Construct 10 wet floodwater retarding dams including one significant-hazard structure and ten low-hazard structures</td> <td></td> <td>Construct 10 dry floodwater retarding dams including one significant-hazard structure and ten low-hazard structures</td> <td></td> </tr> </tbody> </table>					No Action	✓ if RMS	Alternative 1	✓ if RMS	Alternative 2	✓ if RMS	No action		Construct 10 wet floodwater retarding dams including one significant-hazard structure and ten low-hazard structures		Construct 10 dry floodwater retarding dams including one significant-hazard structure and ten low-hazard structures	
No Action	✓ if RMS	Alternative 1	✓ if RMS	Alternative 2	✓ if RMS												
No action		Construct 10 wet floodwater retarding dams including one significant-hazard structure and ten low-hazard structures		Construct 10 dry floodwater retarding dams including one significant-hazard structure and ten low-hazard structures													
Resource Concerns																	
In Section "F" below, analyze, record, and address concerns identified through the Resources Inventory process. (See FOTG Section III - Resource Planning Criteria for guidance).																	
F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. Effects of Alternatives																
	No Action Amount, Status, Description <i>(Document both short and long term impacts)</i>		Alternative 1 Amount, Status, Description <i>(Document both short and long term impacts)</i>	Alternative 2 Amount, Status, Description <i>(Document both short and long term impacts)</i>													
SOIL: EROSION <small>Excessive bank erosion from streams, shorelines or water conveyance channels</small>	Continued stream and bank erosion will widen and degrade streams and result in increased sedimentation to downstream waterbodies.	<input type="checkbox"/> NOT meet PC	The floodwater retarding dams will provide grade control and peak flow reduction, reducing degradation and bank erosion and reducing sedimentation.	<input type="checkbox"/> NOT meet PC	The floodwater retarding dams will provide grade control and peak flow reduction, reducing degradation and bank erosion and reducing sedimentation.												
SOIL: EROSION <small>Channels are degrading and widening and experiences bank erosion from major storm events.</small>	Continued sheet and rill erosion will result in large sediment loads.	<input type="checkbox"/> NOT meet PC	Implementation of land treatment measures in the dam's subwatersheds to meet PL-566 land treatment requirements will reduce sheet and rill erosion.	<input type="checkbox"/> NOT meet PC	Implementation of land treatment measures in the dam's subwatersheds to meet PL-566 land treatment requirements will reduce sheet and rill erosion.												
SOIL: SOIL QUALITY DEGRADATION <small>No resource concern identified</small>		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC													
WATER: EXCESS / INSUFFICIENT WATER <small>Excess (Ponding, flooding, seasonal high water table, seeps, and drifted Flood damages from frequent precipitation events</small>	Continued flood damages from small storm events.	<input type="checkbox"/> NOT meet PC	The 11 floodwater dams will work as a system to lower the peak discharge from storm events and reduce flood damages.	<input type="checkbox"/> NOT meet PC	The 11 floodwater dams will work as a system to lower the peak discharge from storm events and reduce flood damages.												
WATER: WATER QUALITY DEGRADATION <small>Excessive sediment in surface waters Erosion causes sediment to enter water bodies and impair water quality.</small>	Sediment will continue to enter streams and water bodies, allowing an influx of nutrients to enter and compromising the water quality.	<input type="checkbox"/> NOT meet PC	The floodwater retarding dams will decrease downstream sedimentation and capture and store upstream sediment, preventing it from entering downstream water bodies.	<input type="checkbox"/> NOT meet PC	The floodwater retarding dams will decrease downstream sedimentation and capture and store upstream sediment, preventing it from entering downstream water bodies.												

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. (continued)				
	No Action		Alternative 1		Alternative 2
Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC
AIR: AIR QUALITY IMPACTS					
No resource concern identified		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
PLANTS: DEGRADED PLANT CONDITION					
No resource concern identified		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
ANIMALS: INADEQUATE HABITAT FOR FISH AND WILDLIFE					
Habitat degradation	Stream erosion and sedimentation will continue to degrade in-stream habitat.	<input type="checkbox"/> NOT meet PC	Floodwater retarding dams will create 400-acres of permanent pool for fish habitat and protect in-stream habitat through grade control.	<input type="checkbox"/> NOT meet PC	Will protect in-stream habitat through grade control.
Sedimentation from bed and bank erosion degrades downstream aquatic habitats.					<input type="checkbox"/> NOT meet PC
ANIMALS: LIVESTOCK PRODUCTION LIMITATION					
No resource concern identified		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
ENERGY: INEFFICIENT ENERGY USE					
No resource concern identified		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC	<input type="checkbox"/> NOT meet PC
HUMAN: ECONOMIC AND SOCIAL CONSIDERATIONS					
Public Health and Safety	Continued flooding could result in threat to public's health and safety.		Reduced threat of harm and economic damages due to flooding.		Reduced threat of harm and economic damages due to flooding.
Continued flooding could harm the public's health and safety.					

Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.

In Section "G" complete and attach Environmental Procedures Guide Sheets for documentation as applicable. Items with a "•" may require a federal permit or consultation/coordination between the lead agency and another government agency. In these cases, effects may need to be determined in consultation with another agency. Planning and practice implementation may proceed for practices not involved in consultation.

G. Special Environmental Concerns (Document existing/benchmark conditions)	J. Impacts to Special Environmental Concerns					
	No Action	Alternative 1	Alternative 2			
	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action
•Clean Air Act Guide Sheet FS1 FS-2	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>		<input type="checkbox"/>
•Clean Water Act / Waters of the U.S. Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	May Effect USACE CWA Section 404 Permit would be obtained prior to implementation.	<input type="checkbox"/>	USACE CWA Section 404 Permit would be obtained prior to implementation.	<input type="checkbox"/>
•Coastal Zone Management Guide Sheet Fact Sheet Not present in planning area	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	N/A	<input type="checkbox"/>
Coral Reefs Guide Sheet Fact Sheet Not present in planning area	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	N/A	<input type="checkbox"/>
•Cultural Resources / Historic Properties (Required) Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	May Effect Consultation with Tribes and NeSHPO complete. See supporting documentation.	<input type="checkbox"/>	May Effect Consultation with Tribes and NeSHPO complete. See supporting documentation.	<input type="checkbox"/>
•Endangered and Threatened Species (Required) Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	Not likely to adversely affect Platte River consumptive use totals below benchmark. Tree clearing dates will not occur between June 1 - July 31 to protect northern long-eared bat. Informal consultation with USFWS complete.	<input type="checkbox"/>	Not likely to adversely affect Platte River consumptive use totals below benchmark. Tree clearing dates will not occur between June 1 - July 31 to protect northern long-eared bat. Informal consultation with USFWS complete.	<input type="checkbox"/>
Environmental Justice Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>
•Essential Fish Habitat Guide Sheet Fact Sheet Not present in planning area	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	N/A	<input type="checkbox"/>
Floodplain Management Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect Located within the regulatory 100-year floodplain. NFIP requirements will be met in conjunction with NeDNR.	<input type="checkbox"/>	No Effect Located within the regulatory 100-year floodplain. NFIP requirements would be met in conjunction with NeDNR.	<input type="checkbox"/>
Invasive Species Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>
•Migratory Birds/Bald and Golden Eagle Protection Act Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	May Effect Adverse impacts to migratory birds will be avoided by construction timeliness.	<input type="checkbox"/>	May Effect Adverse impacts to migratory birds will be avoided by construction timeliness.	<input type="checkbox"/>
Natural Areas Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>
Prime and Unique Farmlands Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect No Farmland Protection Policy Act significant concerns.	<input type="checkbox"/>	No Effect No Farmland Protection Policy Act significant concerns	<input type="checkbox"/>
Riparian Area Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>
Scenic Beauty Guide Sheet Fact Sheet	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>

•Wetlands Guide Sheet Fact Sheet		No Effect <input type="checkbox"/>	May Effect Wetland impacts will be mitigated for through CWA Section 404 permit process. <input type="checkbox"/>	May Effect Wetland impacts would be mitigated for through CWA Section 404 permit process. <input type="checkbox"/>																																			
•Wild and Scenic Rivers Guide Sheet Fact Sheet		No Effect <input type="checkbox"/>	No Effect <input type="checkbox"/>	No Effect <input type="checkbox"/>																																			
K. Other Agencies and Broad Public Concerns		No Action	Alternative 1	Alternative 2																																			
Easements, Permissions, Public Review, or Permits Required and Agencies Consulted.		None required.	Easements will be required, CWA Section 404 permit will be required.	Easements would be required, CWA Section 404 permit would be required.																																			
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)		Flooding and damage will continue at small rain events, erosion will continue and water quality will be compromised.	Will provide reduction in flooding, flood related damages and erosion and overall protect water quality within the subwatershed. Will work as a system with previously installed flood risk reduction structures in the watershed to improve flood reduction downstream.	Will provide reduction in flooding, flood related damages and erosion and overall protect water quality within the subwatershed. Will work as a system with previously installed flood risk reduction structures in the watershed to improve flood reduction downstream.																																			
L. Mitigation (Record actions to avoid, minimize, and compensate)		None required.	Impacts to sensitive resources were avoided and minimized to the extent possible. Mitigation for wetlands, streams, and woodlands is anticipated.	Impacts to sensitive resources were avoided and minimized to the extent possible. Mitigation for wetlands, streams, and woodlands is anticipated.																																			
M. Preferred Alternative	✓ preferred alternative	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																			
	Supporting reason		NED Alternative. Meets purpose and need and protects downstream areas from flooding.																																				
N. Context (Record context of alternatives analysis)		local																																					
The significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality.																																							
O. Determination of Significance or Extraordinary Circumstances																																							
<p>Intensity: Refers to the severity of impact. Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.</p> <p>If you answer ANY of the below questions "yes" then contact the State Environmental Liaison as there may be extraordinary circumstances and significance issues to consider and a site specific NEPA analysis may be required.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Yes</td> <td style="width: 10%;">No</td> <td colspan="3"></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td colspan="3"> <ul style="list-style-type: none"> • Is the preferred alternative expected to cause significant effects on public health or safety? • Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas? </td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td colspan="3"> <ul style="list-style-type: none"> • Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial? • Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment? </td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td colspan="3"> <ul style="list-style-type: none"> • Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration? </td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td colspan="3"> <ul style="list-style-type: none"> • Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time? </td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td colspan="3"> <ul style="list-style-type: none"> • Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species. </td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td colspan="3"> <ul style="list-style-type: none"> • Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment? </td> </tr> </table>					Yes	No				<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Is the preferred alternative expected to cause significant effects on public health or safety? • Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas? 			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial? • Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment? 			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration? 			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time? 			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? 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Yes	No																																						
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<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration? 																																					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time? 																																					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species. 																																					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> • Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment? 																																					
P. To the best of my knowledge, the data shown on this form is accurate and complete:																																							
In the case where a non-NRCS person (e.g. a TSP) assists with planning they are to sign the first signature block and then NRCS is to sign the second block to verify the information's accuracy.																																							
<input type="text"/> Signature (TSP if applicable) <input type="text"/>		Environmental Engineer <input type="text"/> Title <input type="text"/>		<input type="text"/> Date <input type="text"/>																																			
Signature (NRCS) <input type="text"/>		Title <input type="text"/>		Date <input type="text"/>																																			
If preferred alternative is not a federal action where NRCS has control or responsibility and this NRCS-CPA-52 is shared with someone other than the client then indicate to whom this is being provided.																																							

The following sections are to be completed by the Responsible Federal Official (RFO)

NRCS is the RFO if the action is subject to NRCS control and responsibility (e.g., actions financed, funded, assisted, conducted, regulated, or approved by NRCS). These actions do not include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance and situations where NRCS is making a technical determination (such as Farm Bill HEL or wetland determinations) not associated with the planning process.

Q. NEPA Compliance Finding (check one)

The preferred alternative:

Action required

<input type="checkbox"/>	1) is not a federal action where the agency has control or responsibility.	Document in "R.1" below. No additional analysis is required
<input type="checkbox"/>	2) is a federal action ALL of which is categorically excluded from further environmental analysis AND there are no extraordinary circumstances as identified in Section "O" .	Document in "R.2" below. No additional analysis is required
<input type="checkbox"/>	3) is a federal action that has been sufficiently analyzed in an existing Agency state, regional, or national NEPA document and there are no predicted significant adverse environmental effects or extraordinary circumstances .	Document in "R.1" below. No additional analysis is required.
<input type="checkbox"/>	4) is a federal action that has been sufficiently analyzed in another Federal agency's NEPA document (EA or EIS) that addresses the proposed NRCS action and its' effects and has been formally adopted by NRCS . NRCS is required to prepare and publish its own Finding of No Significant Impact for an EA or Record of Decision for an EIS when adopting another agency's EA or EIS document. (Note: This box is not applicable to FSA)	Contact the State Environmental Liaison for list of NEPA documents formally adopted and available for tiering. Document in "R.1" below. No additional analysis is required
<input checked="" type="checkbox"/>	5) is a federal action that has NOT been sufficiently analyzed or may involve predicted significant adverse environmental effects or extraordinary circumstances and may require an EA or EIS.	Contact the State Environmental Liaison. Further NEPA analysis required.

R. Rationale Supporting the Finding

R.1 Findings Documentation	
R.2 Applicable Categorical Exclusion(s) (more than one may apply)	
7 CFR Part 650 Compliance With NEPA, subpart 650.6 <i>Categorical Exclusions</i> states prior to determining that a proposed action is categorically excluded under paragraph (d) of this section, the proposed action must meet six sideboard criteria. See NECH 610.116.	

I have considered the effects of the alternatives on the Resource Concerns, Economic and Social Considerations, Special Environmental Concerns, and Extraordinary Circumstances as defined by Agency regulation and policy and based on that made the finding indicated above.

S. Signature of Responsible Federal Official:

Signature

Title

Date

Additional notes



United States Department of the Interior

FISH AND WILDLIFE SERVICE
9325 South Alda Road
Wood River, Nebraska 68883



January 2, 2020

FWS-NE: 2020-126

Mr. Ritch Nelson
Nebraska – Natural Resource Conservation Service
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866

RE: Watershed Planning Effort, Wahoo Creek Watershed, Saunders County, Nebraska

Dear Mr. Nelson:

This responds to your September 11, 2019, and October 28, 2019, requests for comments and concurrence from the U.S. Fish and Wildlife Service (Service) regarding the proposed Watershed Planning Effort for the Wahoo Creek Watershed in Saunders County, Nebraska. The proposed project includes construction of 11 dams for the purpose of flood control. The Service has responsibility for the conservation and management of fish and wildlife resources for the benefit of the American public under the following authorities: 1) Endangered Species Act (ESA); 2) Fish and Wildlife Coordination Act (FWCA); 3) Bald and Golden Eagle Protection Act (Eagle Act); and 4) Migratory Bird Treaty Act (MBTA). Compliance with all of these statutes and regulations is required to be in compliance with the National Environmental Policy Act.

ENDANGERED SPECIES ACT

Pursuant to section 7(a)(2) of the ESA, every federal agency, shall in consultation with the Service, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. If the watershed planning effort may affect federally listed species or designated critical habitat, section 7 consultation is required.

The Service has completed its review of the Wahoo Creek Watershed Planning Project and concurs with Natural Resource Conservation Service's (NRCS) determination that the project may affect, but is not likely to adversely affect, the Northern long-eared bat (NLEB), pallid sturgeon, Interior least tern, and piping plover. We base our concurrence on your September 11, 2019, email confirmation that tree clearing activities will occur outside of the June 1 – July 31

INTERIOR REGION 5
MISSOURI BASIN

KANSAS, MONTANA*, NEBRASKA, NORTH DAKOTA,
SOUTH DAKOTA

INTERIOR REGION 7
UPPER COLORADO RIVER BASIN

COLORADO, NEW MEXICO, UTAH, WYOMING

pup season and thus would avoid impacts to the NLEB. Additionally, in accordance with the programmatic agreement between NRCS and the Service dated July 12, 2001, the Service also acknowledges that if the NRCS would implement projects that will adversely affect the Interior least tern, piping plover, and pallid sturgeon via depletion to the Platte River, these adverse effects would be programmatically offset by water conservation actions implemented by NRCS in the basin. Because the calculated consumptive use for all proposed dam construction sites is below 25 acre-feet, the proposed action is covered by the aforementioned programmatic agreement.

We acknowledge the no effect determination for the western prairie fringed orchid given the geographic position of the species in the watershed (upstream) in relation to Wahoo Creek and the Platte River. There are no populations of this species downstream of the proposed project sites that would be influenced by changes in Platte River hydrology.

We recommend additional coordination with the Nebraska Game and Parks Commission (NGPC) to ensure compliance with the Nebraska Nongame and Endangered Species Conservation Act. The Service recommends that the project proponent contact Melissa Marinovich, NGPC, 2200 North 33rd Street, Lincoln, NE 68503-0370.

REVIEW, COMMENTS, AND RECOMMENDATIONS ON THE PROPOSED PROJECT ACTION UNDER OTHER FISH AND WILDLIFE STATUTES

Fish and Wildlife Coordination Act

The FWCA requires consultation with the Service and state fish and wildlife agency for the purpose of giving equal consideration to fish and wildlife resources in the planning, implementation, and operation of federal and federally funded, permitted, or licensed water resource development projects. The FWCA requires that federal agencies take into consideration the effect that water related projects may have on fish and wildlife resources, to take action to avoid impact to these resources, and to provide for the enhancement of these resources. The Service recommends that impacts to wetlands, streams, and riparian areas be avoided or minimized. If wetlands or streams will be impacted by the proposed project, a Department of the Army permit from the U.S. Army Corps of Engineers may be needed. The Service will provide FWCA comments pursuant to a permit application. The Service recommends that impacts to wetlands, streams, and riparian areas be minimized and avoided.

To determine if the proposed project may affect fish and wildlife resources of the State of Nebraska under the FWCA, the Service recommends that the project proponent contact Shannon Sjolie, NGPC, 2200 North 33rd Street, Lincoln, NE 68503-0370.

Migratory Bird Treaty Act

Under the MBTA (16 U.S.C. 703-712; Ch. 128 as amended) construction activities in grassland, roadsides, wetland, riparian (stream), shrubland and woodland habitats, and those that occur on bridges or culverts (e.g., which may affect swallow nests on bridge girders) that would otherwise result in the impacts to migratory birds, eggs, young, and/or active nests should be avoided.

Although the provisions of MBTA are applicable year-round, most migratory bird nesting activity in Nebraska occurs during the period of April 1 to July 15. However, some migratory birds are known to nest outside of the aforementioned primary nesting season period. For example, raptors can be expected to nest in woodland habitats during February 1 through July 15, whereas sedge wrens, which occur in some wetland habitats, normally nest from July 15 to September 10.

The Service recommends that the NRCS avoid removal or impacts to vegetation during primary nesting season of breeding birds. In the event that construction work cannot be avoided during peak breeding season, the Service recommends that the project manager (or construction contractor) arrange to have a qualified biologist conduct an avian pre-construction risk assessment of the affected habitats (grassed drainages, streamside vegetation) to determine the absence or presence of breeding birds and their nests. Surveys should be conducted during the nesting season. Breeding bird and nesting surveys should use appropriate and defensible sampling designs and survey methods to assist the proponent in avoiding the unnecessary take of migratory birds. The Service further recommends that field surveys for nesting birds, along with information regarding the qualifications of the biologist(s) performing the surveys, be thoroughly documented and that such documentation be maintained on file by the NRCS (and/or construction contractor) until such time as construction on the proposed project has been completed.

The Service requests that the following be provided to this office prior to the initiation of the proposed project if the above conditions occur.

- a) A copy of any survey(s) for migratory birds done in conjunction with this proposed project, if any. The survey should provide detail in regard to survey methods, date and time of survey, species observed/heard, and location of species observed relative to the proposed project site.
- b) Written description of specific work activity that will take place in all proposed project areas.
- c) Written description of any avoidance measures that can be implemented at the proposed project site to avoid the take of migratory birds.

We appreciate the opportunity to review and comment on this proposed project. Should you have questions, please contact Mr. Runge within our office at jeff_runge@fws.gov or (308) 382-6468, extension 209.

Sincerely,



Eliza Hines
Nebraska Field Supervisor

cc: Melissa Marinovich, Assistant Division Administrator, Nebraska Game and Parks Commission
Shannon Sjolie, Environmental Analyst Supervisor, Nebraska Game and Parks Commission

Upper Wahoo Creek Watershed Plan-EA
 Monthly Estimated Evapotranspiration Tables

Site	Months	Evapotranspiration (acre-feet)		
		Prior	Post	Net*
Site 26a	March	0.4	-0.9	-0.5
	April	1.1	-2.4	-1.2
	May	3.4	-3.5	-0.1
	June	6.5	-4.8	1.8
	July	7.2	-5.0	2.3
	August	6.0	-4.3	1.8
	September	3.3	-3.5	-0.2
	October	0.9	-2.6	-1.7
	November	0.2	-0.6	-0.4
	Total: All Months	29.2	-27.5	-4.1**
	Total: February through July	18.7	-16.5	-1.8**
Site 26b	March	0.9	-1.8	-0.9
	April	2.4	-4.6	-2.2
	May	6.5	-6.8	-0.3
	June	12.2	-9.2	2.9
	July	14.3	-9.6	4.7
	August	12.0	-8.2	3.8
	September	6.9	-6.9	0.0
	October	2.0	-5.2	-3.1
	November	0.4	-1.2	-0.9
	Total: All Months	57.5	-53.6	-7.5**
	Total: February through July	36.2	-32.0	-3.4**
Site 27	March	1.3	-2.6	-1.2
	April	3.5	-6.5	-3.0
	May	6.8	-9.7	-2.9
	June	12.5	-13.1	-0.7
	July	17.5	-13.6	3.8
	August	15.0	-11.7	3.3
	September	8.8	-9.7	-0.9
	October	3.0	-7.2	-4.2
	November	0.5	-1.7	-1.2
	Total: All Months	68.9	-152.7	-83.8**
	Total: February through July	28.0	-91.6	-63.6**

*Positive numbers are accretions, Negative numbers are depletions

**Accumulative Net depletions, accretions are not included in the Net Totals

Upper Wahoo Creek Watershed Plan-EA
 Monthly Estimated Evapotranspiration Tables

Site	Months	Evapotranspiration (acre-feet)		
		Prior	Post	Net*
Site 55	March	1.1	-1.9	-0.8
	April	2.9	-4.7	-1.8
	May	9.6	-7.7	2.0
	June	17.6	-11.4	6.2
	July	19.6	-11.8	7.8
	August	16.4	-10.1	6.3
	September	9.7	-7.6	2.1
	October	2.7	-5.3	-2.6
	November	0.4	-1.2	-0.8
	Total: All Months	80.0	-61.7	-6.03**
	Total: February through July	50.7	-37.5	-2.6**
Site 66	March	1.7	-2.9	-1.2
	April	4.5	-7.5	-2.9
	May	12.1	-12.6	-0.5
	June	23.0	-19.7	3.4
	July	27.0	-20.4	6.6
	August	22.7	-17.3	5.5
	September	12.8	-11.9	0.9
	October	3.8	-7.5	-3.7
	November	0.7	-1.8	-1.1
	Total: All Months	108.4	-101.5	-9.4**
	Total: February through July	68.4	-63.1	-4.7**
Site 77	March	6.1	-11.3	-5.1
	April	16.2	-28.5	-12.3
	May	36.4	-42.6	-6.2
	June	63.7	-57.7	6.0
	July	87.4	-59.9	27.5
	August	74.8	-51.5	23.3
	September	46.9	-43.3	3.6
	October	15.3	-32.5	-17.2
	November	2.4	-7.7	-5.3
	Total: All Months	349.2	-335.0	-46.1**
	Total: February through July	209.8	-199.9	-23.6**

*Positive numbers are accretions, Negative numbers are depletions

**Accumulative Net depletions, accretions are not included in the Net Totals

Upper Wahoo Creek Watershed Plan-EA
 Monthly Estimated Evapotranspiration Tables

Site	Months	Evapotranspiration (acre-feet)		
		Prior	Post	Net*
Site 82	March	1.4	-2.5	-1.1
	April	3.6	-6.4	-2.7
	May	7.4	-10.1	-2.7
	June	13.9	-14.7	-0.8
	July	18.7	-15.2	3.5
	August	16.0	-13.0	3.0
	September	9.2	-9.9	-0.7
	October	3.1	-6.8	-3.7
	November	0.6	-1.6	-1.1
	Total: All Months	73.8	-80.2	-12.8**
	Total: February through July	45.0	-48.9	-7.4**
Site 84	March	4.0	-5.8	-1.9
	April	12.4	-14.8	-2.5
	May	31.8	-25.7	6.1
	June	51.4	-41.2	10.2
	July	62.6	-42.8	19.8
	August	51.4	-36.3	15.1
	September	31.2	-24.8	6.5
	October	9.5	-15.6	-6.2
	November	1.6	-3.7	-2.2
	Total: All Months	255.8	-331.8	-12.7**
	Total: February through July	162.2	-203.7	-4.3**
Site 85	March	0.9	-1.4	-0.5
	April	2.4	-3.6	-1.2
	May	5.8	-6.0	-0.1
	June	10.1	-9.1	1.0
	July	13.4	-9.4	4.0
	August	11.5	-8.0	3.5
	September	7.2	-5.6	1.6
	October	2.3	-3.7	-1.4
	November	0.4	-0.9	-0.5
	Total: All Months	54.0	-47.7	-3.8**
	Total: February through July	32.7	-29.5	-1.9**

*Positive numbers are accretions, Negative numbers are depletions

**Accumulative Net depletions, accretions are not included in the Net Totals

Upper Wahoo Creek Watershed Plan-EA
 Monthly Estimated Evapotranspiration Tables

Site	Months	Evapotranspiration (acre-feet)		
		Prior	Post	Net*
Site 86	March	0.8	-1.4	-0.5
	April	2.2	-3.5	-1.3
	May	5.0	-5.8	-0.8
	June	9.0	-8.9	0.1
	July	12.0	-9.2	2.8
	August	10.3	-7.8	2.5
	September	6.2	-5.4	0.8
	October	2.0	-3.5	-1.5
	November	0.3	-0.8	-0.5
	Total: All Months	47.9	-46.3	-4.6**
Total: February through July		29.0	-28.7	-2.6**

*Positive numbers are accretions, Negative numbers are depletions

**Accumulative Net depletions, accretions are not included in the Net Totals

Section 6.16. FRD Floodwater Retarding Dam Breach Overlay District

6.16.01 Intent:

The intent of this district is to protect certain areas of Saunders County below Floodwater Retarding Dams (hereinafter referred to as FRD) that may be subject to substantial flooding should a FRD breach (dam failure) occur or that would increase the Dam Hazard Classification. This could result in significant losses due to:

1. The cumulative effect of obstructions in the FRD breach impact area district causing increases in flood heights and velocities; and
2. The occupancy of the FRD breach impact area district by uses vulnerable to floods or hazardous to others which are inadequately elevated or otherwise protected from flood damage.

The FRD breach impact area district is designed to permit the gainful use of certain lands which are considered to be in the path of potential flood waters and from which structures and other valuable property use that is subject to damage by flood water should be regulated. This would permit surface runoff through such areas in the event of a FRD breach with a minimum of structural damage or property loss, and a minimum of obligation upon governmental authorities for flood or disaster assistance.

As such, this Article is intended to promote the public health, safety, and general welfare, and minimize these losses by applying the provisions of this article to the designated areas within Saunders County. And by taking action to:

1. Restrict or prohibit uses which are dangerous to health, safety, or property in the FRD breach impact area, or which might cause undue increase in flood heights; and
2. Protect individuals from buying lands for the purpose of building in the FRD breach impact area which is unsuited for intended purposes because of flood hazard.

6.16.02 Findings of Fact:

1. The FRD breach impact area district of Saunders County, Nebraska, is subject to inundation which, in the event of a FRD breach, could result in potential loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood relief, and impairment of the tax base; all of which adversely affect the public health, safety, and general welfare.

2. Such flood losses are caused by:

- a. The cumulative effect of obstructions in FRD breach impact areas causing increases in flood heights and velocities.
- b. The occupancy of FRD breach impact areas by uses vulnerable to floods or hazardous to others, and which are inadequately elevated or otherwise protected from flood damages.

3. This article uses a reasonable method of analyzing FRD breach impact flood hazards which consists of a series of interrelated steps, as follows:

- a. The use of engineering calculations and breach impact studies which indicate the area and potential depth of inundation for each FRD.
- b. Delineation of breach impact area encroachment lines within which no habitable structure is permitted which could cause any increase in flood height

6.16.03 General Provisions

1. Land to which Regulations Apply. This article shall apply to all lands within the unincorporated portion of Saunders County, Nebraska, identified on the FRD Maps as elaborated by the official Professional Engineering Breach Impact Studies. No development of habitable structures shall be permitted in any defined FRD breach impact area except as authorized herein.

2. The Enforcement Officer. The Zoning Administrator of Saunders County, Nebraska or his designee is designated as the enforcement officer.

3. Rules for Interpretation of District Boundaries. The boundaries of the FRD breach impact area district shall be determined by scaling distances on the engineering Breach Impact Studies. The Enforcement Officer shall make all interpretations as to the exact location of said boundaries. In such cases where the interpretation is contested, the Board of Zoning Appeals will resolve the dispute.

4. Existing Development: No development of habitable structures presently located within a known FRD breach impact area shall be relocated, extended, converted, or structurally altered without permit with the exception that a structure may be relocated to an approved site out of a FRD breach impact area.

5. Abrogation and Greater Restrictions: It is not intended by this Article to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this Article imposes greater restrictions, the provisions of this Article shall prevail. All other regulations inconsistent with this Article are hereby repealed to the extent of the inconsistency only.

6. Interpretation: In their interpretation and application, the provisions of this Article shall be held to be minimum requirements and shall be liberally construed in favor of the Governing body and Saunders County.

7. Warning and Disclaimer of Liability: The degree of flood protection required by this Article is considered reasonable for regulatory purposes and is based on engineering and scientific methods of study. In the event of a FRD breach, larger floods may occur on rare occasions or the flood height may be increased by man-made or natural causes. This Article does not imply that areas outside boundaries of the FRD breach impact area or land uses permitted within such districts will be free from flooding or flood damages. This Article shall not create liability on the part of Saunders County or any officer or employee thereof for any flood damages that may result from reliance on this Article or any administrative decision lawfully made thereunder.

8. Appeal: Where a request for a permit to develop, build, locate, extend, convert or structurally alter any structure or building is denied by the Enforcement Officer, the applicant may appeal such decision and apply for relief to the Board of Zoning Appeals in the method provided in these Regulations for appeals.

6.16.04 Permitted Uses

Only uses having a low flood damage potential and not obstructing flood flows shall be permitted within the Floodwater Retarding Dam Breach Impact Overlay District to the extent they are not prohibited by any other provision of these Regulations, and provided they do not require structures or storage of materials or equipment. Subject to the requirements of these Regulations, the following uses are permitted:

- a. Agricultural uses.
- b. Residential uses such as lawns, gardens, parking, play, and yard areas that do not have a habitable structure.
- c. Nonresidential uses such as loading areas, parking, landing strips, and
- d. Public and private recreational uses such as golf courses, archery ranges, picnic grounds, parks, and wildlife and nature preserve.
- e. Residential structures with a finished floor elevation certified to exceed a minimum of one-foot above the Wahoo Creek Dam Breach Inundation elevation.
- f. Or other uses that will not affect the Dam Hazard Classification and are in conformance with the underlying zoning district.

Section 5.21. FRD Floodwater Retarding Dam Breach Overlay District

5.21.01 Intent:

The intent of this district is to protect certain areas of Wahoo below Floodwater Retarding Dams (hereinafter referred to as FRD) that may be subject to substantial flooding should a FRD breach (dam failure) occur or that would increase the Dam Hazard Classification. This could result in significant losses due to:

1. The cumulative effect of obstructions in the FRD breach impact area district causing increases in flood heights and velocities; and
2. The occupancy of the FRD breach impact area district by uses vulnerable to floods or hazardous to others which are inadequately elevated or otherwise protected from flood damage.

The FRD breach impact area district is designed to permit the gainful use of certain lands which are considered to be in the path of potential flood waters and from which structures and other valuable property use that is subject to damage by flood water should be regulated. This would permit surface runoff through such areas in the event of a FRD breach with a minimum of structural damage or property loss, and a minimum of obligation upon governmental authorities for flood or disaster assistance.

As such, this Article is intended to promote the public health, safety, and general welfare, and minimize these losses by applying the provisions of this article to the designated areas within Wahoo. And by taking action to:

1. Restrict or prohibit uses which are dangerous to health, safety, or property in the FRD breach impact area, or which might cause undue increase in flood heights; and
2. Protect individuals from buying lands for the purpose of building in the FRD breach impact area which is unsuited for intended purposes because of flood hazard.

5.21.02 Findings of Fact:

1. The FRD breach impact area district of Wahoo, Nebraska, is subject to inundation which, in the event of a FRD breach, could result in potential loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood relief, and impairment of the tax base; all of which adversely affect the public health, safety, and general welfare.

2. Such flood losses are caused by:

- a. The cumulative effect of obstructions in FRD breach impact areas causing increases in flood heights and velocities.
 - b. The occupancy of FRD breach impact areas by uses vulnerable to floods or hazardous to others, and which are inadequately elevated or otherwise protected from flood damages.
3. This article uses a reasonable method of analyzing FRD breach impact flood hazards which consists of a series of interrelated steps, as follows:
- a. The use of engineering calculations and breach impact studies which indicate the area and potential depth of inundation for each FRD.
 - b. Delineation of breach impact area encroachment lines within which no habitable structure is permitted which could cause any increase in flood height

5.21.03 General Provisions

1. Land to which Regulations Apply. This article shall apply to all lands within the incorporated portion of Wahoo, Nebraska, and its Extra Territorial Jurisdiction (ETJ) identified on the FRD Maps as elaborated by the official Professional Engineering Breach Impact Studies. No new development of habitable structures shall be permitted in any defined FRD breach impact area except as authorized herein.
2. The Enforcement Officer. The Zoning Administrator of Wahoo, Nebraska or their designee is designated as the enforcement officer.
3. Rules for Interpretation of District Boundaries. The boundaries of the FRD breach impact area district shall be determined by scaling distances on the engineering Breach Impact Studies. The Zoning Administrator shall make

all interpretations as to the exact location of said boundaries. In such cases where the interpretation is contested, the Board of Zoning Appeals will resolve the dispute.

4. Existing Development: No development of habitable structures presently located within a known FRD breach impact area shall be relocated, extended, converted, or structurally altered without a permit with the exception that a structure may be relocated to an approved site out of a FRD breach impact area.

5. Abrogation and Greater Restrictions: It is not intended by this Article to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this Article imposes greater restrictions, the provisions of this Article shall prevail. All other regulations inconsistent with this Article are hereby repealed to the extent of the inconsistency only.

6. Interpretation: In their interpretation and application, the provisions of this Article shall be held to be minimum requirements and shall be liberally construed in favor of the Governing body and Wahoo.

7. Warning and Disclaimer of Liability: The degree of flood protection required by this Article is considered reasonable for regulatory purposes and is based on engineering and scientific methods of study. In the event of a FRD breach, larger floods may occur on rare occasions or the flood height may be increased by man-made or natural causes. This Article does not imply that areas outside boundaries of the FRD breach impact area or land uses permitted within such districts will be free from flooding or flood damages. This Article shall not create liability on the part of Wahoo or any officer or employee thereof for any flood damages that may result from reliance on this Article or any administrative decision lawfully made thereunder.

8. Appeal: Where a request for a permit to develop, build, locate, extend, convert or structurally alter any structure or building is denied by the Zoning Administrator, the applicant may appeal such decision and apply for relief to the Board of Zoning Appeals in the method provided in these Regulations for appeals.

5.21.04 Permitted Uses

Only uses having a low flood damage potential and not obstructing flood flows shall be permitted within the Floodwater Retarding Dam Breach Impact Overlay District to the extent they are not prohibited by any other provision of these Regulations, and provided they do not require structures or storage of materials or equipment. Subject to the requirements of these Regulations, the following uses are permitted:

- a. Agricultural uses.
- b. Residential accessory uses such as lawns, gardens, parking, play areas, and yard areas that do not have a habitable structure.
- c. Nonresidential uses such as loading areas, parking, landing strips, and
- d. Public and private recreational uses such as golf courses, archery ranges, picnic grounds, parks, and wildlife and nature preserve.
- e. Residential structures with a finished floor elevation certified to exceed a minimum of one-foot above the Wahoo Creek Dam Breach Inundation elevation.
- f. Or other uses that will not affect the Dam Hazard Classification and are in conformance with the underlying zoning district.