Vermilion Headwaters Watershed Plan

Livingston, McLean, Ford, & Iroquois County Illinois

11/30/2023

Prepared and Submitted by the American Farmland Trust, The Wetlands Initiative and Northwater Consulting

American Farmland Trust   THE WETLANDS INITIATIVE   northwater WATER + GEOSCIENCE EXPERTS   VERMILION HEADWATERS WATERSHED PARTNERSHIP

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Acronyms

1. AC - Acres
2. ACEP – Agricultural Conservation Easement Program
3. AFT – American Farmland Trust
4. BMP – Best Management Practice
5. CCA – Certified Crop Advisors
6. CREP – Conservation Reserve and Enhancement Program
7. CRP – Conservation Reserve Program
8. CSP – Conservation Stewardship Program
9. CBS – Contour Buffer Strip
10. CZ – Critical Zone
11. DEM – Digital Elevation Models
12. DRV – Deep Rooted Vegetation
13. DWM – Drainage Water Management
14. EQIP – Environmental Quality Incentive Program
15. FS – Filter Strip
16. GIS – Geographic Information System
17. GPS – Geographic Positioning System
18. HUC – Hydrologic Unit Code
19. HRU – Hydrologic Response Unit
20. ICGA – Illinois Corn Growers Association
21. IDNR – Illinois Department of Natural Resources
22. IDOA – Illinois Department of Agriculture
23. Illinois EPA – Illinois Environmental Protection Agency
24. INLRS – Illinois Nutrient Loss Reduction Strategy
25. INSAC – Illinois Nutrient Science Advisory Committee
26. ISA – Illinois Stewardship Alliance
27. ISAP – Illinois Sustainable Ag Partnership
28. ISGS – Illinois State Geologic Survey
29. LRR – Lateral Recession Rate
30. LSU - Landscape Unit
31. MGD – Million Gallons Per Day
32. MRBI – Mississippi River Basin Healthy Watersheds Initiative
33. MUSLE – Modified Universal Soil Loss Equation
34. MSB – Multi-Species Buffer
35. NFWF – National Fish and Wildlife Foundation
36. NH4 – Ammonia
37. NHD – National Hydrography Dataset
38. NLCD – National Land Cover Database
39. NO2 – Nitrite
40. NO3 – Nitrate
41. NPDES – National Pollutant Discharge Elimination System
42. NPS– Nonpoint Source Pollution
43. NRCS – National Resource Conservation Service
44. NTCHS – National Technical Committee for Hydric Soils
45. NWI – National Wetlands Inventory
46. NWISweb – National Water Information System: Web Interface
47. NWQL – National Water Quality Laboratory
48. PCM – Precision Conservation Management
49. RCPP – Regional Conservation Partnership Program
50. SHP – Soil Heath Partnership
51. SRP – Soluble Reactive Phosphorus
52. STAR – Saving Tomorrow's Agriculture Resources Program
53. STEPL – Spreadsheet Tool for Estimating Pollutant Loads
54. STP – Sewage Treatment Plant
55. SWCD – Soil and Water Conservation District
56. SWAT - Soil Water Assessment Tool
57. SSG – Stiff Stemmed Grass
58. SBS – Streambank Stabilization
59. TKN – Total Kjeldahl Nitrogen
60. TMDL – Total Maximum Daily Load
61. TN – Total Nitrogen
62. TNC – The Nature Conservancy
63. TP – Total Phosphorus
64. TSP – Technical Service Providers
65. TSS – Total Suspended Solids
66. USDA – U.S. Department of Agriculture
67. USEPA – U.S. Environmental Protection Agency
68. USFWS – U.S. Fish and Wildlife Service
69. USGS – United States Geological Survey
70. USLE – Universal Soil Loss Equation
71. VHW – Vermilion Headwaters Watershed
72. VRT – Variable Rate Technology
73. VSS – Volatile Suspended Solids
74. WASCOB – Water and Sediment Control Basin
75. WBP – Watershed Based Plan
76. WTP – Water Treatment Plant

Executive Summary

The Vermilion River Headwaters Watershed

The Vermilion River Headwaters watershed plan includes 305,573 acres from 13 United States Geological Survey (USGS) Hydrologic Unit Code (HUC)-12 watersheds located in the greater Vermilion River HUC-8 basin. The plan provides a road map to achieve goals developed by the Vermilion Headwaters Watershed (VHW) Partner Steering Committee; these water quality goals are in alignment with the Illinois Nutrient Loss Reduction Strategy (INLRS). This plan is intended to be adapted and updated as cost-effective implementation activities continue to achieve the highest load reductions, especially for nitrogen which is the primary water quality concern. Priority or critical areas identified for in-field and structural management practices should serve as a starting point to guide implementation and outreach efforts, as project partners recognize the need for these practices on more acreage than what is currently prioritized.

Many people and groups in the VHW watershed work to enhance water resources and improve water quality. The VHW Watershed Partnership, headed by the VHW Partner Steering Committee, is comprised of local stakeholders such as farmers, state and federal agency staff, local agricultural retailers, and non-profit groups and will support efforts and execution of this plan. Projects underway during plan development include a grant from the National Fish and Wildlife Federation to fund a Conservation Technician, as well as grants from Compeer Financial and the Natural Resources Conservation Service (NRCS) for priority Best Management Practices (BMPs) and water quality monitoring through the Mississippi River Basin Healthy Watersheds Initiative Programs.

The Partnership Steering Committee adopted three specific watershed goals that aim to achieve social, economic, and environmental outcomes:

1. Increase awareness of the INLRS goals, including the promotion of in-field and edge-of-field nitrate loss reduction practices.
2. Increase implementation of nitrate loss reduction practices by 15% in a minimum of two priority subwatersheds.
3. Increase conservation tillage activity by 15% in a minimum of two priority subwatersheds.

This plan includes a detailed inventory and assessment of current conditions that inform strategic recommendations and projects.

Table 1 summarizes and ranks stream and watershed characteristics.

Table 1 – Watershed Characteristics and Problem Ranking

Inventory/ Assessment Item	Summary	Ranking
Land use, Nutrient and Sediment Loading	Cropland has the greatest influence on water quality and covers 92% of the watershed, followed by low intensity developed (2.8%), and developed open space (1.9%). Nutrient loading is higher than urban and other land and is responsible for the greatest percentage of nitrogen (97%) and phosphorus (51%) loading. Up to 96% of the cropland nitrogen load is estimated to originate from subsurface flow or drain tiles. Approximately 64% of the watershed is believed to be tiled with some subwatersheds over 90%. Sediment loading from crop ground exceeds other sources and is responsible for 52% of the total. Agricultural BMPs will be very effective in reducing nutrients and sediment, considering cost and feasibility. Further conversion to agriculture is not expected in the future. Prioritized in-field practices, especially those that treat subsurface runoff and tile water, such as cover crops and nutrient management, will significantly reduce nitrogen loading. Structural practices that address tile nitrogen loading such as constructed wetlands, drainage water management, and saturated buffers can be applied to relatively large areas and achieve large reductions. Other edge-of-field and structural practices (e.g., wetlands, filter strips, and grass waterways) will address higher-risk areas and further reduce loading, especially for sediment and phosphorus. At a total estimated annual cost of $71,419,358, cover crops, wetlands, and drainage water management can be applied to treat 153,383 ac, reducing 20% of the total nitrogen load. Filter strips and grassed waterways that treat 236,786 ac can reduce 40% of the total phosphorus and 71% of the total sediment load for a cost of $658,876.	**High**
Gully Erosion	Gully erosion, primarily on crop land is responsible for a large portion of the watershed sediment load, or 33.5%. These areas can be addressed through structural practices, primarily grass waterways or constructed wetlands to capture eroded sediment before reaching a waterbody. Structural practices defined as "critical" in Section 9 should be prioritized. Waterways and wetlands combined could reduce 23% of the annual sediment, 7% of the phosphorus and 8% of the nitrogen load for a total cost of $62,404,713. These practices will generate reductions over multiple years versus, for example, cover crops requiring annual expenditures.	**High**
Water Quality and Monitoring	Water quality data is limited in this watershed, especially for sediment. Historical nitrate and phosphorus monitoring has occurred at numerous stations. However, datasets are generally limited in duration and lack continuous streamflow. A few exceptions are stations immediately outside the watershed. The Vermilion River has been impaired for metals, nitrogen, sedimentation/siltation, and bacteria, some of which were addressed in a 2009 Total Maximum Daily Load or TMDL report. Water quality, especially nitrogen, is of high concern and a priority. A more robust monitoring program is needed to generate accurate estimates of loading and to measure the success of future watershed management efforts.	**Medium**

Inventory/ Assessment Item	Summary	Ranking
Tillage and Highly Erodible Soils	Mulch and reduced-till systems are common on 62% of all field acres in soybeans. Over 60% of all corn acreage is in a conventional tillage system. Area surveys indicate a slight shift towards more reduced tillage and no-till. Conventional acres are responsible for approximately 61% of the crop sediment and 45% of the nutrient load. Conventional yields the greatest sediment per acre. The watershed is very flat and highly erodible and potentially highly erodible soils exist on only 7.5% of the watershed and deliver 35% of the entire cropland sediment load while making up only 8.4% of the total acreage. Most of these acres are being conventionally tilled. Further increasing the percentage of no-till/strip-till and promoting cover crops will measurably reduce sediment and nutrient loading. Applying conservation tillage to 48,350 ac is estimated to reduce 4% of the total sediment load.	**Medium**
Streambank Erosion	Streambank erosion is responsible for a small portion of the watershed nitrogen (0.08%), sediment (4.4%) and phosphorus (2.8%) load. Although it is a natural process, bank erosion is likely severe at a limited number of locations. Access constraints and cost limit stabilization options.	**Low**
NDPES Dischargers	Twelve NPDES (National Pollutant Discharge Elimination System) permitted facilities discharge 0.1% of the total annual nitrogen and 9.3% of the total phosphorus, and 0.05% of the total sediment load. Most of this is generated by the City of Fairbury. All facilities are permitted through the Illinois EPA and United States Environmental Protection Agency (USEPA) and are considered low priority.	**Low**
Land Use Change & Urban Areas	The watershed contains a small amount of developed land, and little to no future development is expected around population centers. Many small communities are decreasing slowly in population. Much of the tillable acres are already cropland and little conversion from natural area is likely to occur, although these areas should be conserved.	**Low**
Septic Systems	There are an estimated 2,061 homes with septic systems in the watershed. It is possible that up to 15% of all systems may be failing, or 309. Failing systems are estimated to account for a low portion of the overall nutrient load (0.17% nitrogen and 4.9% phosphorus). A septic system education program can prevent loading from failing systems in the future.	**Low**

Key Recommendations

Primary watershed recommendations include:

1. Conduct targeted outreach and one-on-one communication with producers and landowners identified as having critical areas of the highest nutrient and sediment losses.
2. Execute an integrated methodology for priority in-field management practices such that no-till/strip-till, cover crops, and nutrient management are adopted in a tiered approach as part of a conservation cropping system. Stacking these with structural practices will achieve the best possible outcomes.

3. Provide educational activities for landowners and producers on conservation practice adoption, management, and benefits.
4. Develop a watershed management and implementation tracking system to monitor practice adoption, load reductions achieved, and progress made towards meeting water quality targets.
5. Continue and enhance existing water quality monitoring efforts.
6. Commit to a long-term strategy of continued, producer-led outreach, implementation, and adaptive management.

1.0 Introduction

The focus of this plan is the 305,573-acre Vermilion Headwaters Watershed (VHW), located in north central Illinois, predominately in Livingston and Ford Counties with smaller portions located in McLean and Iroquois counties. There are 13 United States Geological Survey (USGS) Hydrologic Unit Code (HUC)-12 subwatersheds that make up the project area: Belle Prairie-Indian Creek, Bradbury Landing Strip - North Fork Vermilion River, Fivemile Creek, Indian Creek, Indian Grove - South Fork Vermilion River, Kelly Creek, Piper City - North Fork Vermilion River, Pleasant Ridge - North Fork Vermilion River, Town of Cullom - North Fork Vermilion River, Town of Fairbury, Town of Forrest - South Fork Vermilion River, Town of Kempton - Kelly Creek, and Turtle Pond - South Fork Vermilion River. The VHW is part of the greater Vermilion River HUC-8 watershed (07130002), which is a tributary to the Illinois River. Figure 1 shows the location of the VHW and subwatershed boundaries and locations.

In the Science Assessment which accompanies the Illinois Nutrient Loss Reduction Strategy (INLRS), University of Illinois scientists identified the Vermilion-Illinois River Basin as one of the top five major (HUC 8 scale) watersheds in Illinois yielding the most nitrogen. This plan characterizes the project area and defines an achievable implementation strategy to address water quality concerns, specifically, nutrients and sediment. The plan also summarizes and unites ongoing efforts to identify, prioritize, and plan new conservation projects. The plan will provide a road map to achieve watershed goals developed by the Vermilion Headwaters Partnership in alignment with the INLRS. The Partnership's goals include the increased use of priority nitrate practices listed in the INLRS, which include, but are not limited to, cover crops, nutrient management, bioreactors, wetlands, buffers, and permanent grasses. Priority or critical areas for in-field management and structural practices are a starting point to guide implementation and outreach efforts.

This plan is intended to be adapted and updated as implementation activities progress to achieve the highest load reductions for the least possible investment. Ideally, this plan will be reviewed and updated every ten years. Table 2 lists those people and organizations who were responsible for creating this Watershed-Based Plan (WBP). For this WBP, American Farmland Trust (AFT) is the lead organization. Significant input to the plan was provided by The Wetlands Initiative and Northwater Consulting.

Table 2 - Plan Contributors

Planning Group	
Name	**Organization**
Jean Brokish	American Farmland Trust
Helen VanBeck	American Farmland Trust
Shelby Best	American Farmland Trust
Rachel Lechuga	American Farmland Trust
Jill Kostel	The Wetlands Initiative
Jim Monchak	The Wetlands Initiative
Jeff Boeckler	Northwater Consulting

This report includes the required Watershed Based Plan components and is organized into the following sections:

Section 1 –Introduction
Section 2 –Watershed History
Section 3 –Watershed Resource Inventory
Section 4 –Pollutant Loading
Section 5 –Sources of Watershed Impairments
Section 6 –Nonpoint Source Management Measures and Load Reductions
Section 7 –Cost Estimates
Section 8 –Water Quality Targets
Section 9 –Critical Areas
Section 10 –Technical and Financial Assistance
Section 11 –Implementation Milestones, Objectives and Schedule
Section 12 –Information and Education
Section 13 –Water Quality Monitoring Strategy

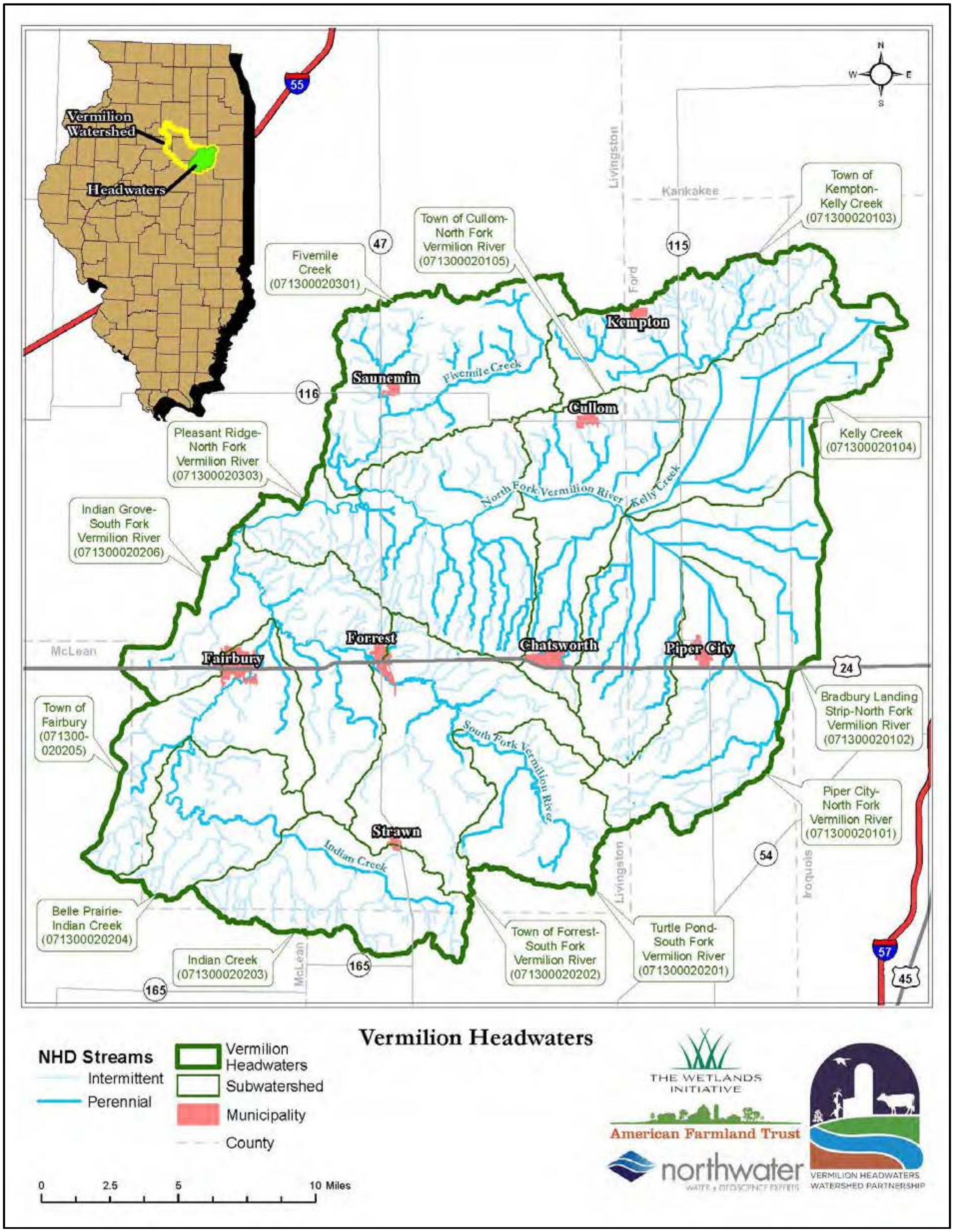

Figure 1 - Vermilion Headwaters Watershed

2.0 Watershed History

Significant conservation efforts have taken place in the VHW. Since 2015, more than $1.7M has been invested in conservation practices as an extension of the collaboration between the Vermilion Headwaters Partnership, the Livingston and Ford County Soil and Water Conservation Districts (SWCD), and the Natural Resources Conservation Service (NRCS).

Since 2004, a 14-mile section of the Vermilion River directly downstream of the project area has been listed on Illinois' 303(d) list of impaired waters due to excessive nitrate concentrations. Nitrate pollution has been a priority concern in the VHW for decades. In the late 1980's and early 1990's, the Vermilion Watershed Task force was formed to "promote a healthy, sustainable watershed through enhancement of the Vermilion River and its tributaries." Primary outcomes and successes of this effort include:

- BMPs for Nitrogen Management distributed to over 8,200 people.
- Watershed articles distributed to 4,000 stakeholders.
- EPA approval of the 1998 Vermilion River Watershed Implementation Plan.
- A Watershed Planning Grant to develop a subwatershed plan for Fivemile Creek, with a draft of plan completed in 1999.
- A Conservation 2000 grant for public outreach campaigns.

Additional planning efforts that have been previously completed include The Vermilion River Basin (In the Illinois River Watershed): An Inventory of the Region's Resources, completed in 2004 by the Illinois Department of Natural Resources (IDNR), and the 2009 Vermilion River Watershed (IL Basin) Total Maximum Daily Load (TMDL) Report.

There are many partners in the watershed actively contributing to protection and conservation activities that provide technical assistance, education, and outreach. In 2016, a group of farmers, agriculture professionals, area residents, government agencies, and non-profit organizations formed the Vermilion Headwaters Partnership to enhance local soil health and water quality by increasing the efficiency of local nitrogen management and maximizing farm productivity in the headwaters of the Vermilion-Illinois River Basin.

The Partnership is a coalition led by AFT and headed by the Vermilion Headwaters Partnership Steering Committee. The Partnership works to achieve goals such as reducing nitrogen and phosphorus loading, increasing conservation activities, increasing awareness and understanding of water quality issues and the benefits of nutrient management, and increasing soil health, reducing ephemeral gully erosion, and improving farmer profitability. Ongoing activities include farmer and non-operator landowner outreach (field days, workshops, farmer interviews), soil transect surveys, and water quality monitoring. The Partnership Steering Committee consists of representatives from Livingston County's local SWCD and

NRCS, local agriculture retailer locations, Ford County's local SWCD and NRCS, Livingston County Farm Bureau, local farmers, Precision Conservation Management (a program of the Illinois Corn Growers Association), The Wetlands Initiative, and AFT.

The Partnership Steering Committee adopted three specific watershed goals that aim to achieve social, economic, and environmental outcomes:

1. Increase awareness of the INLRS goals, including the promotion of in-field and edge-of-field nitrate loss reduction practices.
2. Increase implementation of nitrate loss reduction practices by 15% in a minimum of two priority subwatersheds.
3. Increase conservation tillage activity by 15% in a minimum of two priority subwatersheds.

3.0 Watershed Resource Inventory

The Watershed Resource Inventory summarizes characteristics specific to the watershed. It includes information on hydrology, land use, soils, habitat and water quality, demographics, and other relevant information.

3.1 Location and Watershed Boundary

Figure 1 shows the location of the VHW and its subwatersheds. It is located predominately in Livingston and Ford Counties; smaller portions of the watershed fall within McLean and Iroquois counties. The VHW is a tributary to the Illinois River and contains 13 HUC12 subwatersheds, which are located within the larger Vermilion River HUC 8 watershed (07130002). This plan focuses on the area and subwatersheds of the VHW that extend to the east to include Kelly Creek in the northwest corner of Iroquois county, and west to McLean County, at the confluence of Indian Creek and the South Fork Vermilion River.

3.2 Water Quality Standards, Impairments and TMDL

This section provides an overview of standards of importance, past and current impairments in the watershed, and a historical TMDL. Recent water quality is compared to standards and recommended levels.

3.2.1 Standards and Impairments

Water quality standards are laws or regulations that states establish to enhance water quality and protect public health and welfare. Standards consist of water quality criteria necessary to support and protect a specific "designated use" of a waterbody, and an antidegradation policy. Examples of designated uses are primary contact, fish consumption, aesthetic quality, protection of aquatic life, and public and food processing water supply. Criteria are expressed numerically for standards with a numeric limit (e.g., 10%

of samples over a given time period cannot exceed the standard expressed as a concentration), or as narrative description for qualitative standards without a numeric limit (e.g., increased algae growth not meeting aesthetic standards). Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected (CDM Smith, 2014). Waterbodies are considered impaired when they exceed these standards, meeting the criteria to be defined as impaired. Section 303(d) of the 1972 Clean Water Act requires states to define impaired waters and identify them on the 303(d) list. When no numeric or narrative criteria is set for a parameter, guidelines are described for a specific use.

Relevant Standards and Water Quality Parameters

Standards which are relevant to this watershed plan are nitrogen and phosphorus. Nitrogen loading is of high importance, with a 2009 TMDL recommending reductions of 9-31% to meet state standards in the larger Vermilion River. In addition, Illinois is a top contributor of nitrogen to the Gulf of Mexico, and the INLRS identified the Vermilion watershed as one of the top five nitrogen loading watersheds in the state. The INLRS calls for an interim 15% reduction goal for nitrogen, while the Gulf Hypoxia Action Plan (2008) calls for a long-term 45% reduction in stream nitrogen to address and reduce the hypoxic zone and achieve plan goals. The INLRS also calls for an interim 25% reduction in phosphorus. Sediment is also an issue and can be a large importer of phosphorus and cause siltation of waterbodies. Each parameter and associated standards or guidelines are discussed below.

Nitrogen The various forms of nitrogen differ in respect to lake health and standards. In high concentrations, these various forms can be toxic to fish and other aquatic organisms. Excess nitrogen also aids in excessive algal growth and blooms. The common forms of nitrogen are:

- **Nitrite (NO2)** – an inorganic form, is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate.

- **Nitrate (NO3)** – an inorganic form, generally occurs in trace quantities in surface water but may attain high levels in some groundwater. Nitrate travels easily through soil carried by water into surface waterbodies and groundwater. The current standard of 10 mg/L for nitrate-nitrogen (nitrogen from nitrate) in drinking water is specifically designated to protect human health.

- **Ammonia (NH4)** – is present naturally in surface waters. Bacteria produce ammonia as they decompose dead plant and animal matter. In Illinois, the total ammonia general use standard is 15 mg/L.

- **Organic nitrogen (TKN)** – is defined functionally as organically bound nitrogen in the tri-negative oxidation state. Organic nitrogen includes nitrogen found in plants and animal materials, which includes such natural materials as proteins and peptides, nucleic acids, and urea. In the analytical procedures, Total Kjeldahl Nitrogen (TKN) determines both organic nitrogen and ammonia. Raw sewage will typically contain more than 20 mg/L.

- **Total nitrogen (TN)** is the sum of TKN (ammonia, organic and reduced nitrogen) and nitrate-nitrite. The Illinois Nutrient Science Advisory Committee (INSAC) recommends wadable stream standards of 3.98 mg/L for the northern ecoregion and 0.910 mg/L for the southern ecoregion (INSAC 2018). The VHW falls in the northern ecoregion.

Phosphorus is a major cellular component of organisms. Phosphorus can be found in dissolved and sediment-bound forms but is often "locked up" as components in aquatic biota, primarily algae. Major sources of phosphorus in the watershed include fertilizers and human and animal waste. In freshwater systems, phosphorous occurs naturally in smaller concentrations than nitrogen, making it the limiting nutrient in these freshwater aquatic systems. Increased nutrient concentrations (especially phosphorus) in a waterbody stimulates algae growth, which can lead to large populations, forming a bloom that can be harmful to water quality and aquatic life. Dissolved phosphorus is especially important because it is readily usable by algae and other plants. The two common forms of phosphorus are:

- **Soluble reactive phosphorus (SRP)** – is dissolved phosphorus readily usable by algae. SRP is often found in very low concentrations in phosphorus-limited systems where the phosphorus is tied up in the algae and cycled very rapidly. Sources of dissolved phosphorus include fertilizers, animal wastes, and septic systems.

- **Total phosphorus (TP)** – includes dissolved and particulate forms of phosphorus. According to Illinois water quality standards, total phosphorus must not be greater than 0.05 mg/L in lakes greater than 20 ac in size; streams may not exceed 0.05 mg/L at the point of entry into a lake. The INSAC recommends a 0.1 mg/L standard for non-wadable rivers; for wadable streams, 0.113 mg/L is recommended for the northern ecoregion of Illinois and 0.110 mg/L for the southern ecoregion (INSAC 2018).

Impairments

Water quality impairments occur in the VHW dating back to at least the 1990s. Below, Table 3 lists waterbodies on the 2004 303(d) list, their historical impairments, and a description of causes. Several waterbodies were impaired for sedimentation/siltation and total suspended solids. Only a very small portion (100 ft) of the Vermilion River (DS-06) segment falls within the planning area. The Vermilion begins at the confluence of the South Fork (DSP-01) and lower North Fork Vermilion River (DSQ-02) segments. A total of 155 miles of assessed Illinois EPA designated waterbodies or streams are found in the watershed. In 2004, impairments existed along 42 miles or 27%.

Table 3 – Historical Impairments on 2004 Illinois EPA 303(d) List

Assessment ID	Waterbody	Year Listed	Size (mi)	Cause
DSQ-03	North Fork Vermilion River	2002	30.63 (upper segment)	Sedimentation/siltation, habitat assessment (streams), total suspended solids

DSQC-01	Kelly Creek	2002	11.44	Sedimentation/siltation, habitat assessment (streams), total suspended solids
DS-06	Vermilion River	1998	14.11 (100 ft in watershed)	Total nitrogen as N, nitrate nitrogen, sedimentation/siltation, total suspended solids

Current impairments from the 2020/2022 303(d) list and the more recent lists (2006 – 2018) are shown in Table 4. Nitrate/nitrogen, fecal coliform, sedimentation, and total suspended solids have persisted through time. The total number of impairments have increased or remained the same with atrazine being added to the Vermilion River (DS-06) in 2022. Approximately 15 miles of streams are currently impaired representing 9.5% of all Illinois EPA designated waterbodies in the planning area. The reduction in impaired stream length since 2004 is primarily a result of the delisting of the upper portion of the North Fork Vermilion River (DSQ-03) in 2018.

More information on impairments can be obtained in the 2022 Integrated Report found on the Illinois EPA website. Figure 2 depicts waterbodies listed in the 2004, 2018, and 2020/2022 303(d) lists, along with their Illinois EPA assessment code.

Table 4 – 2006 - 2022 303(d) Impaired Waterbodies

Assessment ID	Waterbody	Impaired Years	Designated Use	Cause
DS-06	Vermilion River	2022	Fish consumption, primary contact recreation, public and food processing water supplies	Mercury, fecal coliform, atrazine
DS-06	Vermilion River	2018, 2016	Fish consumption, primary contact recreation, public and food processing water supplies	Mercury, fecal coliform, nitrogen, nitrate
DS-06	Vermilion River	2014	Fish consumption, primary contact recreation, public and food processing water supplies	Mercury, fecal coliform, iron, nitrogen, nitrate
DS-06	Vermilion River	2012	Fish consumption, primary contact recreation, public and food processing water supplies	Mercury, Fecal Coliform, nitrogen, nitrate
DS-06	Vermilion River	2010	Fish consumption, primary contact recreation, public and food processing water supplies	Mercury, fecal coliform, total dissolved solids
DS-06	Vermilion River	2008	Primary contact recreation, public and food processing water supplies	Fecal coliform, nitrogen, nitrate
DS-06	Vermilion River	2006	Fish consumption, primary contact recreation, public and food processing water supplies	Mercury, Fecal Coliform, total dissolved solids, nitrogen, nitrate
DSPAA-01	Unnamed Tributary Indian Creek	2014, 2012	Aquatic Life	Dissolved Oxygen

Assessment ID	Waterbody	Impaired Years	Designated Use	Cause
DSQ-03	North Fork Vermilion River	2016, 2014, 2012	Aquatic Life	Iron, phenols, sedimentation/siltation, total suspended solids
DSQ-03	North Fork Vermilion River	2010, 2008	Aquatic Life	Sedimentation/siltation, total suspended solids
DSQ-03	North Fork Vermilion River	2006	Aquatic Life	Nitrogen (total), sedimentation/siltation, total suspended solids
DSQC-01	Kelly Creek	2022, 2018	Aquatic Life	Iron, dissolved oxygen, Sedimentation/Siltation, total suspended solids
DSQC-01	Kelly Creek	2016, 2014, 2012	Aquatic Life	Iron, sedimentation/siltation, total suspended solids
DSQC-01	Kelly Creek	2010, 2008	Aquatic Life	Sedimentation/siltation, total suspended solids
DSQC-01	Kelly Creek	2006	Aquatic Life	Nitrogen (total), sedimentation/siltation, total suspended solids
DSQZA	Cullom WSS Trib	2022, 2018, 2016	Aquatic Life	Boron, dissolved oxygen
DSQZA	Unnamed Tributary to North Fork Vermilion River	2014, 2012	Aquatic Life	Boron, dissolved oxygen
DSQZA	Unnamed Tributary to North Fork Vermilion River	2010, 2008	Aquatic Life	Boron

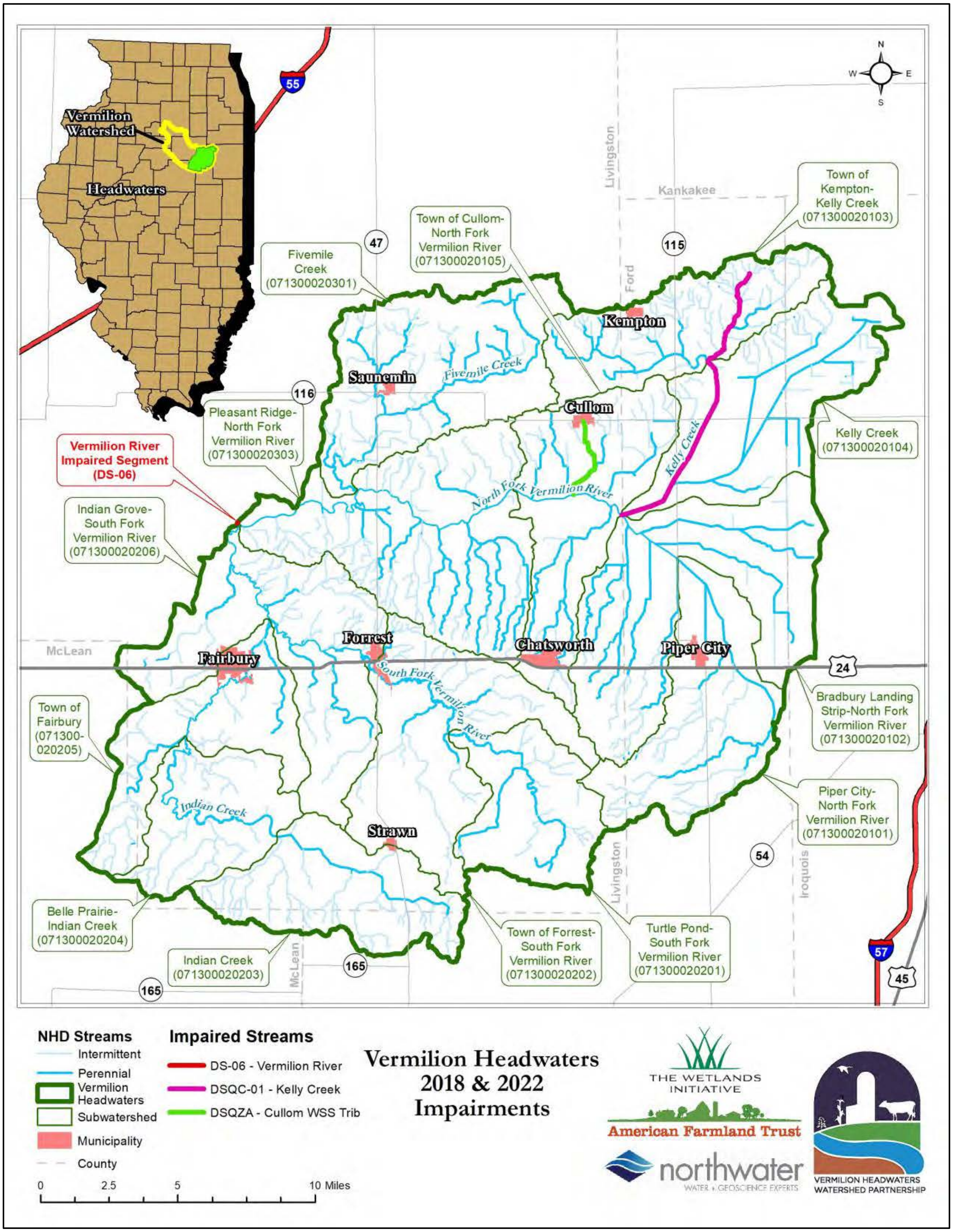

Figure 2 – Impaired Waterbodies in 2018 and 2022

3.2.2 TMDL Overview

Impaired bodies of water can be prioritized for TMDL development. A TMDL is a calculation of the maximum quantity of a pollutant that a water body can receive while still achieving water quality standards. It accounts for seasonal variability of pollutant loads so that water quality standards are met during all seasons of the year. The only TMDL plan relevant to the watershed is the 2009 Vermilion River Watershed (IL Basin) report.

The TMDL addressed nitrate/nitrogen and fecal coliform over a range of flows. Vermilion River segments included DS-06 upstream of Pontiac (14.4 miles), DS-14 downstream of Pontiac (17.33 miles), and DS-10 upstream of Streator (15.44 miles). Table 5 below lists waterbodies and parameters addressed. Nitrate and fecal coliform impairments were widespread with a high percentage of samples exceeding the standard. Nitrate levels are important considering the public water supply intake at Pontiac. Fecal coliform is a concern for primary contact or swimming use. More details can be found in the TMDL report.

Table 5 – Recommended Reductions in 2009 Vermilion River Watershed TMDL

Assessment ID	Waterbody	TMDL Parameter	TMDL Recommended Reductions: Percent Load
DS-06	Vermilion River	Nitrate	9% for high flows and 17% for moist flows
		Fecal Coliform	91% for high flows, 52% for moist flows, 28% for mid-range flows, and 48% for low flows
DS-10	Vermilion River	Nitrate	31% for high flows, 21% for moist flows, and 3% for mid-range flows
DS-14	Vermilion River	Nitrate	29% for high flows and 11% for moist flows

3.3 Water Quality

As described in Section 3.2.1, waterbodies have exceeded state standards since the 1990's. This section synthesizes recent and available water quality data for watershed streams comparing them to applicable standards or guidelines. Table 6 lists monitoring stations and sampling dates, and Figure 3 depicts their location.

Table 6 – Historic Water Quality Sampling Sites, 1986 – 2021

Station Code	Long	Lat	Supporting Agency	Waterbody	Range of Data	Parameters	Number of entries after 2008
05554500 (outside of watershed)	-88.63611	40.87778	USGS	Vermilion River	2011-2018	Flow	Probe data
05554300	-88.53000	40.72278		Indian Creek	1986-2021	Flow, Nitrogen	Probe data

Station Code	Long	Lat	Supporting Agency	Waterbody	Range of Data	Parameters	Number of entries after 2008
WQX-DSQZA-01	-88.26972	40.87691	Illinois EPA	Cullom WSS tributary	2002	Nitrogen and Phosphorus	0
WQX-DSQZA-02	-88.26611	40.86333					0
WQX-DSQZA-03	-88.27667	40.84167					0
WQX-DSQB-01	-88.43219	40.85325		Fivemile Creek	1999, 2004, 2009 and 2014		27
WQX-DSPA-01	-88.52989	40.72279		Indian Creek	1999, 2004, 2010-2015		218
WQX-DSPA-02	-88.54255	40.70190			2010-2015		193
WQX-DSPA-03	-88.47854	40.65584					206
WQX-DSPA-04	-88.36627	40.62136					156
WQX-DSPA-FB-A1	-88.49830	40.74380			2009		2
WQX-DSPA-FB-C1	-88.49720	40.75470			2009		2
WQX-DSPAA-01	-88.55881	40.70272		Unnamed-trib Indian Creek	2010-2015		191
WQX-DSQC-01	-88.22296	40.83287		Kelly Creek	2009 and 2014		28
WQX-DSQ-03	-88.27971	40.83781		North Fork Vermilion River	2009 and 2014		30
WQX-DSP-03	-88.40766	40.74088		South Fork Vermilion River	1999, 2004, 2009 and 2014		27
WQX-DSPA-FB-C2	-88.48900	40.75890		Indian Creek Natural Branch	2009		2
WQX-DS-06 (outside of watershed)	-88.34508	40.49833		Vermilion River	2004-2020	TDS	98

Table 6 presents the different existing stations within or relevant to the planning area. The stations presenting the most complete data sets are located along Indian Creek. For graphical readability, the data from this waterbody is presented separately. Most parameters indicated as impairments did not have any data available, such as sediment or total suspended solids. Only inorganic nitrogen and total phosphorus are addressed.

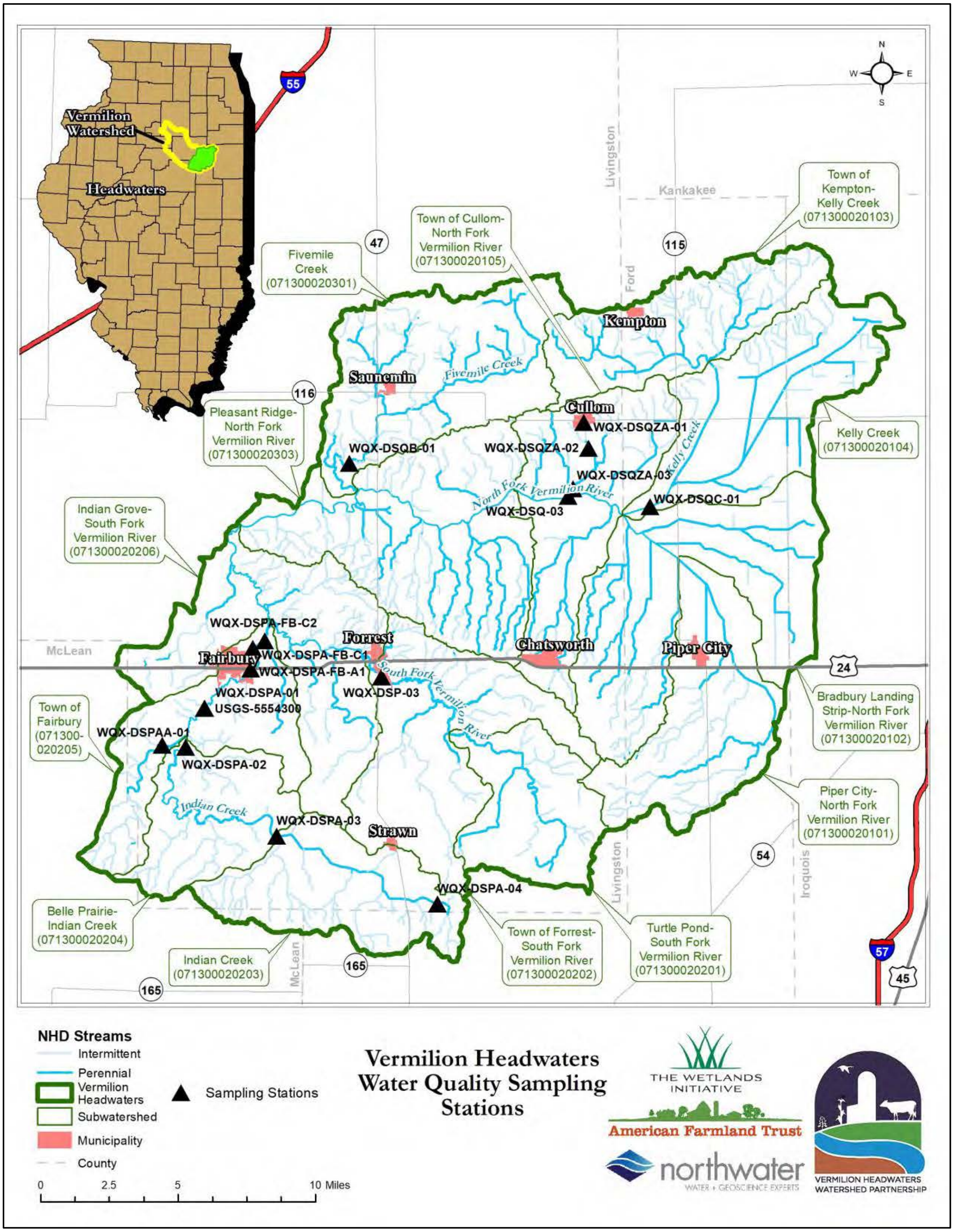

Figure 3 – Water Quality Sampling Stations

3.3.1 Total Phosphorus

Total Phosphorus is not listed as an impairment; however, it is addressed as there was data available and it is a source of concern for water quality as well as a component of the Illinois NLRS. Based on data mining performed by AFT, information was available from 2009 through 2015. Values are compared with the 0.05 mg/L reservoir drinking water standard and the 0.133 mg/L INSAC guideline. The highest phosphorus concentrations were observed on Indian Creek in 2010 (0.568 mg/L), an Unnamed Tributary of Indian Creek in 2014 (0.568 mg/L), and on the North Fork Vermilion River in 2014 (0.542 mg/L).

3.3.1.1 Indian Creek

Total phosphorus in Indian Creek regularly exceeds the reservoir drinking water standard and the INSAC recommendation (Table 7). At the four stations, 9% to 55% of the samples exceeded both the standard and the INSAC recommendation (Table 7). Figure 4 shows changes in total phosphorus concentrations through time. Higher concentrations correlate to the timing of agricultural activities and seasonal factors, with higher concentrations during the fall and spring (Figure 4). Phosphorus spikes during low flow periods may suggest other land use or wastewater sources. Higher median concentrations are found at the two most downstream locations (stations 01 and 02). Station 03 has lower concentrations than its upstream counterpart (station 04), perhaps indicating spatial heterogeneity of loading. In 2014 and 2015, the concentrations were significantly lower than previous years. These years had higher precipitation and river flows and it is possible that there was more dilution of nutrients or reduced agricultural activity.

Table 7 – Summary of Total Phosphorus Results for Indian Creek (2009 – 2015)

Station Code	Date range	Total Samples	Average Value mg/L	Minimum Value mg/L	Median Value mg/L	Percentile 95 mg/L	Max Value mg/L	Exceed 0.05 mg/L Standard		Exceed 0.113 mg/L INSAC Recommendation	
								Count	%	Count	%
WQX-DSPA-01	2009-2015	75	0.061	0.005	0.050	0.180	0.267	37	49%	8	11%
WQX-DSPA-02	2010-2015	66	0.070	0.009	0.056	0.174	0.242	36	55%	11	17%
WQX-DSPA-03	2010-2015	70	0.048	0.009	0.032	0.140	0.281	21	30%	6	9%
WQX-DSPA-04	2010-2015	45	0.074	0.015	0.046	0.221	0.595	18	40%	4	9%

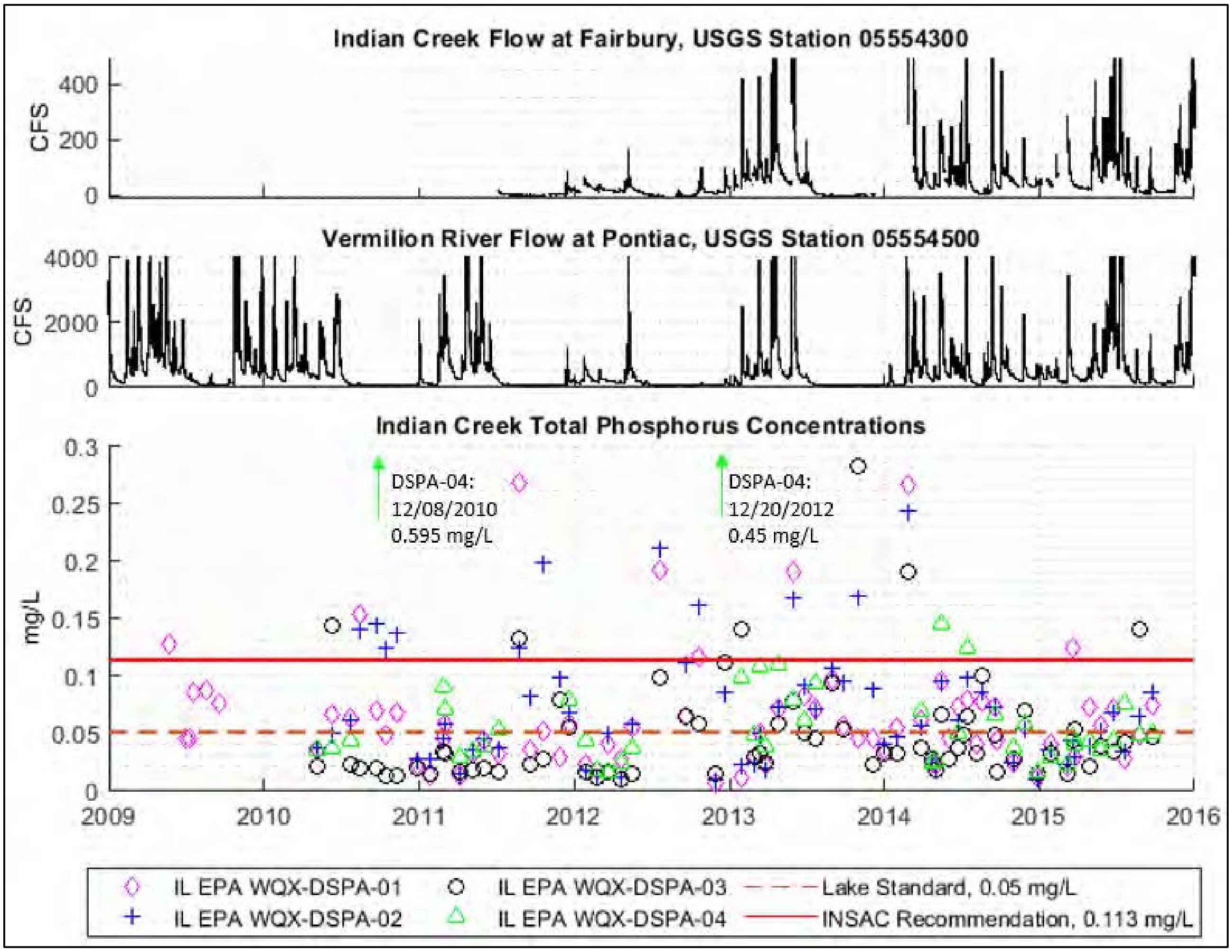

Figure 4 – Total Phosphorus Concentrations of Indian Creek and Comparison to Indian Creek and Vermilion River Flows

3.3.1.2 Other Vermilion River Tributaries

Other tributaries with phosphorus data available are South Fork, Unnamed Tributary of the Indian Creek, North Fork, Fivemile, and Kelly Creek. Data is intermittent and scarce and limited to the period of 2009 to 2014.

The data is presented in Table 8 and Figure 5. Generally, concentrations were lower in 2014 than in 2009. However, 2009 may be an anomalous year of high concentrations based on the more complete dataset from Indian Creek. Tributary data is all statistically in the same range and phosphorus loading appears to be homogenous in these subbasins. The water quality standard and INSAC recommendation are often exceeded (Table 8). It is important to note that there is limited data, and more collection is necessary to evaluate trends and assess the tributary subwatersheds.

Table 8 – Summary of Total Phosphorus Results for Vermilion Tributaries (2009 – 2015)

Station Code	Date range	Total Samples	Average Value mg/L	Minimum Value mg/L	Median Value mg/L	Percentile 95 mg/L	Max Value mg/L	Exceed 0.05 mg/L Standard		Exceed 0.113 mg/L INSAC Recommendation	
								Count	%	Count	%
WQX-DSP-03 [1]	2009 & 2014	12	0.081	0.038	0.074	0.138	0.138	8	67%	3	25%
WQX-DSPAA-01 [2]	2010 - 2015	64	0.061	0.008	0.035	0.262	0.568	21	33%	7	11%
WQX-DSQ-03 [3]	2009 & 2014	11	0.150	0.025	0.120	0.527	0.542	9	82%	6	55%
WQX-DSQB-01 [4]	2009 & 2014	11	0.077	0.029	0.062	0.168	0.169	6	55%	3	27%
WQX-DSQC-01 [5]	2009 & 2014	11	0.087	0.017	0.092	0.126	0.126	9	82%	4	36%

[1] South Fork Vermilion River, [2] Unnamed tributary of Indian Creek, [3] North Fork Vermilion River, [4] Fivemile Creek, [5] Kelly Creek

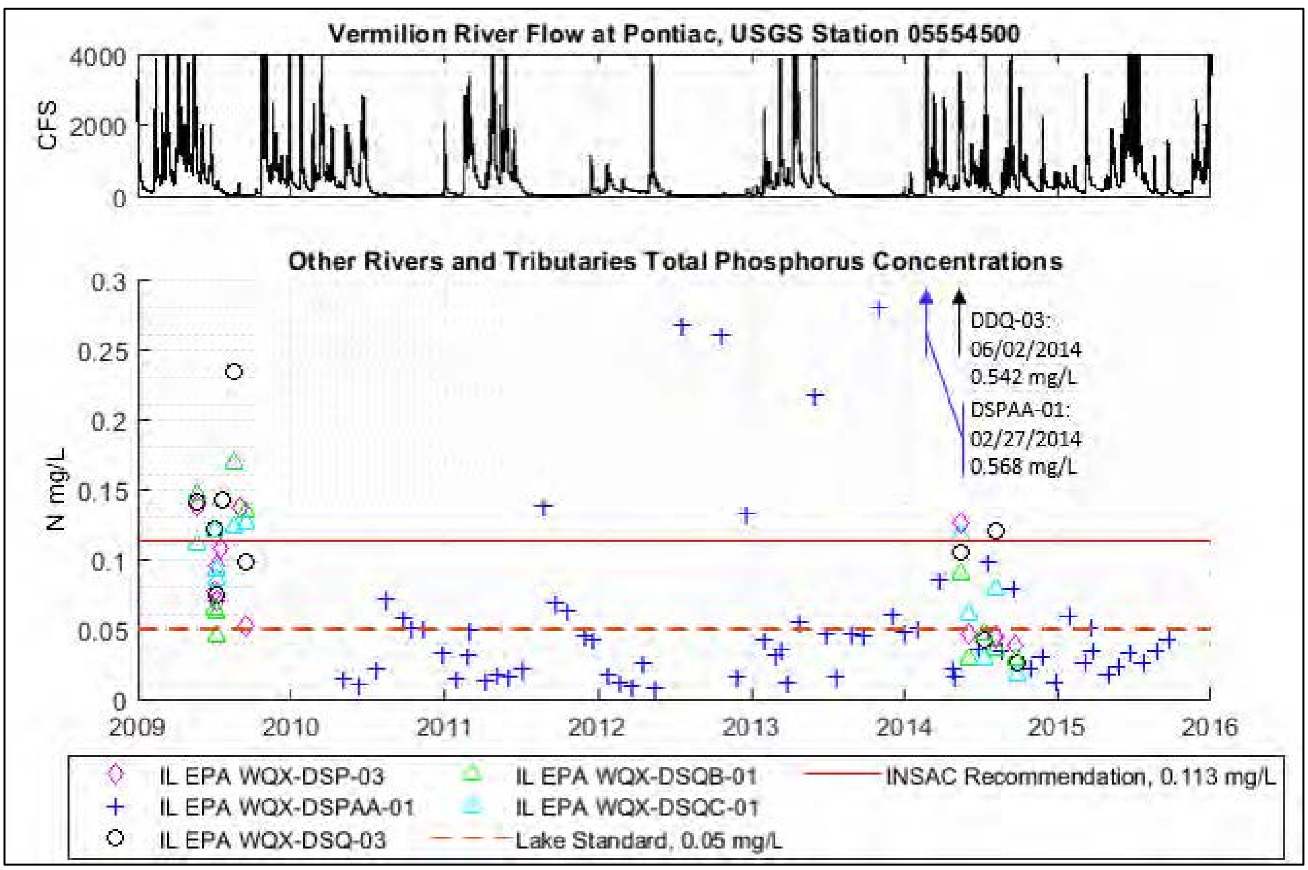

Figure 5 – Total Phosphorus Concentrations of Vermilion Tributaries and Comparison to Vermilion River Flows (2009–2015)

3.3.2 Nitrogen

Nitrogen is listed as an impairment (2016-2018 303(d)) for the Vermilion River, North Fork Vermilion River (DSQ-3 station) and Kelly Creek (DSQC-01) and was an impairment of the Vermilion River in 2004. Most of the historical data is reported as nitrate + nitrite, and this section compares those results to the drinking water standard of 10 mg/L and the INSAC recommendation of 3.98 mg/L.

3.3.2.1 Indian Creek Nitrogen Concentration

Indian Creek data was reported as nitrate + nitrite, also known as inorganic nitrogen. Inorganic forms are readily available for macrophytes plants and algae uptake. The data available was from Illinois EPA sampling sites and a nitrogen data logger at the USGS station 05554300 located near Fairbury.

Indian Creek concentrations from 2009 - 2019 are presented in Table 9 and Figure 6, and a subset of 2012-2013 is shown in Figure 7. Nitrogen is strongly correlated to flow, mostly due to surface runoff and tile flow from agricultural areas. During low flow, concentrations are also low, likely due to less runoff and denitrification in the waterbodies. Low flow concentrations also indicate that nitrogen sources are more related to nonpoint source (NPS) runoff and not groundwater. All stations exhibit similar results except for the upstream station (DSPA-04). At DSPA-04, all results exceeded the INSAC recommendation and 94% exceeded the drinking water standard. Other stations had 87% to 91% of samples exceeding the INSAC recommendation, and 41% to 44% exceeding the drinking water standard.

The USGS station logger reported 186,000 readings from 2011 to 2019. The median value is 7.3 mg/L, well above the INSAC recommendation, 70% of the time. The water quality standard was exceeded in 33% of available readings. Concentrations present some yearly variations largely correlated to flows and there was no evident temporal increasing or decreasing trend over the data period.

Table 9 – Summary of Nitrogen Results for Indian Creek (2009 – 2019)

Station Code	Date range	Total Samples	Average Value mg/L	Minimum Value mg/L	Median Value mg/L	Percentile 95 mg/L	Max Value mg/L	Exceed 10 mg/L Standard		Exceed 3.98mg/L INSAC Recommendation	
								Count	%	Count	%
WQX-DSPA-01	2009-2015	128	9.4	0.12	9	17.3	21.9	53	41%	115	90%
WQX-DSPA-02	2010-2015	115	10	0.14	9.26	17.7	33.2	51	44%	105	91%
WQX-DSPA-03	2010-2015	124	9.4	0.14	9.2	16.9	33.2	53	43%	108	87%
WQX-DSPA-04	2010-2015	105	19.9	6.1	18	33.8	58.8	99	94%	105	100%
USGS 05554300	2011-2019	186,144	7.3	0	7.27	16.1	29.2	60,525	33%	131,130	70%

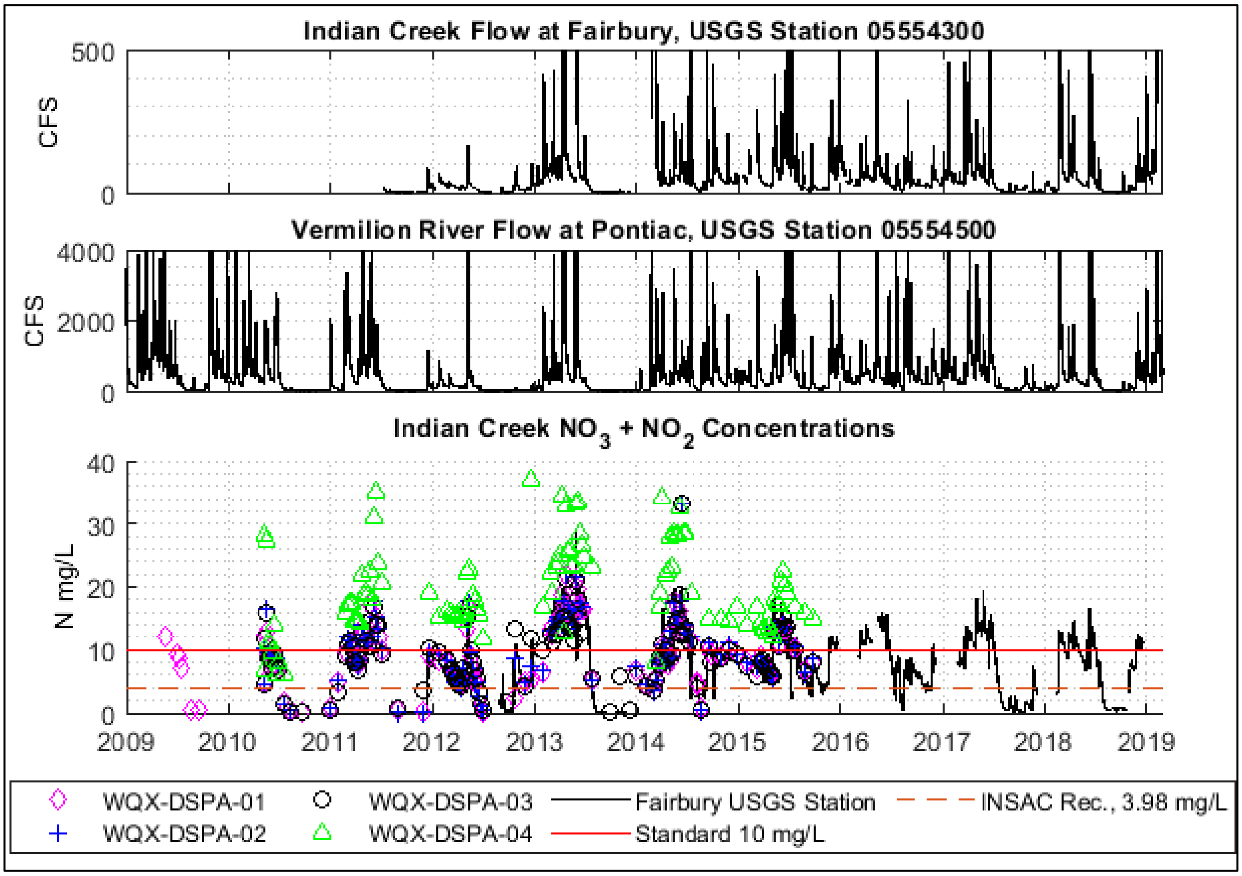

Figure 6 – Nitrate + Nitrite Concentrations of Indian Creek and Comparison to Indian Creek and Vermilion River Flows (2009 – 2019)

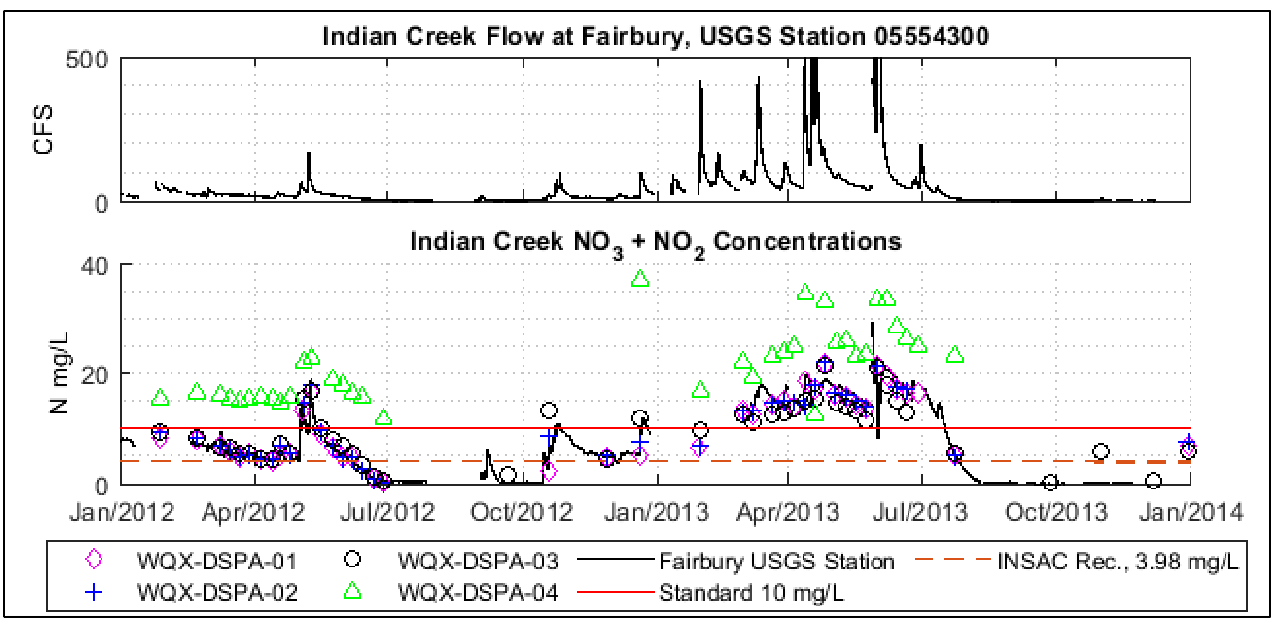

Figure 7 – Nitrate + Nitrite Concentrations of Indian Creek and Comparison to Indian Creek Flows (2012 – 2013)

3.3.2.2 Other Vermilion River Tributaries

As is the case for phosphorus, nitrogen data from other tributaries is intermittent, scarce, and limited to the period from 2009 to 2014.

The data is presented in Figure 8 and Table 10. Concentrations are similar between stations and higher values correlate to higher flow events, especially in the spring and early summer. All stations except for WQX-DSP-03 on the South Fork present similar phosphorus concentrations and trends. The South Fork has lower concentrations, and higher variability.

Based on the data, 80% exceeds the INSAC recommendation, except for 70% of South Fork results. The 10 mg/L drinking water standard is exceeded across 17% to 39% of samples. Generally, nitrogen concentration decreases in the late summer possibly related to decreases in dissolved oxygen. It is important to note that there is limited data. Additional and complementary collection is necessary to evaluate trends and assess tributaries.

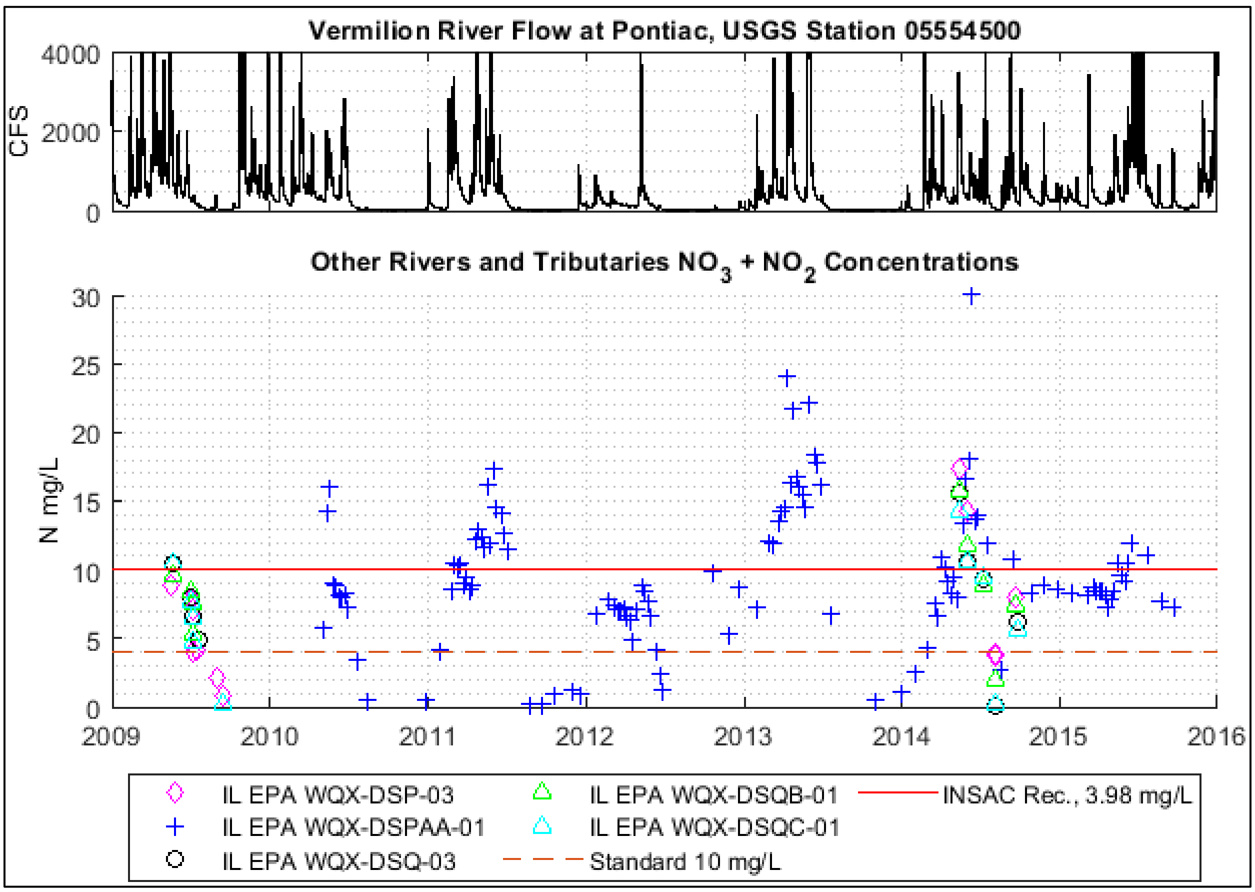

Figure 8 - Nitrogen Concentrations of Vermilion Tributaries and Comparison to Vermilion River Flows (2009–2015)

Table 10 - Summary of Nitrogen Results for Vermilion Tributaries (2009 – 2015)

Station Code	Date range	Total Samples	Average Value mg/L	Minimum Value mg/L	Median Value mg/L	Percentile 95 mg/L	Max Value mg/L	Exceed 10 mg/L Standard		Exceed 3.98 mg/L INSAC Recommendation	
								Count	%	Count	%
WQX-DSP-03 [1]	2009 & 2014	12	6.821	0.78	5.66	17.1	17.4	2	17%	8	67%
WQX-DSPAA-01 [2]	2010 - 2015	117	9.63	0.18	8.74	17.9	30	46	39%	103	88%
WQX-DSQ-03 [3]	2009 & 2014	9	7.97	0.1	7.97	15.6	15.6	3	33%	8	89%
WQX-DSQB-01 [4]	2009 & 2014	10	7.68	0.23	7.99	15.8	15.8	2	20%	8	80%
WQX-DSQC-01 [5]	2009 & 2014	10	6.96	0.2	7.08	14.2	14.2	3	30%	8	80%

[1] South Fork Vermilion River, [2] Unnamed tributary of Indian Creek, [3] North Fork Vermilion River, [4] Fivemile Creek, [5] Kelly Creek

3.4 Demographics and Watershed Jurisdictions

3.4.1 Demographics

The VHW spans 15 townships and is comprised of 13 individual HUC 12 subwatersheds. Table 11 lists townships by subwatershed.

Table 11 - Townships by Subwatershed

Subwatershed	12-digit HUC	Township Name
Belle Prairie-Indian Creek	071300020204	Indian Grove
		Belle Prairie
		Forrest
Bradbury Landing Strip - North Fork Vermilion River	071300020102	Charlotte
		Pella
		Chatsworth
		Brenton
		Danforth
		Douglas
Fivemile Creek	071300020301	Union
		Broughton
		Saunemin
		Sullivan

Subwatershed	12-digit HUC	Township Name
Indian Creek	071300020203	Belle Prairie
		Fayette
		Cropsey
		Sullivan
Indian Grove - South Fork Vermilion River	071300020206	Yates
		Avoca
		Pleasant Ridge
		Forrest
		Indian Grove
		Fayette
		Belle Prairie
Kelly Creek	071300020104	Milks Grove
		Mona
		Ashkum
		Pella
		Danforth
Piper City - North Fork Vermilion River	071300020101	Pella
		Brenton
		Lyman
		Chatsworth
		Germanville
Pleasant Ridge - North Fork Vermilion River	071300020303	Saunemin
		Avoca
		Pleasant Ridge
		Sullivan
		Charlotte
		Forrest
		Chatsworth
Town of Cullom - North Fork Vermilion River	071300020105	Sullivan
		Mona
		Pella
		Charlotte
		Chatsworth
Town of Fairbury	071300020205	Yates
		Indian Grove
		Forrest
		Belle Prairie
		Lawndale
Town of Forrest - South Fork Vermilion River	071300020202	Pleasant Ridge

Subwatershed	12-digit HUC	Township Name
		Forrest
		Chatsworth
		Fayette
		Germanville
Town of Kempton - Kelly Creek	071300020103	Rogers
		Milks Grove
		Sullivan
		Mona
Turtle Pond - South Fork Vermilion River	071300020201	Forrest
		Chatsworth
		Germanville
		Fayette

The population of the VHW's 15 Townships has remained stable over the past decade with only a slight decrease, according to the United States Census Bureau. In 2020, the total population was 18,378, with approximately 20% being over the age of 65. The largest Township for the past decade has been Indian Grove, with a population of 4,148 in 2020. The township of Fayette has the oldest population, with 96% of the population being over the age of 65. Significant change in population growth over the next 50 years is not expected. Information by Township is summarized below in Table 12.

Table 12 - Population Change and Percent Population Over 65 by Township

Townships	2010 Population	2020 Population	% Change	% Population Over 65
Union (Livingston)	240	195	-2	15%
Broughton (Livingston)	313	303	-0.32	11%
Rogers (Ford)	449	381	-1.6	12%
Milk's Grove	214	204	-0.48	14%
Saunemin	666	612	-0.84	15%
Sullivan	724	657	-0.97	21%
Mona	334	267	-2.2	14%
Ashkum	1,545	1,420	-0.84	14%
Avoca	405	417	0.29	10%
Pleasant Ridge	252	256	1.6	14%
Charlotte	136	164	1.9	15%
Pella	176	160	-0.95	27%
Danforth	929	883	-0.51	22%
Yates	287	270	-0.61	20%
Indian Grove	4,298	4,148	-0.35	19%
Forrest	1,602	1,408	-1.3	15%

Townships	2010 Population	2020 Population	% Change	% Population Over 65
Chatsworth	1,369	1,344	-0.18	18%
Brenton	973	861	-1.2	22%
Belle Prairie	133	142	0.66	22%
Fayette	270	246	-0.93	96%
Germanville	69	66	-0.44	16%
Cropsey	222	199	-1.1	14%
Sullivan	510	479	-0.63	17%
Lawndale	158	168	0.62	25%
Douglas	2,104	2,049	-0.26	22%
TOTAL	**18,378**	**17,299**	**-0.06**	**20%**

There are a total of eight municipalities in the VHW (see Table 13). Fairbury is the largest, with a population of 3,633, followed by Forrest and Chatsworth. The average median annual household income across the eight municipalities is approximately $50,000, and 22% of the population is over the age of 65. The municipalities and the corresponding demographic information, according to the United States Census Bureau, is presented in Table 13.

Table 13 - Population, Median Household Income, and Population Over 65 by Municipality

Municipality	Township	Population	Median Annual Household Income
Kempton	Mona	176	$52,083
Saunemin	Saunemin	406	$61,375
Cullom	Sullivan	520	$41,875
Fairbury	Indian Grove	3,633	$54,833
Forrest	Forrest	1,041	$58,839
Chatsworth	Chatsworth	1,344	$34,861
Piper City	Brenton	745	$40,592
Strawn	Fayette	101	$55,625
Average		**996**	**$50,010**

3.4.2 Watershed Jurisdictions and Jurisdictional Responsibilities

Within the VHW, there are no properties that are federally owned or administered by agencies such as the U.S. Fish and Wildlife Service (USFWS) or the U.S. Forest Service (USFS). The IDNR manages several properties in the watershed. Three of these are managed by the Illinois Natural Area Inventory program, including the Kelly Creek – Charlotte Reach Natural Area (37.9 ac) and English Prairie (0.5 ac) in Livingston

County and the Gardner Prairie Restoration (6.6 ac) in Ford County. Additionally, the IDNR manages the Chatsworth State Habitat Area (160 ac), a public hunting area that provides nesting, brooding, and winter cover for grassland birds, which is enrolled in the USDA Conservation Reserve Program (CRP) State Acres for Wildlife (SAFE) (IDNR, 2018). There are three properties in Livingston County totaling 186 ac that are privately managed by the Prairie Lands Foundation, including the Fugate Woods (128 ac), the James Family Woods (47.9 ac), and the Griswold Prairie (9.6 ac) (Prairie Lands Foundation, 2021). There are also 262 acres in the watershed that have been placed in a conservation easement program through the Livingston County SWCD.

3.5 Geology, Hydrogeology, Topography

This section includes information on surficial geology and hydrogeology, in addition to wells, surface elevation, and slope.

3.5.1 Geology

Most of the unlithified sediments that overlie the bedrock in the VHW area were deposited by the succession of continental glaciers that advanced across the area during the Pleistocene Epoch, or Great Ice Age (IDNR, 2000). These sediments fall into three major categories: till, outwash, and lacustrine (lake) deposits. Till is a mixture of all sizes of rocks and ground-up rock debris, and each layer (or bed) of till may represent a particular glacial advance, particularly if it can be recognized over large regions. Outwash is sand and gravel that literally "washed out" from the ice in meltwater streams along the front of a glacier. Lacustrine (lake) deposits generally consist of fine-grained sediments such as silt and clay deposited in temporary lakes that commonly formed along the margin of the ice as it melted or between a moraine and the melting ice front. Lacustrine sediments are commonly poorly drained.

The spatial extents and statistics of each of these surficial deposit types in the VHW are listed below in Table 14. Surficial geology was adapted from Illinois State Geologic Survey (ISGS) 1998 Stack-Unit mapping of the top 15 meters of earth materials (ISGS, 1998).

Table 14 - Surficial Geology of the Vermilion Headwaters Watershed

Surficial Geology	Description	Area (ac)	Percent of Watershed
Lacustrine Deposits	Thin lacustrine deposits of the Equality formation underlain by Winnebago till deposits at depths greater than 6 m from the surface.	51,724	16.9%
Outwash	Thin layer of sand and gravel outwash from Henry formation underlain by sandy Winnebago till deposits at depths greater that 6 m from the surface.	16,469	5.4%
Till	Sandy Winnebago till deposits at depths greater than 6 m from the surface.	67,549	22.1%

Surficial Geology	Description	Area (ac)	Percent of Watershed
	Sandy Winnebago till deposits underlain by silty and clayey Glasford till at depths greater than 6 m from the surface.	83,024	27.2%
	Sandy Winnebago till deposits underlain by silty and clayey Glasford till at depths greater than 6 m. Pennsylvania shale present at depths between 6 m and 15 m below the surface.	9,806	3.2%
	Sandy Winnebago till deposits underlain by sand and gravel Winnebago till deposits at depths between 6 m and 15 m below the surface.	57,895	19%

3.5.2 Hydrogeology

There are an estimated 976 private water wells in the VHW, according to the ISGS Wells and Borings database. Based on the available dataset, the average depth of wells is 160 ft, with a minimum of 17 ft and a maximum of 716 ft. The Town of Fairbury subwatershed has the greatest number, followed by Indian Grove - South Fork Vermilion River and Town of Cullom – North Fork Vermilion River. Indian Grove – South Fork Vermilion River subwatershed has the deepest well, at 2,172 ft, and the shallowest is located in the Bradbury Landing Strip – North Fork Vermilion River. The majority of the water wells were completed in sand, gravel, limestone, or sandstone aquifers. Table 15 provides a summary of the depth and composition information for water wells grouped by subwatershed.

Table 15 - Well Counts and Description by Subwatershed

Subwatershed	12-digit HUC	Total Number of Wells	Average Depth (ft)	Min Depth (ft)	Max Depth (ft)	Primary Aquifer Material
Belle Prairie-Indian Creek	071300020204	26	57	35	130	Sand, gray sand, gravel
Bradbury Landing Strip - North Fork Vermilion River	071300020102	84	104	4	530	Sand, gravel
Fivemile Creek	071300020301	58	206	9	700	Sand, gravel, sandstone, limestone
Indian Creek	071300020203	67	90	9	255	Sand, gravel
Indian Grove - South Fork Vermilion River	071300020206	123	113	15	2,172	Sand, sandstone
Kelly Creek	071300020104	47	150	23	365	Sand, limestone, rock
Piper City - North Fork Vermilion River	071300020101	62	116	34	300	Sand

Subwatershed	12-digit HUC	Total Number of Wells	Average Depth (ft)	Min Depth (ft)	Max Depth (ft)	Primary Aquifer Material
Pleasant Ridge - North Fork Vermilion River	071300020303	86	127	12	375	Sand, gravel
Town of Cullom - North Fork Vermilion River	071300020105	109	167	9	1,670	Sand, gravel
Town of Fairbury	071300020205	144	67	10	1,586	Sand, gravel, sandstone, silt
Town of Forrest - South Fork Vermilion River	071300020202	82	103	14	290	Sand, gravel
Town of Kempton - Kelly Creek	071300020103	52	242	16	700	Limestone
Turtle Pond - South Fork Vermilion River	071300020201	36	97	35	240	Sand, gravel
		Total: 976	**Avg: 126**	**Avg: 17.3**	**Avg: 716**	

3.5.3 Topography

Elevation statistics by subwatershed are found in

Table 16, and watershed elevation is shown in Figure 9. Elevation ranges from about 544 ft above sea level (fasl) to 854 ft fasl. Most of the watershed is at 777 fasl or lower, with an average elevation of about 704 fasl. The lowest elevations can be found along the North Fork Vermilion River and its tributaries. Kelly Creek subwatershed has the lowest average elevation (662 fasl). The highest elevations are in the South Fork Vermilion River and Indian Creek subwatersheds. Indian Creek has the highest average elevation (777 fasl).

Slope statistics are found in Table 17 and watershed slopes are shown in Figure 10. Most of the watershed has less than a 3% slope. The average is 2.12% (1.21°), and the maximum is 416% (76.4°). The main creek and river tributary areas are flatter, with steeper slopes in the subwatershed headwaters and immediately adjacent to the stream and river corridors.

Table 16 – Elevation by Subwatershed in Feet Above Sea Level

Subwatershed	12-digit HUC	Average Elevation (fasl)	Minimum Elevation (fasl)	Maximum Elevation (fasl)
Belle Prairie-Indian Creek	071300020204	738	684	802
Bradbury Landing Strip – North Fork Vermilion River	071300020102	680	639	817
Fivemile Creek	071300020301	700	633	761
Indian Creek	071300020203	777	725	854
Indian Grove – South Fork Vermilion River	071300020206	690	630	760
Kelly Creek	071300020104	662	544	731
Piper City – North Fork Vermilion River	071300020101	706	643	831
Pleasant Ridge – North Fork Vermilion River	071300020303	678	630	781
Town of Cullom – North Fork Vermilion River	071300020105	678	639	791
Town of Fairbury	071300020205	714	651	800
Town of Forrest – South Fork Vermilion River	071300020202	736	669	835
Town of Kempton – Kelly Creek	071300020103	704	653	767
Turtle Pond – South Fork Vermilion River	071300020201	763	699	833
VHW		**Avg: 709**	**Min: 544**	**Max: 854**

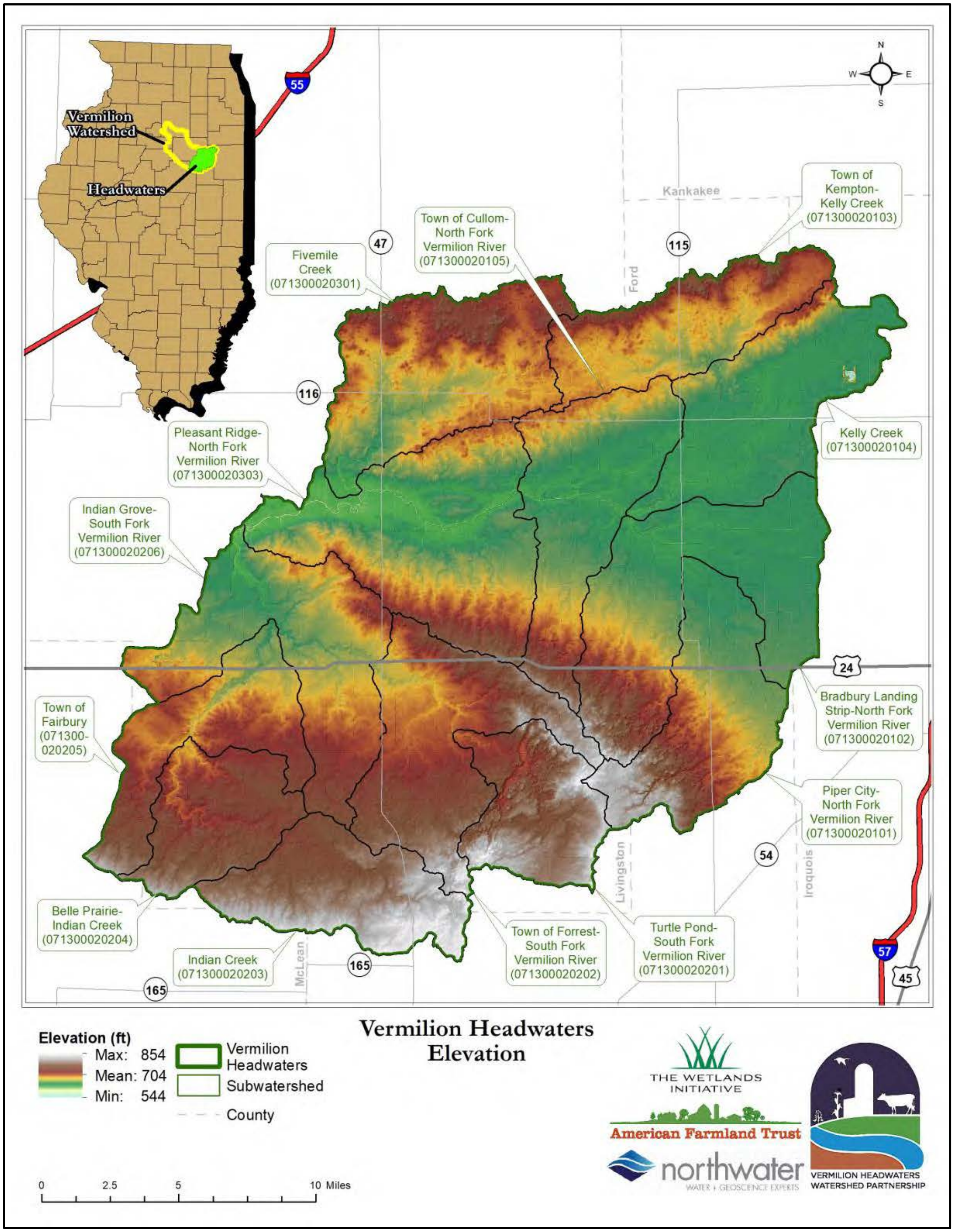

Figure 9 – Surface Elevation in Feet

Table 17 – Slope by Subwatershed in Percent

Subwatershed	12-digit HUC	Avg Slope (%)	Max Slope (%)
Belle Prairie-Indian Creek	071300020204	2	126
Bradbury Landing Strip – North Fork Vermilion River	071300020102	1.9	110
Fivemile Creek	071300020301	2.3	99
Indian Creek	071300020203	2.1	87
Indian Grove – South Fork Vermilion River	071300020206	1.8	194
Kelly Creek	071300020104	2	416
Piper City – North Fork Vermilion River	071300020101	2.3	100
Pleasant Ridge – North Fork Vermilion River	071300020303	2.2	144
Town of Cullom – North Fork Vermilion River	071300020105	2	134
Town of Fairbury	071300020205	1.9	97
Town of Forrest – South Fork Vermilion River	071300020202	2.1	104
Town of Kempton – Kelly Creek	071300020103	2.3	83
Turtle Pond – South Fork Vermilion River	071300020201	3	131
VHW		**Avg: 2.1**	**Max: 416**

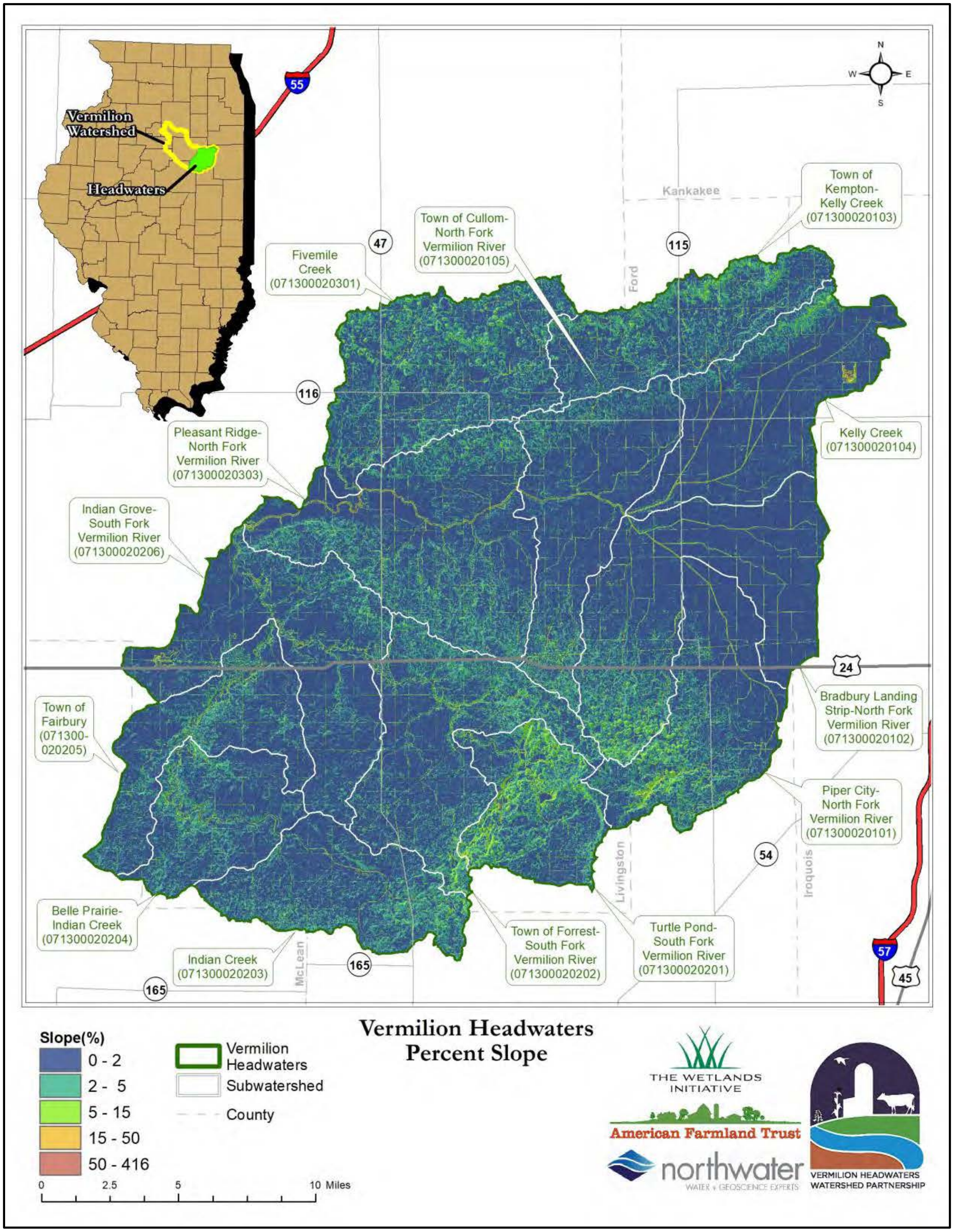

Figure 10 - Watershed Surface Slope in Percent

3.6 Climate

Climate data was obtained for 15 years (April 2006–March 2021) from the PRISM Climate Group, part of the Northwest Alliance for Computational Science and Engineering based at Oregon State University and supported by the USDA Risk Management Agency. Average monthly temperature and precipitation statistics are listed in Table 18.

Annually, the average temperature is 51° F, the average minimum is 41° F, and the average maximum is 61° F. The highest and lowest temperatures occur in July and January respectively. The highest average monthly value is 85° F (July) and the lowest is 16° F (January). Average monthly temperatures above 70° F occur June to August, and monthly maximum temperatures above 80° F likewise occur June through August.

Average monthly precipitation is 3.4 inches, and the average annual amount is 40.6 inches. The wettest part of the year is May to July with an average precipitation of nearly 5 inches per month; precipitation then drops in August to October to an average of roughly 3.5 inches per month. January and February are typically the driest months with 2.1 inches each.

Table 18 – Monthly Climate, 2006–2021

Month	Average Temp. (°F)	Minimum Temp. (°F)	Maximum Temp. (°F)	Average Precipitation (in)
Jan	24	16	32	2.1
Feb	25	16	34	2.1
Mar	40	29	50	2.7
Apr	50	39	62	3.9
May	62	51	74	4.7
Jun	72	61	83	5.0
Jul	74	64	85	4.2
Aug	72	61	83	3.7
Sep	66	54	79	3.7
Oct	54	42	65	3.6
Nov	41	31	50	2.2
Dec	30	22	38	2.6
Average	**51**	**41**	**61**	**3.4 (40.6 Yearly)**

3.7 Land Use

The predominant land use in the VHW is agriculture, with 281,792 ac, or 92% of the watershed used for cultivated crops and 3,242 ac (1.06%) utilized for hay / pasture. The majority of cultivated cropland is managed for production of corn and soybeans.

The watershed also has relatively small areas of low intensity development and open space or 8,480 ac and 5,652 ac respectively. Table 19 lists land use classifications, corresponding area, and percentages of the total watershed. Data was obtained from the National Land Cover Database (NLCD, 2019) and is depicted in Figure 11. Impervious surfaces account for 80-100% of the cover in high intensity developed areas as shown Figure 12. Impervious surfaces account for 50%-79% and 20%-49% of the land cover in medium and low intensity developed areas, respectively.

Table 19 - Land Use Category and Area

Land Use Category	Area (ac)	Percent of Watershed Area (%)
Barren Land	148	0.05%
Cultivated Crops	281,792	92%
Deciduous Forest	1,327	0.43%
Developed - High Intensity	482	0.16%
Developed - Medium Intensity	1,901	0.62%
Developed - Low Intensity	8,480	2.78%
Developed - Open Space	5,652	1.85%
Emergent Herbaceous Wetlands	57	0.02%
Evergreen Forest	21	0.01%
Hay/Pasture	3,242	1.06%
Herbaceous	146	0.05%
Mixed Forest	676	0.22%
Open Water	497	0.16%
Shrub/Scrub	6	0.002%
Woody Wetlands	983	0.32%

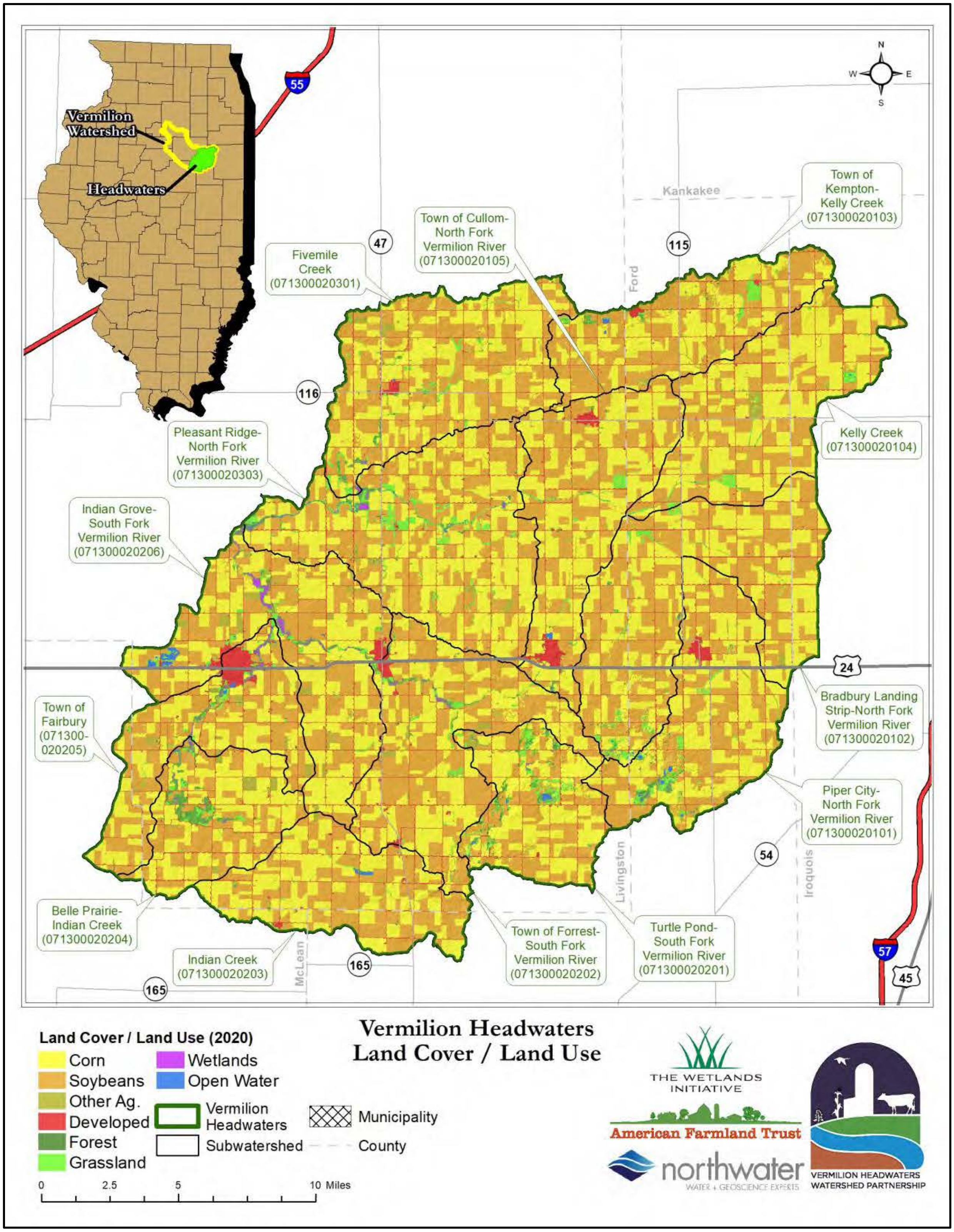

Figure 11 - Land use

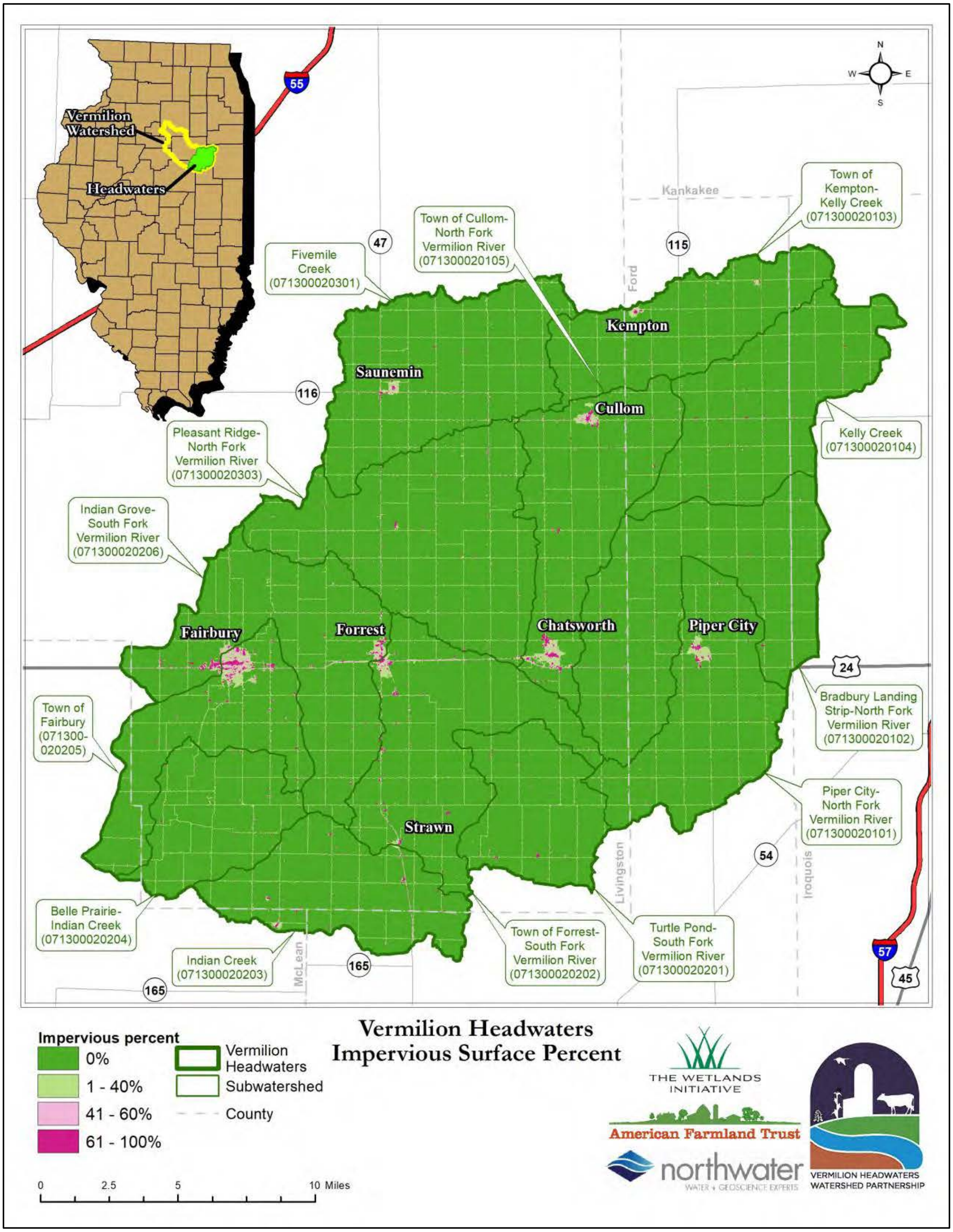

Figure 12 – Percent Impervious Surface

3.8 Soils

Based on soils data from the NRCS National Cooperative Soil Survey, 112 soil types exist in the watershed (NRCS, 2021). Ashkum silty clay loam is the dominant soil, accounting for nearly 16% of the entire watershed, or 48,078 ac. Bryce silty clay and Pella clay loam are also prevalent and account for 10.3% (31,388 ac) and 9.3% (28,400 ac), respectively. Sixteen other soil types each account for 1% to 7% of the total VHW, while the 93 remaining individual soil types only account for less than 15%. Table 20 shows the total acreage and percentage of the watershed for the predominant soil types present in the VHW, and Figure 13 shows where each is located.

The NRCS gives official descriptions for each soil series (NRCS, 2018). Ashkum loam consists of very deep, poorly drained soils on till plains, formed in colluvial sediments and in the underlying silty clay loam till with slopes ranging from 0% - 3%. The Bryce series consists of very deep, poorly drained soils which form in clayey water-sorted sediments and the underlying clayey till on till plains or glacial lake with a slope range of 0% - 2%. The Pella series consists of very deep, poorly drained soils formed in loamy or silty sediments and the underlying stratified loamy glacial sediments on lake plains, outwash plains, and till plains with a slope range of 0% - 3%.

Table 20 – Soil Types in the Vermilion Headwaters Watershed

Soil Type	Acres	Percent of Watershed (%)
Ashkum silty clay loam, 0 to 2 percent slopes	48,078	15.7%
Bryce silty clay, 0 to 2 percent slopes	31,388	10.3%
Pella clay loam, Glacial Lake Watseka, 0 to 2 percent slopes	28,400	9.3%
Milford silty clay loam, 0 to 2 percent slopes	21,887	7.2%
Drummer silty clay loam, 0 to 2 percent slopes	17,699	5.8%
Elliott silt loam, 0 to 2 percent slopes	13,612	4.5%
Swygert silty clay loam, 2 to 4 percent slopes, eroded	12,189	4%
Swygert silty clay loam, 0 to 2 percent slopes	11,906	3.9%
Reddick clay loam, 0 to 2 percent slopes	11,422	3.7%
Andres silt loam, 0 to 2 percent slopes	10,941	3.6%
Elliott silty clay loam, 2 to 4 percent slopes, eroded	10,402	3.4%
Chenoa silty clay loam, 0 to 2 percent slopes	6,611	2.2%
Lisbon silt loam, 0 to 2 percent slopes	6,513	2.1%
Selma loam, 0 to 2 percent slopes	6,311	2.1%
Martinton silt loam, 0 to 2 percent slopes	5,488	1.8%
Symerton silt loam, 2 to 5 percent slopes	5,205	1.7%
Saybrook silt loam, 2 to 5 percent slopes	5,061	1.7%
Rowe silty clay loam, 0 to 2 percent slopes	3,947	1.3%
Clarence silty clay loam, 2 to 4 percent slopes, eroded	3,235	1.1%

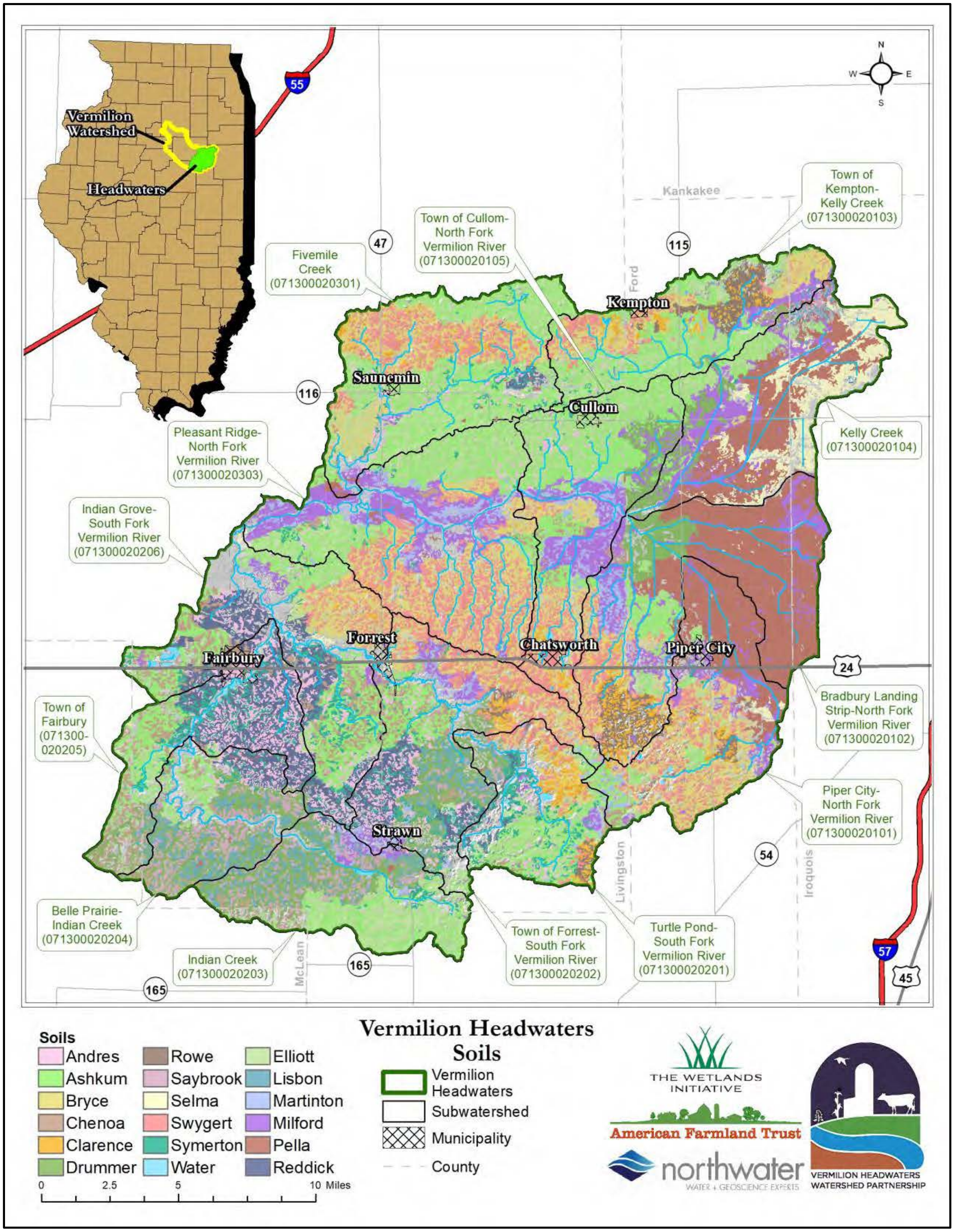

Figure 13 – Soils in the Vermilion Headwaters Watershed

3.8.1 Highly Erodible Soils

As defined by the NRCS, a highly erodible soil (HEL), or soil map unit, has a maximum potential for erosion that is greater than eight times the tolerable erosion rate (NRCS, 1993). The maximum erosion potential is calculated without consideration to crop management or conservation practices, which can markedly lower the actual erosion rate on a given field. The HEL data for this report was gathered from each county individually through the Illinois NRCS Conservation Compliance program.

About 22,136 ac of HEL or potentially HEL (PHEL) soils exist, representing 7.5% of the total watershed area (Table 21). HEL and PHEL soils are generally located immediately adjacent to streams and in steep forested or grassed areas (Figure 14). The Turtle Pond – South Fork Vermilion River subwatershed contains the highest percentage or 21.5%, whereas the Town of Cullom – North Fork Vermilion River subwatershed contains the least or 0.5%.

Table 21 – HEL/PHEL Soils in the Vermilion Headwaters Watershed

Subwatershed	HUC 12 Code	Subwatershed Area (Acres)	Acres HEL/PHEL	Percentage of Subwatershed
Belle Prairie-Indian Creek	071300020204	14,790	565	3.8%
Bradbury Landing Strip - North Fork Vermilion River	071300020102	32,125	1,204	3.7%
Fivemile Creek	071300020301	28,265	3,107	11%
Indian Creek	071300020203	18,891	903	4.8%
Indian Grove - South Fork Vermilion River	071300020206	27,862	1,030	3.7%
Kelly Creek	071300020104	25,321	467	1.8%
Piper City - North Fork Vermilion River	071300020101	22,627	2,482	11%
Pleasant Ridge - North Fork Vermilion River	071300020303	34,287	3,702	11%
Town of Cullom - North Fork Vermilion River	071300020105	23,736	119	0.5%
Town of Fairbury	071300020205	17,581	161	0.9%
Town of Forrest - South Fork Vermilion River	071300020202	25,815	2,505	9.7%
Town of Kempton - Kelly Creek	071300020103	19,053	2,621	14%
Turtle Pond - South Fork Vermilion River	071300020201	15,220	3,269	22%
Total		**305,573**	**22,135**	**Avg: 7.5%**

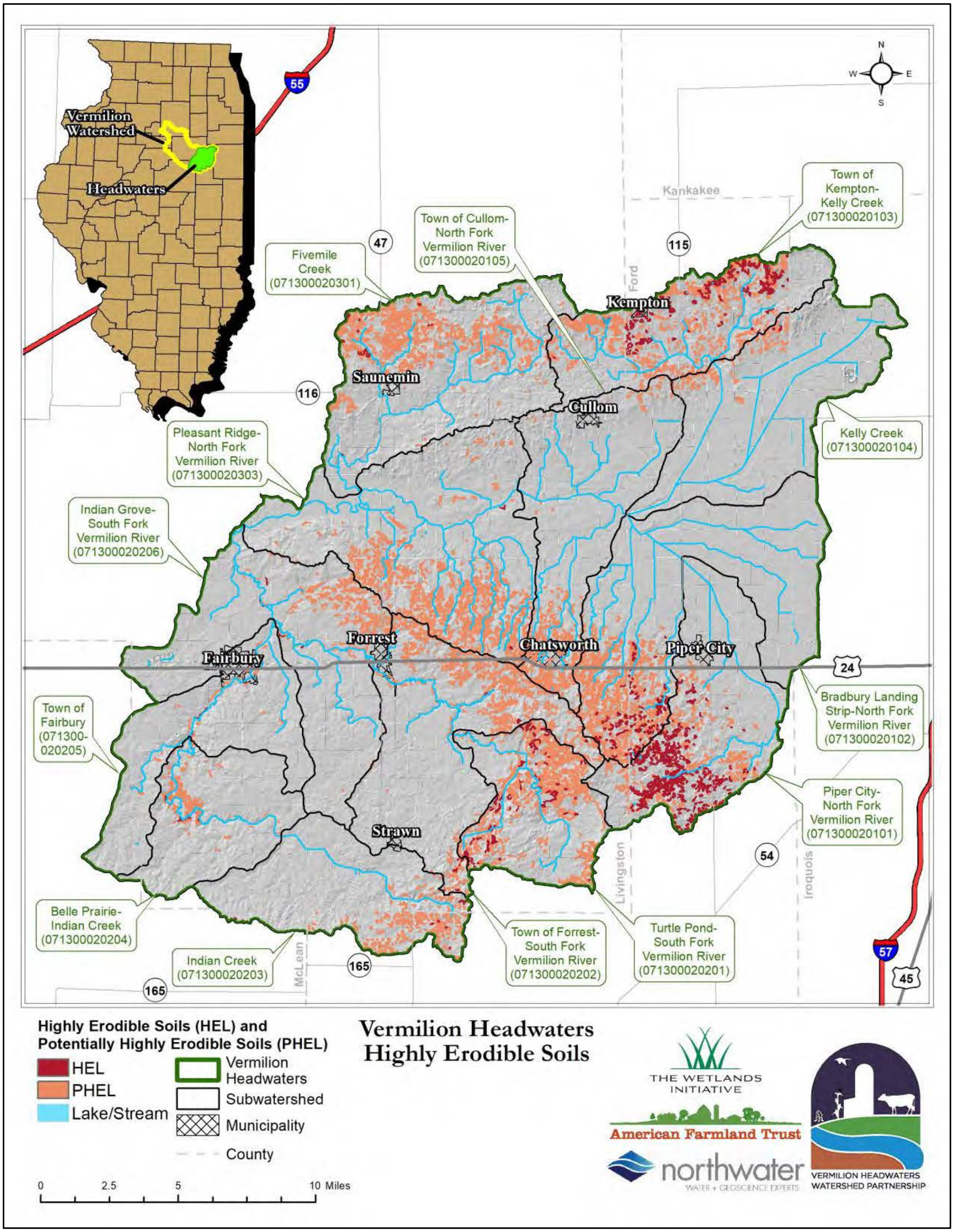

Figure 14 – Highly Erodible (HEL) and Potentially Highly Erodible (PHEL) soils.

3.8.2 Hydric Soils

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation (NRCS, 2018). Table 22 shows the total area of hydric soils and corresponding acres for each subwatershed. Figure 15 shows the hydric rating (%). As an indicator of the potential for wetland development, understanding where hydric soils are located can inform wetland restoration and creation activities.

There is a total of 161,932 ac of hydric soils, or 53% of the watershed. The Kelly Creek subwatershed contains the highest percentage (73%) followed by Bradbury Landing Strip – North Fork Vermilion River subwatershed with 66% and Belle Prairie-Indian Creek subwatershed with 65%; the Town of Cullom – North Fork Vermilion River contains the smallest percentage of hydric soils with only 34%.

Table 22 – Hydric Soils in the Vermilion Headwaters Watershed

Subwatershed	HUC 12 Code	Subwatershed Area (ac)	Hydric Soil (ac)	Percentage of Subwatershed Area
Belle Prairie-Indian Creek	071300020204	14,790	9,569	65%
Bradbury Landing Strip - North Fork Vermilion River	071300020102	32,125	21,242	66%
Fivemile Creek	071300020301	28,265	13,048	46%
Indian Creek	071300020203	18,891	11,024	58%
Indian Grove - South Fork Vermilion River	071300020206	27,862	14,131	51%
Kelly Creek	071300020104	25,321	18,425	73%
Piper City - North Fork Vermilion River	071300020101	22,627	12,000	53%
Pleasant Ridge - North Fork Vermilion River	071300020303	34,287	13,217	39%
Town of Cullom - North Fork Vermilion River	071300020105	23,736	7,955	34%
Town of Fairbury	071300020205	17,581	10,545	60%
Town of Forrest - South Fork Vermilion River	071300020202	25,815	15,332	59%
Town of Kempton - Kelly Creek	071300020103	19,053	7,940	42%
Turtle Pond - South Fork Vermilion River	071300020201	15,220	7,503	49%
Total		**305,573**	**161,932**	**Avg: 53%**

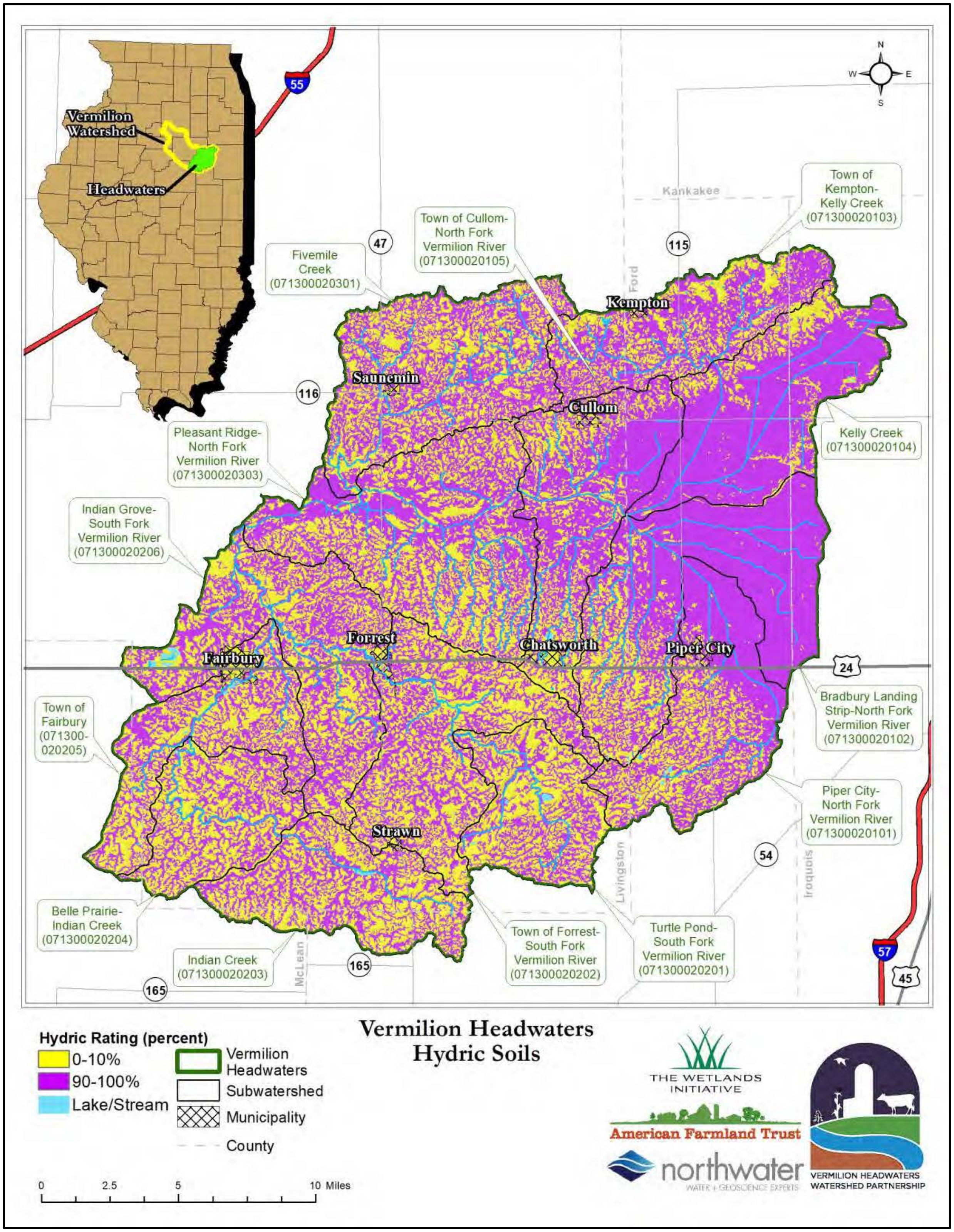

Figure 15 – Hydric Soils

3.8.3 Hydrologic Soil Groups

The NRCS has four hydrologic soil groups based on infiltration capacity and runoff potential. The groups are A, B, C, and D. Group A has the greatest infiltration capacity and least runoff potential, while D has the least infiltration and greatest runoff potential. A hydrologic group is determined by the water transmitting layer with the lowest saturated hydraulic conductivity and depth to an impermeable layer or to a water table (USDA, 2007). For those with two groups, certain wet soils are tabulated as D based solely on the presence of a water table within 24 inches of the surface, even though the saturated hydraulic conductivity may be favorable for water transmission. When adequately drained to a seasonal water table at least 24 inches below surface, dual hydrologic groups (A/D, B/D, C/D) are given, based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained (USDA, 2007). This analysis uses current USDA National Cooperative Soil Survey data.

Table 23 lists the total area of each group in by subwatershed and Figure 16 their locations. The dominant hydrologic soil is C/D, which accounts for 61%, indicating potentially high rates of runoff under both drained and undrained conditions, followed by group B/D, encompassing 21%. The Pleasant Ridge - North Fork Vermilion River and Fivemile Creek subwatersheds have the greatest acreage of C/D soils.

Table 23 – Hydrologic Soil Groups in the Vermilion Headwaters Watershed

Subwatershed	HUC 12 Code	Subwatershed Area (ac)	Hydrologic Groupings and Total Area (ac)							
			A	A/D	B	B/D	C	C/D	D	Unclassified
Belle Prairie-Indian Creek	071300020204	14,790	72	6	233	5,030	3,382	6,059	4	0
Bradbury Landing Strip - North Fork Vermilion River	071300020102	32,125	98	58	109	16,428	207	12,001	3,200	9
Fivemile Creek	071300020301	28,265	78	72	27	844	1,030	25,365	836	2
Indian Creek	071300020203	18,891	15	0	99	4,773	3,365	10,544	29	59
Indian Grove - South Fork Vermilion River	071300020206	27,862	174	80	965	2,588	2,646	20,892	157	351
Kelly Creek	071300020104	25,321	232	1,205	117	15,932	680	7,111	29	1
Piper City - North Fork Vermilion River	071300020101	22,627	0	25	165	7,354	163	13,405	1,477	26
Pleasant Ridge - North Fork Vermilion River	071300020303	34,287	0	0	444	583	861	31,792	392	202
Town of Cullom - North	071300020105	23,736	0	0	4	1,582	424	5,820	125	0

Subwatershed	HUC 12 Code	Subwatershed Area (ac)	Hydrologic Groupings and Total Area (ac)							
			A	A/D	B	B/D	C	C/D	D	Unclassified
Fork Vermilion River										
Town of Fairbury	071300020205	17,581	20	2	165	1,721	2,992	12,598	12	64
Town of Forrest - South Fork Vermilion River	071300020202	25,815	254	172	616	4,061	2,760	17,109	826	6
Town of Kempton - Kelly Creek	071300020103	19,053	5	2	12	348	419	15,304	2,947	7
Turtle Pond - South Fork Vermilion River	071300020201	15,220	197	124	377	1,643	2,844	8,224	1,781	23
Total		**305,573**	**1,145**	**1,746**	**3,333**	**62,887**	**21,773**	**186,224**	**11,815**	**750**
Total Percent			**0.4%**	**0.6%**	**1.1%**	**20.6%**	**7.1%**	**60.9%**	**3.9%**	**0.2%**

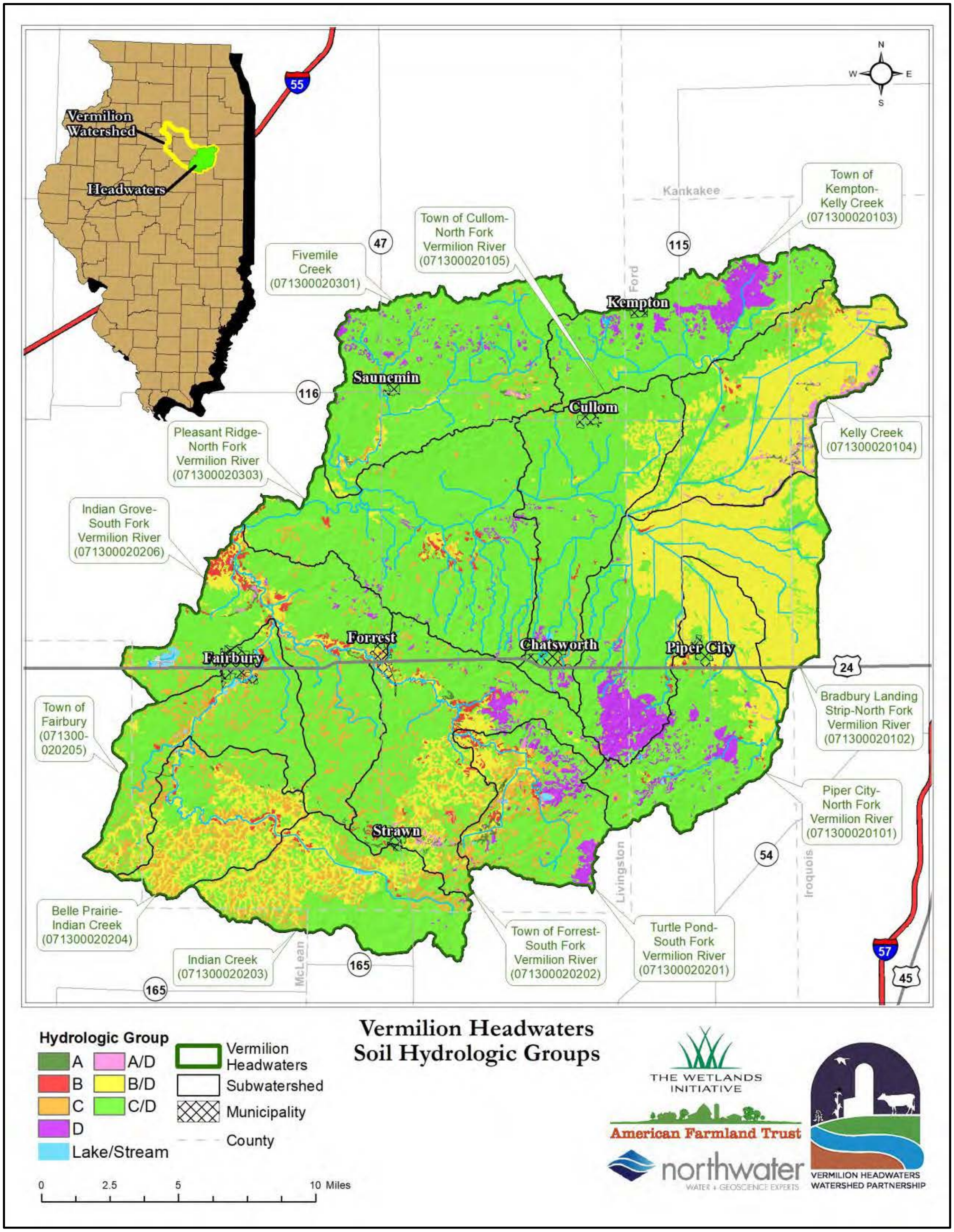

Figure 16 – Soil Hydrologic Groups

3.8.4 Septic System Suitability

Not all soil types support septic systems and improper construction can lead to failure and leaching of wastewater into groundwater and surrounding waterways. Soil data was analyzed by subwatershed for the ability to support septic systems.

Results show that 99.7%, or 304,731 ac (Table 24), of the VHW contain soils classified as "very limited" with respect to septic suitability. This does not indicate that soils are unsuitable for septic systems, but special considerations are required when establishing systems within most of the watershed. A total of 2,046 residences believed to have septic systems are located on soils classified as very limited. The Piper City-North Fork Vermilion River and Town of Cullom-North Fork Vermilion River have the greatest number of septic systems on limiting soils. Figure 17 illustrates the extent of limiting soils.

Table 24 – Soil Septic System Suitability, Total Area and Home Count

HUC12 Code	Subwatershed	Area (ac)	Total Homes on Septic	"Very Limited"		"Somewhat Limited"		"Not Rated"	
				Area (ac)	Homes on Septic	Area (ac)	Homes on Septic	Area (ac)	Homes on Septic
071300020204	Belle Prairie-Indian Creek	14,790	66	14,790	66	0	0	0	0
071300020102	Bradbury Landing Strip-North Fork Vermilion River	32,125	91	32,116	91	0	0	8.8	0
071300020301	Fivemile Creek	28,265	91	28,264	91	0	0	1.8	0
071300020203	Indian Creek	18,891	154	18,832	156	0	0	15	0
071300020206	Indian Grove-South Fork Vermilion River	27,862	172	27,511	157	0	0	351	15
071300020104	Kelly Creek	25,321	65	25,319	65	0	0	1.2	0
071300020101	Piper City-North Fork Vermilion River	22,627	430	22,601	434	0	0	26	0
071300020303	Pleasant Ridge-North Fork Vermilion River	34,287	127	34,085	127	0	0	202	0
071300020105	Town of Cullom-North Fork Vermilion River	23,736	366	23,647	366	0	0	89	0
071300020205	Town of Fairbury	17,581	111	17,513	111	4	0	64	0
071300020202	Town of Forrest-South Fork Vermilion River	25,815	129	25,809	129	0	0	6.0	0
071300020103	Town of Kempton-Kelly Creek	19,053	211	19,046	211	0	0	6.9	0

HUC12 Code	Subwatershed	Area (ac)	Total Homes on Septic	"Very Limited"		"Somewhat Limited"		"Not Rated"	
				Area (ac)	Homes on Septic	Area (ac)	Homes on Septic	Area (ac)	Homes on Septic
071300020201	Turtle Pond-South Fork Vermilion River	15,220	39	15,197	42	0	0	23	0
Total		**305,573**	**2,052**	**304,730**	**2,046**	**4**	**0**	**795**	**15**

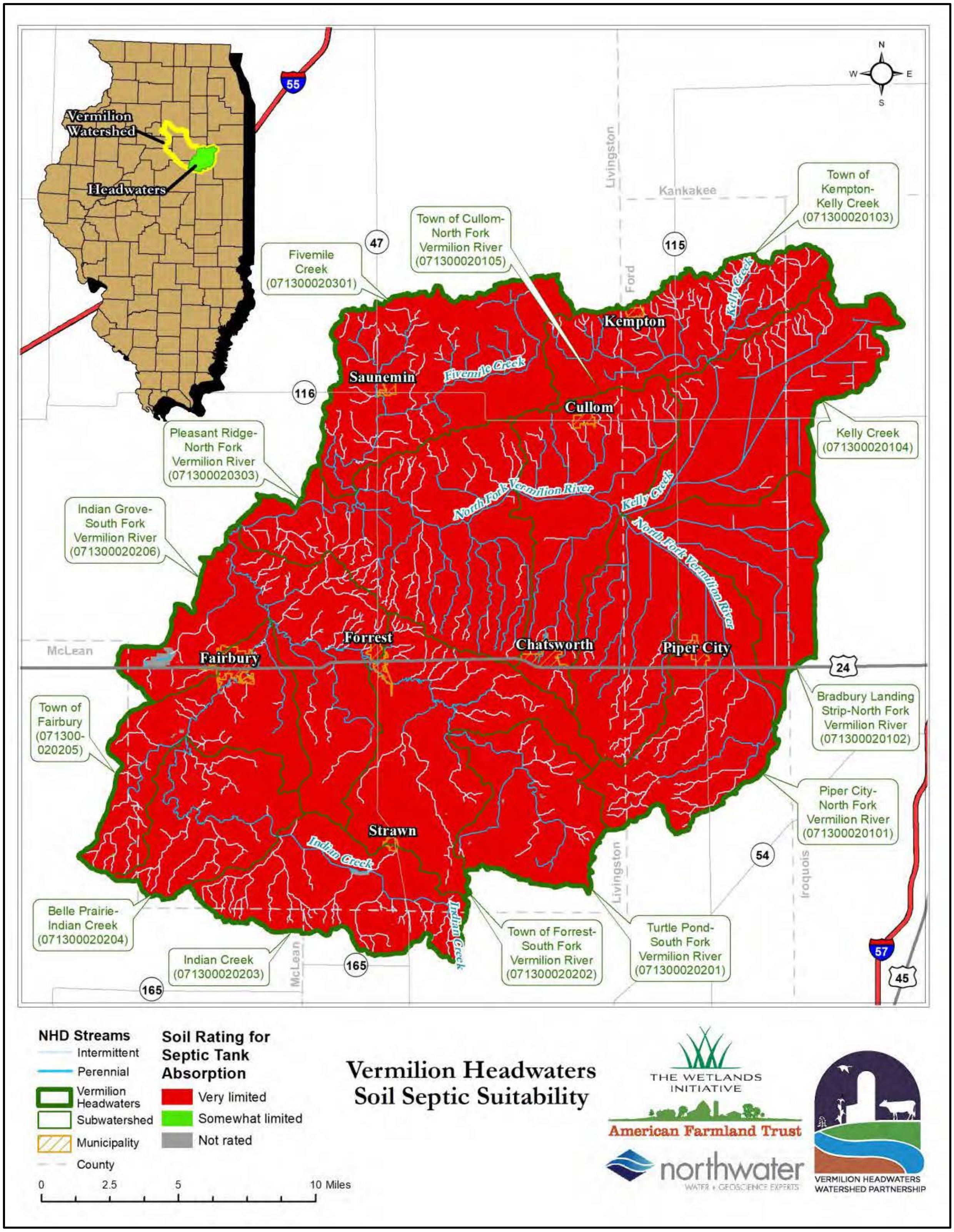

Figure 17 – Soil Septic Suitability

3.9 Tillage

As part of an annual spring tillage transect survey, the Livingston and Ford County SWCD, the AFT, and local partners collect data from approximately 458 fields along a specific route within Livingston, Ford, and Iroquois counties. The transect survey is conducted after crops are planted and determines tillage activities based on the amount of residue left on the soil surface. For the purposes of the survey, tillage is grouped into 4 categories: conventional, reduced-till, mulch-till, and no-till. No-till refers to the practice of refraining from tilling the soil from the time of harvest for the previous crop to the harvest of the current crop (USDA, 2018). Mulch-till is a type of tillage where the soil is tilled less frequently, so soil disturbance is lower than conventional tillage, leaving at least 30% residue on the surface from one harvest to the next (USDA, 2018). Reduced-till is the management of crop and other plant residue on the soil surface that retains between 15% and 30% residue (NRCS, 2013). Conventional tillage applies to various management practices that retain less than 15% residue on the soil surface.

Between 2016 and 2021, these surveys demonstrated a decrease in conventional tillage and an increase in adoption of no-till or mulch-till for both corn and soybean crops. Farmers in the watershed have used conventional tillage at higher rates compared to farms throughout Illinois (53-79% conventional tillage for corn ac in the watershed compared to 44-49% conventional tillage for corn ac throughout the state). These trends can be seen for corn in Figure 18 and for soybeans in Figure 19.

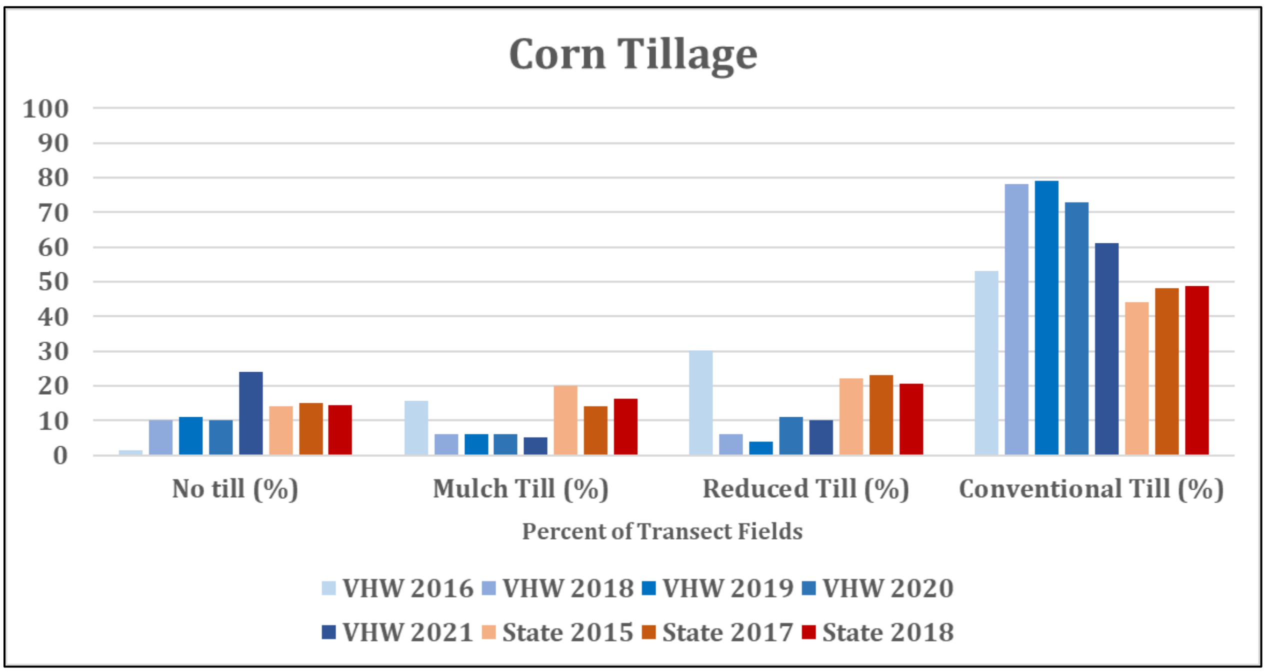

Figure 18 - Tillage Trends for Corn in Vermilion Headwaters Watershed and State of Illinois (shown as percent of transect fields)

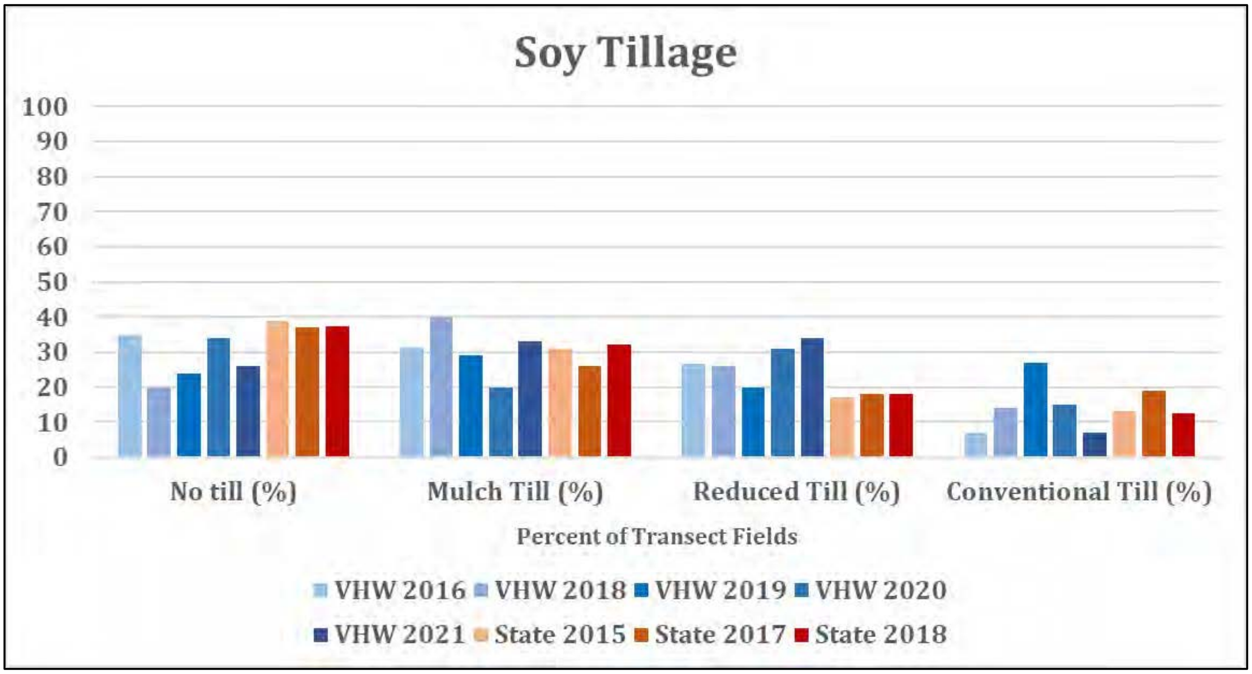

Figure 19 - Tillage Trends for Soybeans in Vermilion Headwaters Watershed and State of Illinois (shown as percent of transect fields)

In 2021, approximately 61% of corn and 6.5% of soybean fields included in the survey used conventional tillage methods, which leaves little or no residue on the surface. An additional 11% of corn fields and 34% of soybean fields used reduced till. The remaining 29% of corn and 59% of soybean fields are mulch-till or no-till. These two conservation tillage systems can significantly reduce soil loss.

To better characterize current conditions, the tables below show the results of the 2021 spring transect survey by county. In all three counties, over half of the corn fields surveyed used conventional tillage in 2021. Livingston County had the highest rate utilizing no-till or mulch-till, with a total of 40%, compared to Ford and Iroquois counties, with 11% and 0% respectively. The survey results for corn fields from each county are shown in Table 25.

Table 25 - Tillage Types for Corn in 2021 Survey

County	Total Fields	No-Till		Mulch-Till		Reduced-Till		Conventional	
		Fields	%	Fields	%	Fields	%	Fields	%
Livingston	127	47	37%	4	3.1%	8	6.3%	68	54%
Iroquois	2	0	0%	0	0%	0	0%	2	100%
Ford	80	3	3.8%	6	7.5%	14	18%	57	71%
Average	**209**	**50**	**20%**	**10**	**5.3%**	**22**	**12.2%**	**127**	**75%**

Compared to corn crops, soybeans in the watershed have a higher rate of no-till and mulch-till practices across all three counties, according to the 2021 survey. All transects in Iroquois County, and over half in

Livingston and Ford, used either no-till or mulch-till. The survey results for soybean fields from each county are shown in Table 26.

Table 26 - Tillage Types for Soybeans in 2021 Survey

County	Total Fields	No-Till		Mulch-Till		Reduced- Till		Conventional	
		Fields	%	Fields	%	Fields	%	Fields	%
Livingston	124	21	16.9%	56	45.2%	40	32.3%	7	5.6%
Iroquois	5	4	80%	1	20%	0	0%	0	0%
Ford	73	29	39.7%	9	12.3%	29	39.7%	6	8.2%
Average	**202**	**54**	**45.5%**	**66**	**25.8%**	**69**	**36%**	**13**	**6.9%**

3.10 Existing Conservation Practices

The existing conservation management practices within the VHW are extensive and include cover crops, no-till, and nutrient management, with structural and edge-of-field practices like grass riparian buffers, grass waterways, ponds and lakes, terraces, water and sediment control basins (WASCOBs), and constructed wetlands. With relatively large reductions still required to meet nutrient and sediment reduction goals stated in this plan, substantial opportunities exist to install new practices. This is especially true where nitrogen and sediment loading is the greatest due to tile drainage or slope, or where pollutants may bypass existing conservation practices, such as tile water bypassing a filter strip. While each practice varies in its ability to effectively remove pollutants, all these practices are proven to provide benefits to water quality and can be integrated into existing crop systems.

Table 27 below shows the total number or length/area of each structural practice in the VHW; Figure 20 and Figure 21 shows their location. The greatest number of WASCOBs are in the Bradbury Landing Strip subwatershed, whereas the highest number of terraces are in the Town of Kempton-Kelly Creek subwatershed. Pleasant Ridge had the highest ac of farmland with buffers (grass, mixed, or forested), though not all buffers were the appropriate width.

Table 27 - Existing Structural Conservation Practices on Agricultural Land

Subwatersheds	HUC12 Code	Conservation Practices	Count / Area
Belle Prairie-Indian Creek	071300020204	Buffer (Grass)	35 ac
		Buffer (Mixed & Forested)	82 ac
		Grassed Waterway	44.5
		Pond/Lake	2.2 ac
		Terrace	10
		WASCOB	0
Bradbury Landing Strip - North Fork Vermilion River	071300020102	Buffer (Grass)	389 ac
		Buffer (Mixed & Forested)	0 ac
		Grassed Waterway	120

Subwatersheds	HUC12 Code	Conservation Practices	Count / Area
		Pond/Lake	13.9 ac
		Terrace	17
		WASCOB	58
Fivemile Creek	071300020301	Buffer (Grass)	220 ac
		Buffer (Mixed & Forested)	3.3 ac
		Constructed Wetland	1.1 ac
		Grassed Waterway	244 ac
		Pond/Lake	5.9 ac
		Terrace	46
		WASCOB	7
Indian Creek	071300020203	Buffer (Grass)	90 ac
		Buffer (Mixed & Forested)	0 ac
		Grassed Waterway	148 ac
		Pond/Lake	35.9 ac
		Terrace	17
		WASCOB	3
Indian Grove - South Fork Vermilion River	071300020206	Buffer (Grass)	96 ac
		Buffer (Mixed & Forested)	68 ac
		Grassed Waterway	105 ac
		Pond/Lake	99.4 ac
		Terrace	0
		WASCOB	0
Kelly Creek	071300020104	Buffer (Grass)	350 ac
		Buffer (Mixed & Forested)	0 ac
		Grassed Waterway	61 ac
		Pond	1.6 ac
		Terrace	4
		WASCOB	2
Piper City - North Fork Vermilion River	071300020101	Buffer (Grass)	260 ac
		Buffer (Mixed & Forested)	2.6 ac
		Grassed Waterway	126 ac
		Pond/Lake	26.7 ac
		Terrace	25
		WASCOB	15
Pleasant Ridge - North Fork Vermilion River	071300020303	Buffer (Grass)	460 ac
		Buffer (Mixed & Forested)	15 ac
		Grassed Waterway	323 ac
		Pond/Lake	3.8 ac
		Terrace	0
		WASCOB	13
Town of Cullom - North Fork Vermilion River	071300020105	Buffer (Grass)	270 ac
		Buffer (Mixed & Forested)	1.5 ac
		Grassed Waterway	120 ac
		Pond/Lake	36.4 ac
		Terrace	5

Subwatersheds	HUC12 Code	Conservation Practices	Count / Area
		WASCOB	5
Town of Fairbury	071300020205	Buffer (Grass)	60 ac
		Buffer (Mixed & Forested)	14 ac
		Grassed Waterway	54 ac
		Pond/Lake	23 ac
		Terrace	0
		WASCOB	0
Town of Forrest - South Fork Vermilion River	071300020202	Buffer (Grass)	110 ac
		Buffer (Mixed & Forested)	47 ac
		Grassed Waterway	200 ac
		Pond/Lake	6.5 ac
		Terrace	17
		WASCOB	4
Town of Kempton - Kelly Creek	071300020103	Buffer (Grass)	180 ac
		Buffer (Mixed & Forested)	0 ac
		Grassed Waterway	193 ac
		Pond/Lake	7.8 ac
		Terrace	102
		WASCOB	13
Turtle Pond - South Fork Vermilion River	071300020201	Buffer (Grass)	79 ac
		Buffer (Mixed & Forested)	34 ac
		Grassed Waterway	168 ac
		Pond/Lake	63.7 ac
		Terrace	30
		WASCOB	20

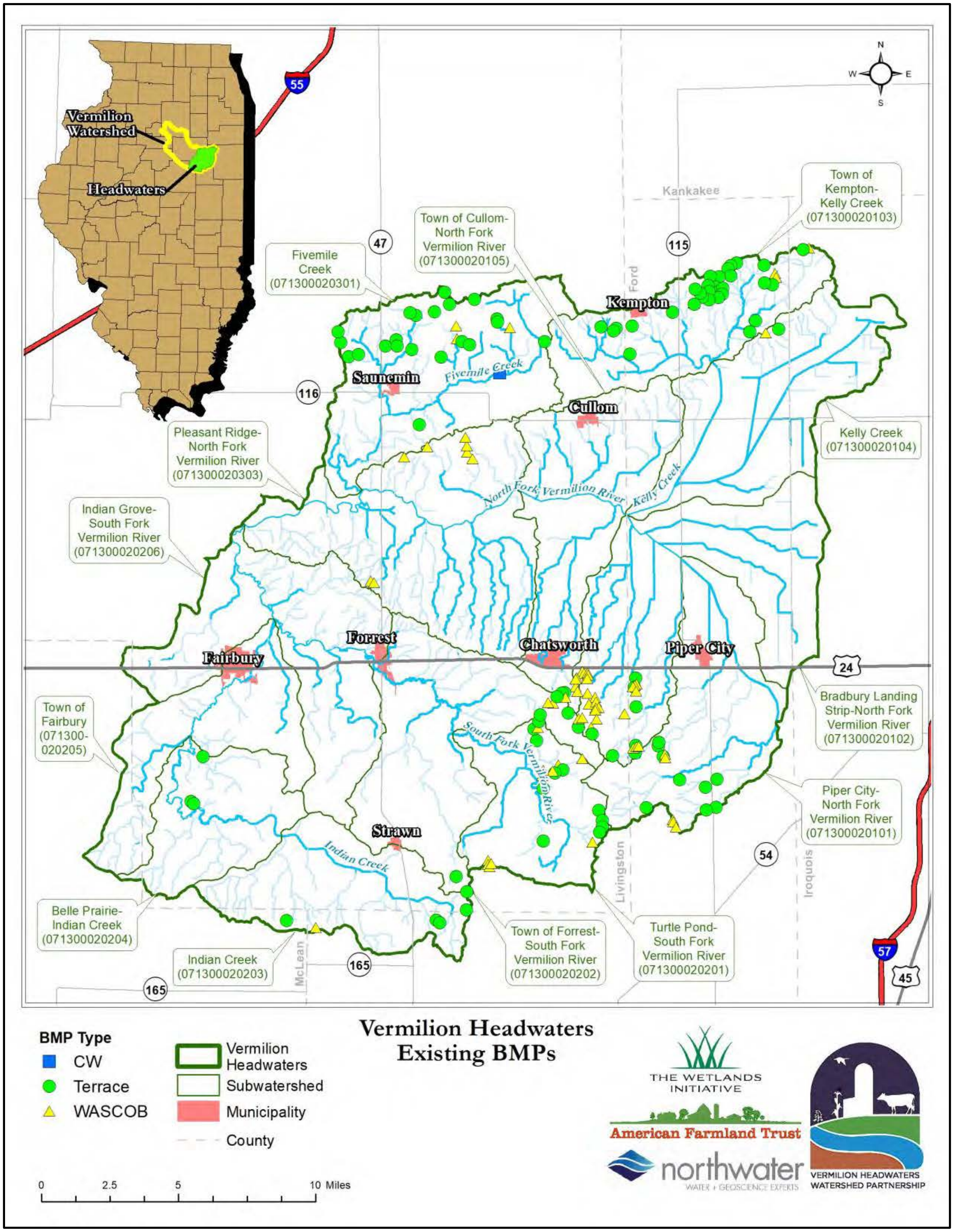

Figure 20 – Existing Structural BMPs (WASCOB, Terrace, and Constructed Wetlands)

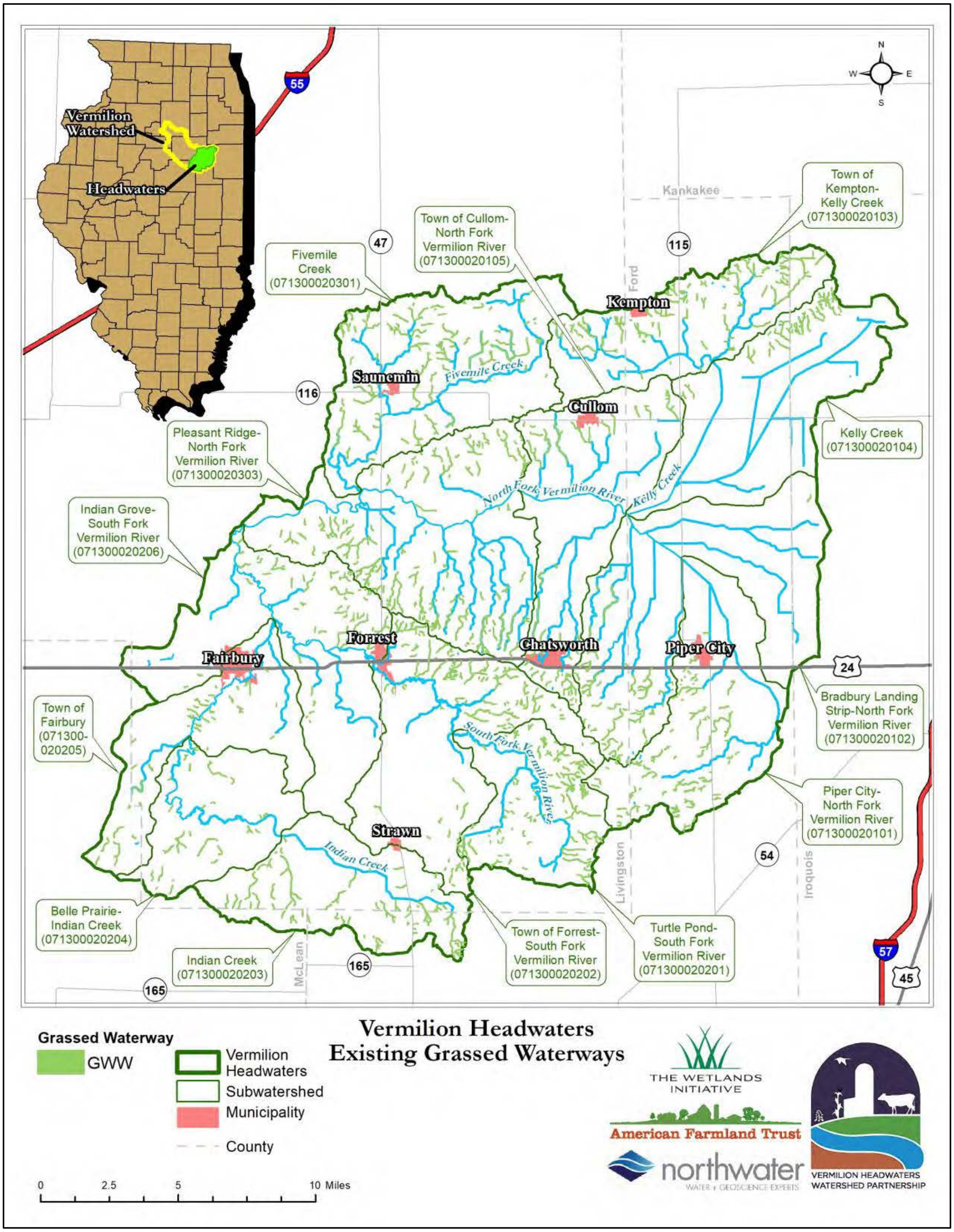

Figure 21 – Existing Grassed Waterways

Structural practices are typically small and there is no direct, universal correlation between the structure size and number of ac treated. These practices are most effective when integrated with whole field management practices like cover crops and reduced tillage. The tables below show the total acreage of crop land in Ford and Livingston counties enrolled in cover crop, no-till, and nutrient management programs through USDA -NRCS, including the Mississippi River Basin Healthy Watersheds Initiative (MRBI), Conservation Stewardship Programs (CSP), Regional Conservation Partnership Programs – Conservation Stewardship Program (RCPP-CSP), and Environmental Quality Incentives Programs (EQIP).

Table 28 shows the total acreage enrolled and financial resources obligated for cover crops, no-till, and nutrient management between 2019 and 2021. Beyond 2021, the table reports planned acreage and financial investment, which is reliably expected to increase as enrollment continues each year. Over the eight-year period between 2019 and 2026, there will be approximately 39,000 ac enrolled in cover crop programs through NRCS with a financial investment of nearly $925,000. Over 37,000 ac and $420,000 will be allocated to no-till practices, and nutrient management will be applied to over 29,000 ac with an investment of approximately $431,000.

Table 28 - Acreage and Financial Investments for Conservation Practices in the VHW

	Conservation Practices					
	Cover Crops		No-Till		Nutrient Management	
Year	Acres	Financial Investment	Acres	Financial Investment	Acres	Financial Investment
2019	4,357.8	$154,227.87	1,630	$5,728.87	1,284	$14,649.89
2020	7,102.3	$160,518.80	3,124	$24,926.28	2,529	$34,474.38
2021	10,254.5	$200,872.46	8,769	$89,517.36	8,052	$122,985.65
2022 (Planned)	5,674.3	$137,321	7,893	$104,038	5,124	$81,510
2023 (Planned)	5,023.8	$104,710	6,776	$87,519	6,569	$78,286
2024 (Planned)	4,007.1	$79,556	5,267	$67,066	4,192	$71,987
2025 (Planned)	2,083.5	$66,427	3,304	$34,876	1,136	$20,241
2026 (Planned)	427.0	$20,659	389	$6,961	260	$7,015
Total:	**38,930.3**	**$924,292.13**	**37,152**	**$420,632.51**	**29,146**	**$431,148.92**

Figure 22 shows the acreage and financial investment for cover crops in Ford and Livingston counties by various NRCS programs between 2019 and 2021. In 2021, the largest cover crop enrollment, with over

4,200 ac, was supported by CSP. For the remaining cover crop acreage, approximately 1,430 ac were enrolled in MRBI, 2,955 ac were enrolled in RCPP – CSP, and 1,603 ac were enrolled in EQIP, totaling over 10,200 ac in the two counties during 2021.

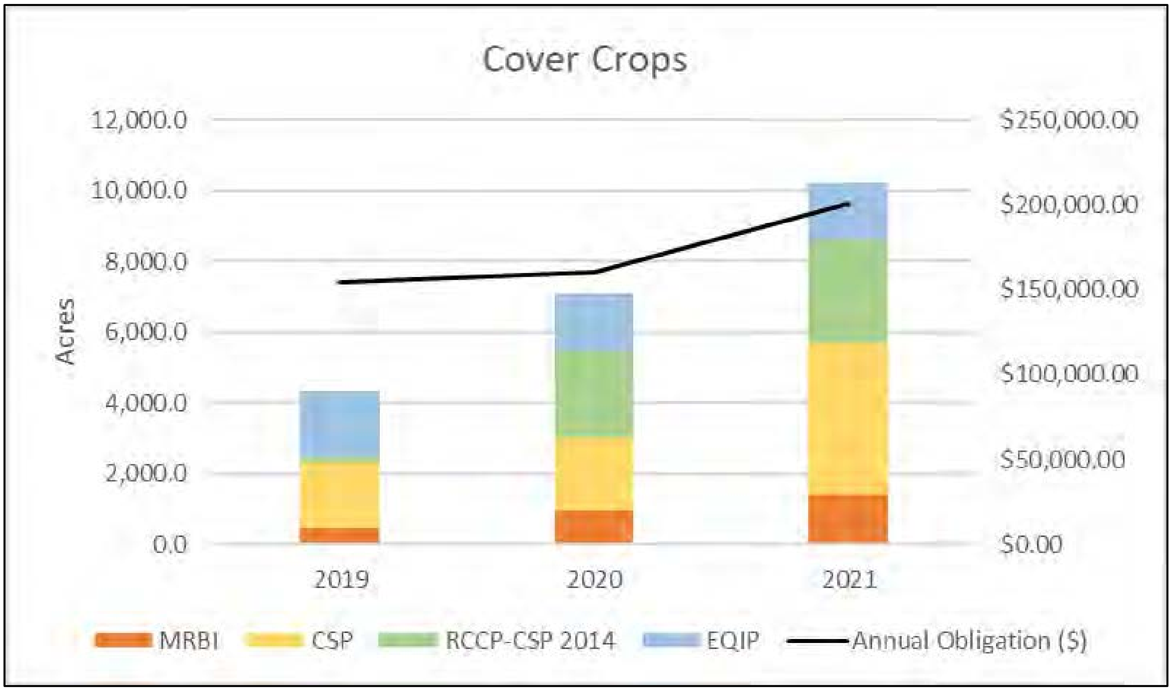

Figure 22 - Acreage and Financial Investment for Cover Crops by Various Programs

Figure 23 shows the acreage and financial investment for no-till practices in Ford and Livingston counties by various NRCS programs between 2019 and 2021. In 2021, the largest enrollment in no-till practices, with over 3,760 ac, was supported by CSP. For the remaining programs, nearly 2,000 ac of no-till were enrolled in MRBI, over 500 ac in RCPP – CSP, and approximately 2,500 ac enrolled in EQIP, totaling over 8,700 ac in the two counties during 2021.

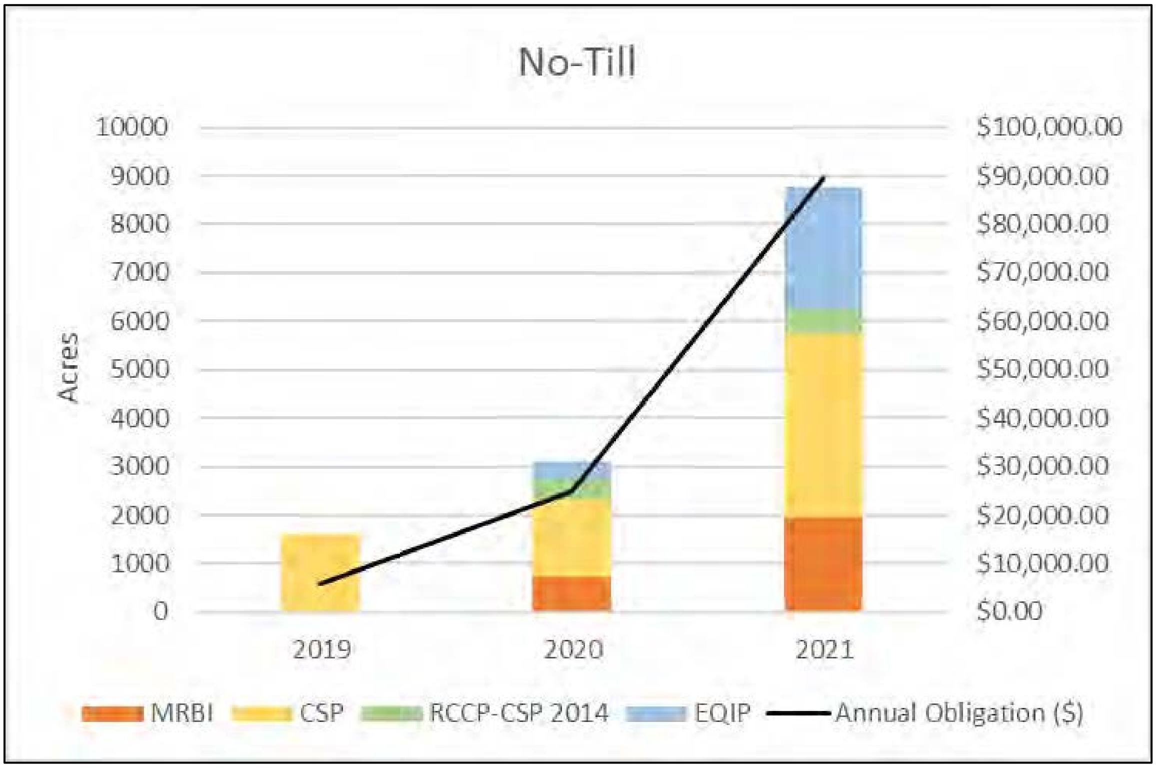

Figure 23 - Acreage and Financial Investment for No-Till by Various Programs

3.11 Hydrology and Drainage System

The only active, continuous water monitoring location in the VHW is USGS gage 05554300 on Indian Creek near Fairbury. This station was installed in 2011 and has a drainage area of 67.5 square miles. At this station, average annual gauge height is 8.8 ft and annual discharge is 57.2 ft^3/sec (USGS, 2019). Due to the relatively small number of stream gauges in the watershed, USGS StreamStats was used to retrieve peak flow data for each subwatershed (Table 29).

Table 29 - Peak Flow Data for Vermilion Headwaters Watershed

Subwatershed	12-digit HUC	Peak Flow Data (ft^3/s) by Recurrence Level Interval (yrs)				Drainage Area (mi^2)	Stream Slope (ft/mi)
		2 yrs	5 yrs	10 yrs	500 yrs		
Belle Prairie-Indian Creek	071300020204	723	1,290	1,710	4,180	23.3	5.1
Bradbury Landing Strip - North Fork Vermilion River	071300020102	1,220	2,180	2,890	7,080	49.2	5.6
Fivemile Creek	071300020301	1,260	2,230	2,950	7,090	42.7	4.6
Indian Creek	071300020203	1,120	2,040	2,740	6,930	29.5	8.9
Indian Grove - South Fork Vermilion River	071300020206	1,050	1,860	2,450	5,850	44.8	4

Subwatershed	12-digit HUC	Peak Flow Data (ft^3/s) by Recurrence Level Interval (yrs)				Drainage Area (mi^2)	Stream Slope (ft/mi)
		2 yrs	5 yrs	10 yrs	500 yrs		
Kelly Creek	071300020104	696	1,220	1,600	3,770	39.6	3.1
Piper City - North Fork Vermilion River	071300020101	1,210	2,190	2,930	7,320	35.9	7.7
Pleasant Ridge - North Fork Vermilion River	071300020303	1,180	2,050	2,670	6,120	54	2.4
Town of Cullom - North Fork Vermilion River	071300020105	1,070	1,900	2,500	6,030	37	4.6
Town of Fairbury	071300020205	777	1,380	1,820	4,390	27.7	4.4
Town of Forrest - South Fork Vermilion River	071300020202	1,170	2,080	2,760	6,740	40.4	5.6
Town of Kempton - Kelly Creek	071300020103	940	1,650	2,180	5,180	32.2	3.7
Turtle Pond - South Fork Vermilion River	071300020201	841	1,520	2,020	5,000	23.6	6.5

Because of limitations with the accuracy of the National Hydrography Dataset (NHD), the ACPF stream network was used to better represent the actual wetted extent of perennial streams in the watershed. ACPF tools generate a stream network from Digital Elevation Models or DEMs, which were manually inspected and corrected against satellite imagery and stream survey data. Table 30 shows perennial open water stream length for the major tributaries of the Vermilion River. Results show a total of 391 miles of streams; the major tributaries in the headwaters include: Fivemile Creek is 16.5 miles, Indian Creek is 29.5 miles, Kelly Creek is 11.9 miles, the North Fork is 36.3 miles, while the South Fork is 29.6 miles in length. All other named and unnamed tributaries total 266.8 miles. Ponds and lakes total 541.4 ac, or 0.18% of the watershed (Table 30).

Table 30 – Open Water Perennial Streams and Tributaries

Major Tributary Name	Stream Length (ft)	Stream Length (mi)
Fivemile Creek	86,917	16.5
Indian Creek	156,022	29.5
Kelly Creek	62,725	11.9
North Fork Vermilion River	191,509	36.3
South Fork Vermilion River	156,081	29.6
Minor Tributaries	1,408,624	266.8
Total	**2,061,878**	**391**

Table 31 – Surface Water Inventory by Subwatershed

Subwatershed	HUC12 Code	Perennial Streams (mi)	NHD Waters* (mi)	Ponds and Lakes (ac)
Belle Prairie-Indian Creek	071300020204	15.7	27	6.1
Bradbury Landing Strip - North Fork Vermilion River	071300020102	53.4	19.6	12
Fivemile Creek	071300020301	28.9	34.8	20.9
Indian Creek	071300020203	12.9	44.1	33.7
Indian Grove - South Fork Vermilion River	071300020206	24.1	44.5	143.5
Kelly Creek	071300020104	46.3	27.4	7.1
Piper City - North Fork Vermilion River	071300020101	31.2	34.5	51.9
Pleasant Ridge - North Fork Vermilion River	071300020303	49.7	65.8	35.9
Town of Cullom - North Fork Vermilion River	071300020105	33.5	24.3	41.7
Town of Fairbury	071300020205	17.0	27.2	48.8
Town of Forrest - South Fork Vermilion River	071300020202	30.5	38.3	6.0
Town of Kempton - Kelly Creek	071300020103	25.4	47.1	39.8
Turtle Pond - South Fork Vermilion River	071300020201	21.9	14.1	94.1
	TOTAL	**390.5**	**448.7**	**541.5**

** = all other NHD water sources outside open water perennial streams, i.e. intermittent or ephemeral tributaries, forested gullies and subsurface drainageways*

3.11.1 Tile Drainage

The area of tile drainage in the VHW was estimated using the ACPF. The Tile Drainage Classification tool estimates which agricultural fields (crop and pasture) are likely to be tiled based on field slope and soils information. The two base conditions were that more than 90% of the field had a slope less than 5% and that more than 40% of the field consists of a D class soil or a dual drainage hydrologic group (i.e., A/D, B/D, or C/D). Each individual subwatershed output was manually reviewed with satellite imagery and the conditions were adjusted to best reflect the observed presence of tiling.

According to the ACPF tool, there are an estimated 253,773 ac of cultivated cropland in the watershed that are likely tile drained, or approximately 90% of the cultivated cropland ac (281,792 ac as reported in land use section of this plan), and 83% of the VHW (Figure 24). The Pleasant River – North Fork Vermilion River subwatershed has the largest area of cropland that is likely tiled – 29,950 ac or 87% of the total subwatershed area. The highest percentage within a subwatershed is in Fivemile Creek where 92%, or 226,004 ac, is likely tiled. Table 32 shows the estimated tile-drained area of cropland in the VHW by subwatershed.

Table 32 - Tile Drainage Area and Percent by Subwatershed based on ACPF Classification

Subwatershed	12-digit HUC	Subwatershed Area (ac)	Tiled Cropland Area (ac)	Percentage of Subwatershed Area
Belle Prairie - Indian Creek	071300020204	14,790	12,696	86%
Bradbury Landing Strip - North Fork Vermilion River	071300020102	32,125	27,175	85%
Fivemile Creek	071300020301	28,265	26,004	92%
Indian Creek	071300020203	18,891	15,267	81%
Indian Grove - South Fork Vermilion River	071300020206	27,862	24,805	89%
Kelly Creek	071300020104	25,321	24,153	95%
Piper City - North Fork Vermilion River	071300020101	22,627	16,425	73%
Pleasant Ridge - North Fork Vermilion River	071300020303	34,287	29,950	87%
Town of Cullom - North Fork Vermilion River	071300020105	23,736	21,910	92%
Town of Fairbury	071300020205	17,581	14,522	83%
Town of Forrest - South Fork Vermilion River	071300020202	25,815	22,585	88%
Town of Kempton - Kelly Creek	071300020103	19,053	12,449	65%
Turtle Pond - South Fork Vermilion River	071300020201	15,220	5,832	38%
	Total	**305,573**	**253,773**	**Avg: 81%**

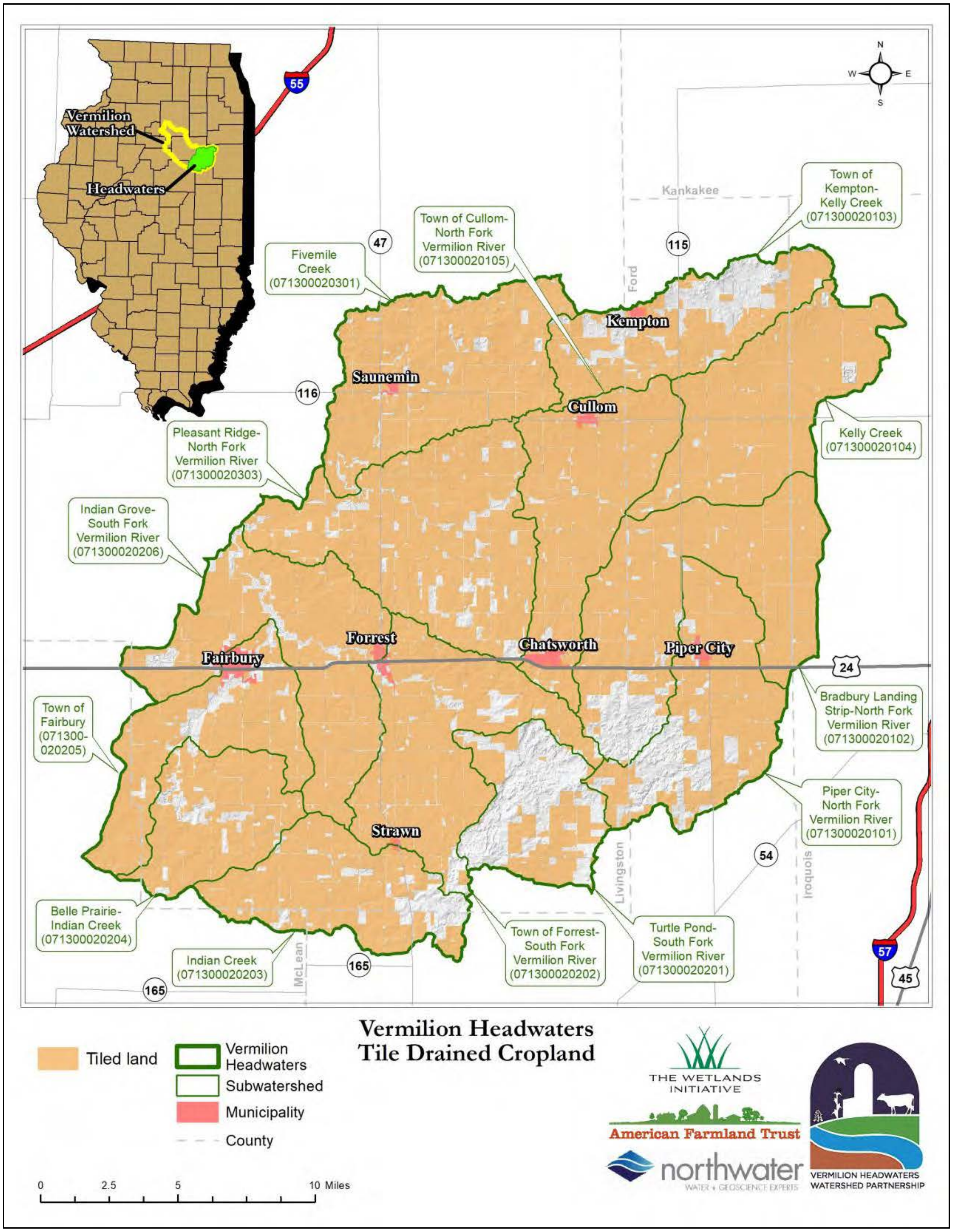

Figure 24 – Distribution of Tile Drained Cropland based on ACPF

3.11.2 Stream Channelization

Stream channelization is the engineering of a river or stream by modifying channel cross section profiles into smooth and uniform trapezoidal or rectangular forms, and can include activities such as straightening, widening, or deepening the channel, clearing riparian and aquatic vegetation, and bank reinforcement. Typically, this causes increased volume and/or velocity of the water which disrupts stream equilibrium, causing conditions such as channel downcutting and bank erosion (known as the Channel Evolution Model; Simon 1989). Aerial imagery from 2020 was evaluated to determine the extent of stream channelization (Table 33 and Figure 25). Results indicate that channelization is very high throughout the headwaters. Out of a total of 390.5 stream miles, 74.8% (292.2 miles) are channelized. Indian Creek and Town of Cullom-North Fork Vermilion River subwatersheds are 100% channelized. Only Belle-Prairie-Indian Creek (11.4%) and Indian Grove – South Fork Vermilion River (39.1%) subwatersheds have less than 50% channelization.

Table 33 – Length of Channelized Streams

Subwatershed	HUC12 Code	Total Length (ft)	Total Length (mi)	Channelized (ft)	Channelized (mi)	% Stream Length Channelized
Belle Prairie-Indian Creek	071300020204	82,713	15.7	9,439	1.8	11.4
Bradbury Landing Strip - North Fork Vermilion River	071300020102	282,177	53.4	231,094	43.8	82
Fivemile Creek	071300020301	152,633	28.9	96,287	18.2	63.1
Indian Creek	071300020203	68,249	12.9	68,249	12.9	100
Indian Grove - South Fork Vermilion River	071300020206	127,418	24.1	49,837	9.4	39.1
Kelly Creek	071300020104	244,411	46.3	243,470	46.1	99.6
Piper City - North Fork Vermilion River	071300020101	164,501	31.2	153,653	29.1	93.2
Pleasant Ridge - North Fork Vermilion River	071300020303	262,471	49.7	214,427	40.6	81.7
Town of Cullom - North Fork Vermilion River	071300020105	176,750	33.5	176,750	33.5	100
Town of Fairbury	071300020205	89,856	17.0	47,362	9	52.7
Town of Forrest - South Fork Vermilion River	071300020202	161,169	30.5	85,302	16.2	52.9
Town of Kempton - Kelly Creek	071300020103	133,872	25.4	89,775	17	67.1
Turtle Pond - South Fork Vermilion River	071300020201	115,657	21.9	77,012	14.6	66.6
	Total	**2,061,879**	**390.5**	**1,542,657**	**292.2**	**74.8**

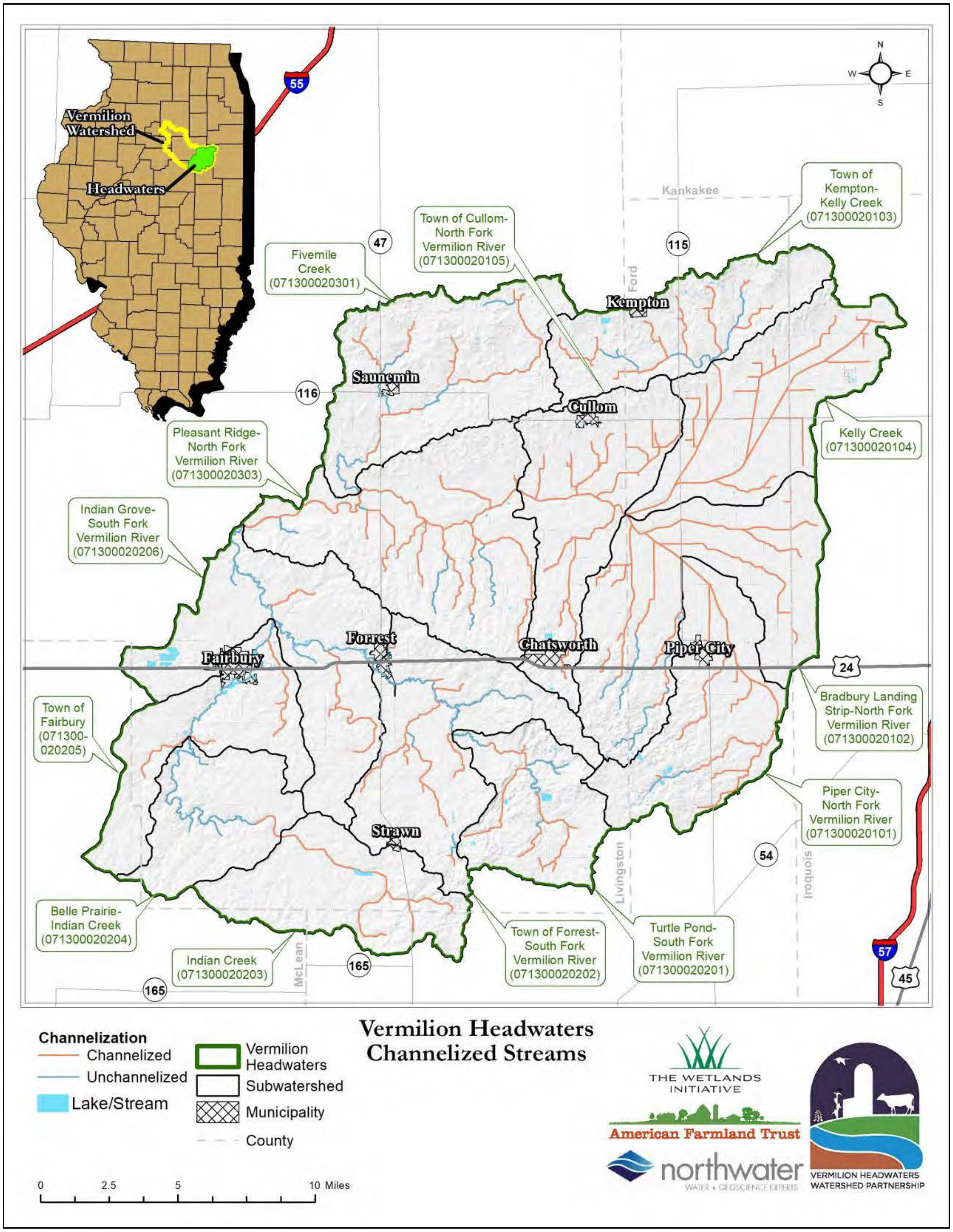

Figure 25 - Extent of Channelization

3.11.3 Riparian Areas and Buffers

The ACPF, creates 15-m wide riparian attribute polygons (RAPs) for each catchment. These polygons are used as geographical units to visualize stream side conditions. An analysis of recent aerial imagery (2017 or 2020) was used to determine the presence (existing or non-existing), type (grassed, wooded, mix of both), land use (e.g., forested, grass, residential, etc.), and relative extent or width of stream buffers for each individual RAP, which has a unique riparian identifier for the left and right bank.

The riparian land use varies, but row crop agriculture accounts for 75% of all riparian stream miles (Table 34). Forest makes up 6.1% with grassland areas at 5.3% and roads at 4.6%. The remaining land use categories combined make up roughly another 6% of the riparian land use.

Table 34 - Riparian land use in the entire VRH

Land Use	Stream Length (mi)	% Stream Length with Buffers
Cemetery	0.14	0.02
Commercial	0.94	0.12
Farmstead/Farm Building	5.14	0.66
Forest	47.37	6.12
Grassland	40.89	5.28
Industrial	0.48	0.06
Parks & Recreational	1.21	0.16
Open Water Pond/Reservoir	0.47	0.06
Pasture*	9.32	1.20
Railroad	0.29	0.04
Roads	35.79	4.62
Row Crops	604.63	78.13
Rural residential	24.48	3.16
Urban residential	2.10	0.27
Utility	0.68	0.09
Total	**771**	**100**

*Grassland was labeled pasture if fencing was visible on aerial imagery.

Substantial riparian buffer areas exist adjacent to streams in the watershed (Figure 26). Streams are well buffered as approximately 63% of all stream miles have a buffer (Table 35). Belle Prairie-Indian Creek has the highest percentage (93%), while Kelly Creek has the lowest, or 42%.

Table 35 - Stream Buffer Existence

Subwatershed	12-digit HUC	Total (ft)	Total (mi)	Existing (mi)	Existing (%)	Non-Existing (mi)	Non-Existing (%)
Belle Prairie-Indian Creek	071300020204	167,904	31.8	29.4	93	2.4	7
Bradbury Landing Strip - North Fork Vermilion River	071300020102	548,818	104	55	53	49	47
Fivemile Creek	071300020301	315,083	59.6	38	64	21.6	36
Indian Creek	071300020203	136,360	25.8	17.3	67	8.5	34
Indian Grove - South Fork Vermilion River	071300020206	249,825	47.3	38.8	82	8.5	18
Kelly Creek	071300020104	464,681	88	37.3	42	50.7	58
Piper City - North Fork Vermilion River	071300020101	328,980	62.3	41.2	66	21.1	34
Pleasant Ridge - North Fork Vermilion River	071300020303	531,637	100.7	68.1	68	32.6	32
Town of Cullom - North Fork Vermilion River	071300020105	350,313	66.3	39	59	27.3	41
Town of Fairbury	071300020205	100,257	33.6	23.6	70	10	30
Town of Forrest - South Fork Vermilion River	071300020202	321,672	60.9	46.2	76	14.7	24
Town of Kempton - Kelly Creek	071300020103	269,493	51	31.2	61	19.9	39
Turtle Pond - South Fork Vermilion River	071300020201	226,162	42.8	26.4	62	16.4	38
	Total	**4,011,185**	**774**	**492**	**63**	**283**	**38**

Despite extent, not all existing buffers are considered adequate. A buffer quality ranking system was developed and applied to individual stream reaches to determine adequate or inadequate. The ACPF suggests two different buffer widths. One is based on the NRCS technical guidance on sizing filter strips using a 2% buffer area to the total contributing area ratio (Dosskey et al., 2011). The second suggested buffer width is based on relative runoff delivery, width of riparian zone, and the height above the channel.

An adequate buffer was one that the measured width was greater than or equal to either the suggested NRCS or ACPF buffer width. Those identified as grassland or forest were considered adequate. The existing buffer was determined to be "not adequate" if the measured width was less than both the NRCS and ACPF threshold. In addition, inadequate areas included row crops, moderately to highly overgrazed pasture, roads, buildings, rural or urban residences, parks, and urban open spaces unless there was identifiable vegetation (stiff, deep rooted, or multi-species) that met the adequate criteria. The fields with a suggested NRCS width of zero may be adequate in terms of having a low runoff risk due to having no to very little slope; however, a minimum 6 m (20 ft) buffer was considered adequate for the purposes of this analysis.

Over 53% of the measured buffers were adequate (Table 36). The Belle-Prairie-Indian Creek subwatershed had more than 80% considered adequate, as it has the most ac of forested area (82 ac). The Kelly Creek subwatershed with 36% had the least number of adequate buffers.

Table 36 - Stream Buffer Adequacy

Subwatershed	12-digit HUC	Total (ft)	Total (mi)	Inadequate (mi)	Inadequate (%)	Adequate (mi)	Adequate (%)
Belle Prairie-Indian Creek	071300020204	167,798	31.8	5.4	17	26.4	83
Bradbury Landing Strip - North Fork Vermilion River	071300020102	548,818	104	60.2	58	43.8	42
Fivemile Creek	071300020301	315,083	59.6	33.7	56	25.9	44
Indian Creek	071300020203	136,360	25.8	13.1	51	12.7	49
Indian Grove - South Fork Vermilion River	071300020206	249,826	47.3	14.7	31	32.6	69
Kelly Creek	071300020104	464,681	88	56.8	64	31.2	36
Piper City - North Fork Vermilion River	071300020101	328,980	62.3	29	46	33.3	54
Pleasant Ridge - North Fork Vermilion River	071300020303	531,637	100.7	45	45	55.7	55
Town of Cullom - North Fork Vermilion River	071300020105	350,233	66.3	35.4	53	30.9	47
Town of Fairbury	071300020205	177,641	33.6	14	42	19.6	58
Town of Forrest - South Fork Vermilion River	071300020202	321,589	60.9	20	33	40.9	67
Town of Kempton - Kelly Creek	071300020103	269,493	51	26.2	51	24.8	49
Turtle Pond - South Fork Vermilion River	071300020201	226,162	42.8	12.6	29	30.2	71
	Total	**4,088,301**	**774**	**366**	**47%**	**408**	**53**

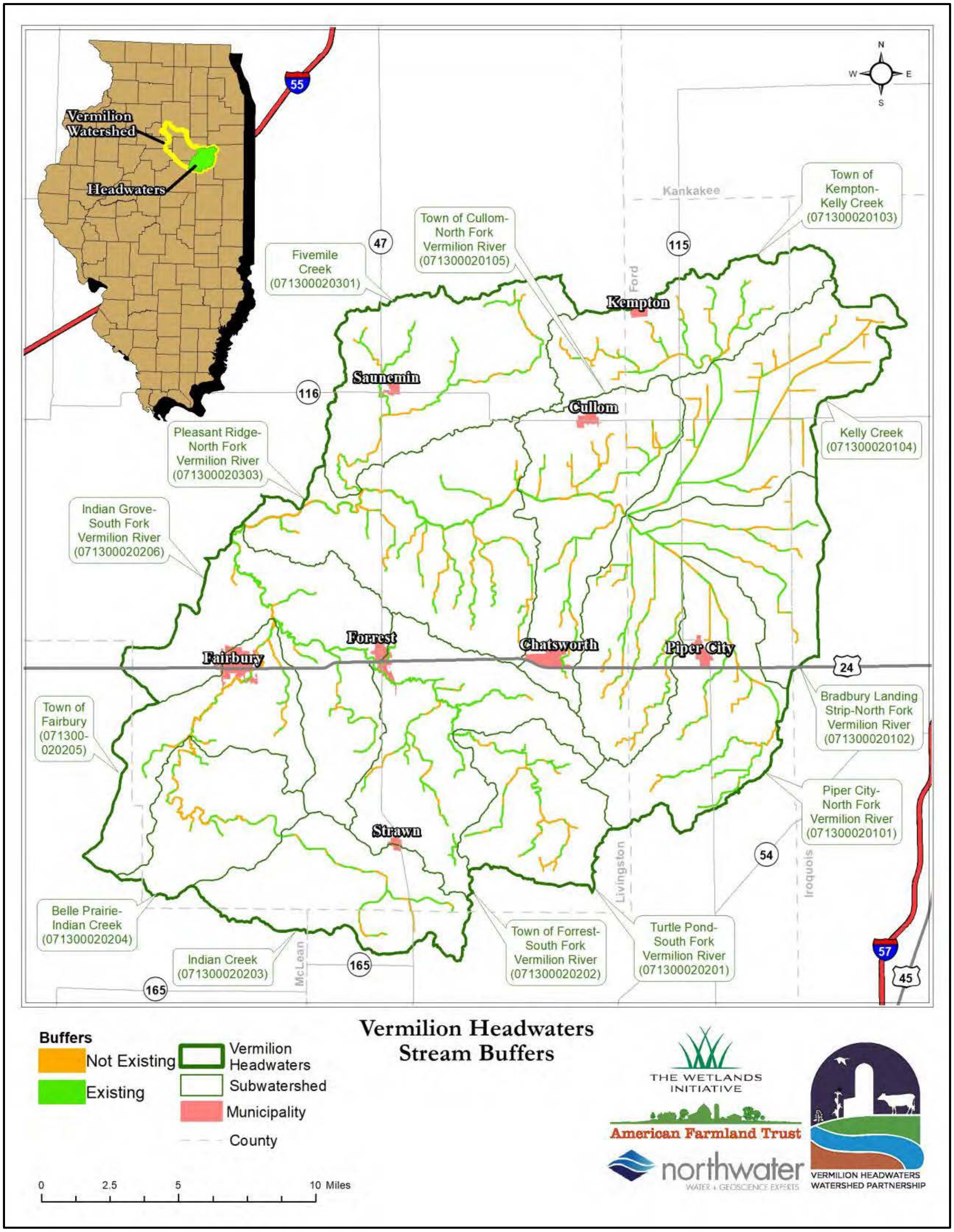

Figure 26 – Stream Buffers in the VHW

3.11.4 Wetlands

Wetlands provide numerous valuable functions that are necessary for the health of the watershed. They play a critical role in protecting and moderating water quality through a combination of filtering and stabilizing processes. Wetlands remove pollutants through absorption, assimilation, and denitrification. This effective treatment of nutrients and physical stabilization leads to an increase in overall water quality to downstream reaches.

In addition, wetlands can increase stormwater detention capacity and attenuation, and moderate high flows. These benefits help to reduce flooding and erosion. Wetlands also facilitate groundwater recharge by allowing water to seep slowly into the ground, thus replenishing underlying aquifers. Groundwater recharge is also valuable to wildlife and stream biota during the summer months when precipitation is low, and the base flow of the river draws on the surrounding groundwater table.

Excluding riverine wetlands, ponds, and lakes, the USFWS National Wetlands Inventory (NWI) indicates there is a total of 1,384 ac (0.45%) of wetlands within the VHW. These wetlands are categorized as freshwater emergent and freshwater forested/shrub wetlands. Results are shown in

Table 37. The average size of the emergent wetlands is 1.5 ac (areas range from 0.07 – 38 ac); whereas the average size of the forested/shrub wetland is 4.8 ac (areas range from 0.0001 – 62 ac). Riverine wetlands, ponds, and lakes account for an additional 2,373 ac, 202 ac, and 137 ac, respectively.

NWI wetlands are identified based on vegetation, visible hydrology, and geography. The accuracy of image interpretation depends on the quality of the imagery (aerial and color infrared), the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. NWI identified wetlands may have changed since the date of the imagery and/or field work. An analysis of open water wetlands using aerial imagery to better understand the current extent. As shown in Figure 27, 1,106 ac (0.36%) of freshwater emergent and forested/shrub wetlands exist in the watershed.

Comparing to NWI data indicates approximately 277 ac of previously delineated wetlands, predominantly emergent (248 ac), have been drained or modified for cropland or pasture. Given the extent of hydric soils in the VHW, there are a significant amount of farmed (or pasture) and prior converted land that may be ecologically and economically suitable for restoration.

Table 37 – Wetlands

Subwatershed	HUC12 Code	NWI Wetlands			Current (Existing) Wetlands		
		Emergent (ac)	Forested/ Shrub (ac)	Total (ac)	Area (ac)	% NWI Total	Farmland Converted (ac)
Belle Prairie-Indian Creek	071300020204	35.5	300	335	327	97.5%	8.46
Bradbury Landing Strip - North Fork Vermilion River	071300020102	6.10	3.99	10.1	2.90	28.7%	7.21
Fivemile Creek	071300020301	86.2	62.1	148	74.7	50.4%	73.5
Indian Creek	071300020203	6.47	1.27	7.74	1.67	21.6%	6.07
Indian Grove - South Fork Vermilion River	071300020206	10.5	286	297	287	96.6%	9.98
Kelly Creek	071300020104	3.15	0.910	4.06	0.912	22.5%	3.15
Piper City - North Fork Vermilion River	071300020101	17.0	2.54	19.5	2.54	13%	17
Pleasant Ridge - North Fork Vermilion River	071300020303	62.2	154	216	155	71.8%	60.8
Town of Cullom - North Fork Vermilion River	071300020105	4.57	0	4.57	0.757	16.6%	3.81
Town of Fairbury	071300020205	1.44	140	142	140	98.7%	1.87
Town of Forrest - South Fork Vermilion River	071300020202	45.6	55	101	63.9	62.5%	37.7
Town of Kempton - Kelly Creek	071300020103	25.9	1.22	27.2	0.102	0.38%	27.1
Turtle Pond - South Fork Vermilion River	071300020201	44.1	27.8	71.9	51.4	71.5%	20.5
Total		**349**	**1,034**	**1,384**	**1,106**	**80%**	**277**

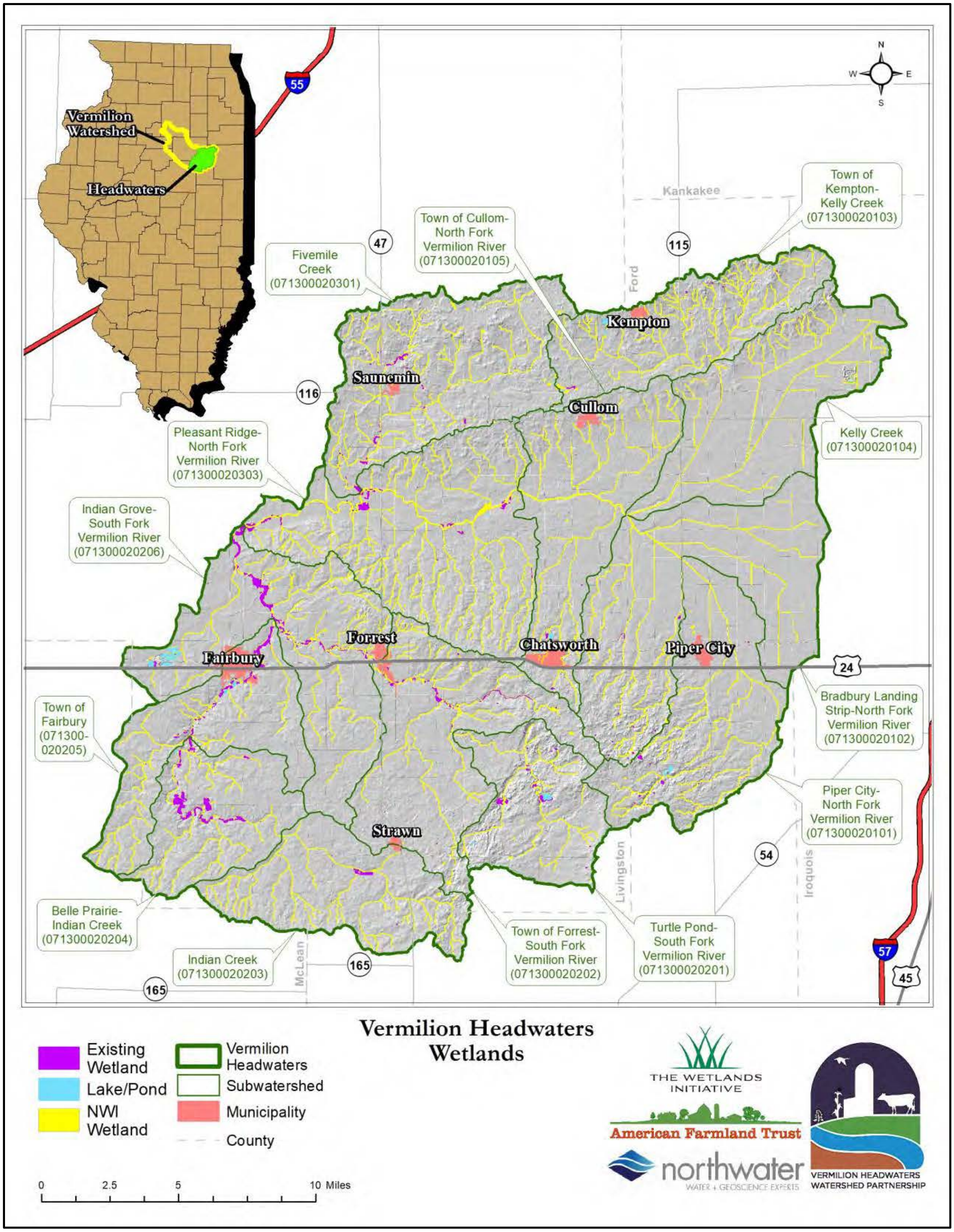

Figure 27 – Wetlands

3.11.4 Floodplain

An analysis of data compiled by The Nature Conservancy indicates that there are 18,951 ac of agriculture and forestry land located within the 100-year floodplain (Freshwater Network, 2021). This is equivalent to approximately 6.2% of the watershed (5.6% agricultural and 0.6% forested).

The Pleasant Ridge subwatershed contains the greatest area of agricultural land in the 100-year floodplain, a total of 3,511 ac or 10.2% of the subwatershed, followed by the Indian Grove and Piper City sub-watersheds. The Town of Kempton – Kelly Creek sub-watershed has the smallest area of agricultural land in the floodplain with only 386 ac, or 2% of the subwatershed (Figure 28). Table 38 shows the acreage and percentage in the 100-year floodplain for each subwatershed.

Table 38 - Agriculture and Forestry Land in 100-year Floodplain

Subwatershed	12-digit HUC	Watershed Area (Acres)	Total Forestry Land in Floodplain (Acres)	Total Ag Land in Floodplain (Acres)	Percent of Watershed in Forest and Ag Land Floodplain
Belle Prairie-Indian Creek	071300020204	14,790	354	592	6.4%
Bradbury Landing Strip - North Fork Vermilion River	071300020102	32,125	0	1,075	3.3%
Fivemile Creek	071300020301	28,265	172	1,670	6.5%
Indian Creek	071300020203	18,891	4	506	2.7%
Indian Grove - South Fork Vermilion River	071300020206	27,862	524	2,028	9.2%
Kelly Creek	071300020104	25,321	0	1,728	6.8%
Piper City - North Fork Vermilion River	071300020101	22,627	2	1,943	8.6%
Pleasant Ridge - North Fork Vermilion River	071300020303	34,287	332	3,511	11.2%
Town of Cullom - North Fork Vermilion River	071300020105	23,736	4	1,462	6.2%
Town of Fairbury	071300020205	17,581	236	455	3.9%
Town of Forrest - South Fork Vermilion River	071300020202	25,815	175	1,327	5.8%
Town of Kempton - Kelly Creek	071300020103	19,053	0	386	2.0%
Turtle Pond - South Fork Vermilion River	071300020201	15,220	45	422	3.1%
Total	-	**305,573**	**1,847**	**17,104**	**6.2%**

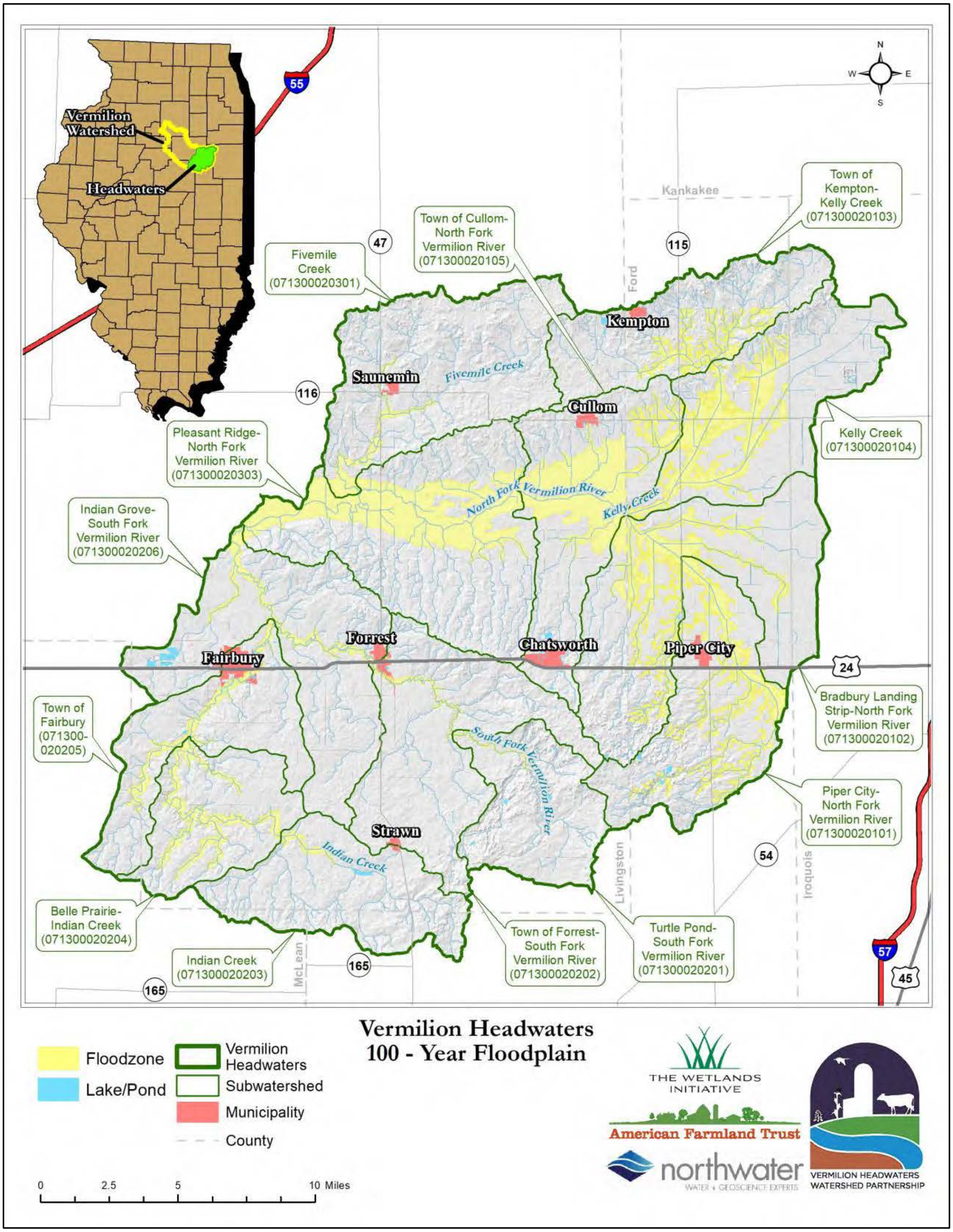

Figure 28 - 100 - Year Floodplain

3.12 Streambank Erosion

Streambank erosion is a source of sediment and nutrients. An evaluation of the extent and severity was performed to quantify sediment, nitrogen, and phosphorus loading. Streambank erosion was evaluated through direct observations during a windshield survey in the fall of 2021. Data was captured with a Geographic Positioning System (GPS) receiver at each road crossing to estimate average eroding bank height and annual recession rates. Results were extrapolated upstream and downstream from each crossing to the next observation point. Data was transferred into a Geographic Information System (GIS) to create a map layer representing general estimates of annual soil loss from streambank erosion.

Annual sediment, nitrogen, and phosphorus loads were calculated using equations derived from the USEPA Region 5 load reduction spreadsheet. Eroding bank height, bank length, and lateral recession rates (LRR) estimated in the field were transferred to GIS. Soil nutrient concentrations for streambanks were obtained from other similar watersheds. The following equations were used to estimate total annual loads for sediment, nitrogen, and phosphorus:

$$\boldsymbol{Sy = L \times LRR \times H \times yd \times SDR \times STF}$$

Sy – sediment yield in tons/yr
L – eroding bank length in ft
LRR – estimated lateral recession rate in ft per year
H – eroding bank height in ft
γd – Soil dry weight density (0.04 tons/ft^3)
SDR – Sediment Delivery Rate (1)
STF – Sediment Transport Factor (0.43)

$$\boldsymbol{TN = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times\ Nc\ x\ Cf}$$

TN – Total nitrogen load from lake banks and streambanks in lbs/yr
Sy – Sediment yield in tons/yr
Nc – Nitrogen concentration in soil (0.000643 lbs/lb)
Cf – Correction factor, 1.0

$$\boldsymbol{TP = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times\ Pc\ x\ Cf}$$

TP – Total phosphorus load from lake banks and streambanks in lbs/yr
Sy – Sediment yield in tons/yr
Pc – Phosphorus concentration in soil (0.000304 lbs/lb)
Cf – Correction factor, 1.0

Streambank erosion is a natural process but the rate at which it occurs is often increased by anthropogenic (human) activities such as urbanization and agriculture. Bank erosion is typically a result of streambed incision and channel widening. Field observations indicate that the severity of streambank erosion is low. Few unstable channels were noted, and smaller tributaries appeared mostly channelized and well vegetated. Un-channelized sections of larger systems such as the North Fork of the Vermilion River also appeared stable and well vegetated.

Results indicate that bank erosion is responsible for delivering 3,892 tons of sediment, 5,005 lbs of nitrogen, and 2,366 lbs of phosphorus annually to watershed streams (Table 39). The Vermilion Headwaters average LRR is 0.04 ft/yr (low) and an average eroding bank height of 0.9 ft.

The Piper City-North Fork Vermilion River subwatershed is estimated to have the highest total streambank sediment and nutrient load - 529 tons/yr, 680 lbs/yr nitrogen, and 321 lbs/yr phosphorus, accounting for 14% of the total sediment load from streambank erosion. Table 39 also provides a relative severity ranking for each subwatershed based on the average across the entire basin. Although streambank erosion is considered low relative to other watersheds in Illinois, there is variability within the Vermilion Headwaters. The Belle Prairie-Indian Creek subwatershed has the highest average sediment load per ft, or 4.1 lbs/ft/yr followed by Indian Grove - South Fork Vermilion River at 3.5. Average per-ft sediment load, and severity are lowest in the Indian Creek subwatershed or 0.4 lbs/ft/yr.

Table 39 – Streambank Erosion and Loading

Subwatershed	HUC12 Code	Bank Length (mi)	Average LRR (ft/yr)	Average Bank Height (ft)	Sediment Load			Nitrogen Load		Phosphorus Load	
					tons/yr	lbs/ft/yr	Severity Ranking [1]	lbs/yr	lbs/ft/yr	lbs/yr	lbs/ft/yr
Belle Prairie-Indian Creek	071300020204	16	0.08	1.3	341	4.1	high	439	0.003	208	0.001
Bradbury Landing Strip-North Fork Vermilion River	071300020102	57	0.04	0.8	435	1.5	low	559	0.001	264	0.0005
Fivemile Creek	071300020301	30	0.04	0.9	225	1.5	low	289	0.001	137	0.0004
Indian Creek	071300020203	13	0.03	0.4	25	0.4	low	32	0.000	15	0.0001
Indian Grove-South Fork Vermilion River	071300020206	36	0.06	1.0	447	3.5	high	575	0.002	272	0.001
Kelly Creek	071300020104	48	0.04	0.9	360	1.5	low	464	0.001	219	0.0004
Piper City-North Fork Vermilion River	071300020101	31	0.06	1.2	529	3.2	high	680	0.002	321	0.001
Pleasant Ridge-North Fork Vermilion River	071300020303	65	0.04	0.9	510	1.9	med	656	0.001	310	0.0006
Town of Cullom-North Fork Vermilion River	071300020105	38	0.04	0.8	224	1.3	low	288	0.001	136	0.0004
Town of Fairbury	071300020205	22	0.05	1.2	229	2.6	med	295	0.002	140	0.0008
Town of Forrest-South Fork Vermilion River	071300020202	30	0.04	0.5	156	1.0	low	200	0.001	95	0.0003
Town of Kempton-Kelly Creek	071300020103	25	0.04	0.7	148	1.1	low	191	0.001	90	0.0003
Turtle Pond-South Fork Vermilion River	071300020201	22	0.05	0.9	262	2.3	med	337	0.001	159	0.0007
Total		**433**	**0.04**	**0.9**	**3,892**	**1.9**	**-**	**5,005**	**0.001**	**2,366**	**0.0006**

[1] – Note the severity ranking is relative to streambank erosion rates in this watershed. Overall, the Vermilion Headwaters exhibits low rates compared to other systems in Illinois.

3.13 Surface Erosion

3.13.1 Gully Erosion

Gully erosion is the removal of soil along drainage lines by surface water runoff. Once started, gullies will continue to move by headward erosion or by slumping of the side walls unless steps are taken to stabilize the disturbance. Gully erosion occurs when water is channeled across unprotected land and washes away the soil along the drainage lines. Under natural conditions, run-off is moderated by vegetation which generally holds the soil together, protecting it from excessive run-off and direct rainfall. To repair gullies, the object is to divert and modify the flow of water moving into and through the gully so that scouring is reduced, sediment accumulates, and vegetation can establish. Stabilizing the gully head is important to prevent damaging water flow and headward erosion. In most cases, gullies can be prevented by good land management practices (Water Resources Solutions, 2014).

Gully erosion was evaluated and estimated using GIS and available aerial imagery and high-resolution elevation data or Lidar. Results presented in this section represents both ephemeral (those that form each year) and permanent (those that receive intermittent streamflow and expand over time such as a forested ditch or channel). Gullies were delineated in GIS and a conservative average estimated width, depth, and years eroding were applied. Total net erosion in tons/year and estimates of nitrogen and phosphorus loading were calculated using GIS and equations derived from the USEPA Region 5 Load Reduction Model. A distance-based delivery ratio was applied to account for distance to a receiving waterbody. The following equations were applied to estimate gully erosion:

$$Sy = \left\{\frac{L \times W \times H}{Y} \times \gamma d\right\} DPS^{0.2069}$$

Sy – sediment yield in tons/yr
L – gully length in ft
W – gully width in ft
D -gully depth in ft
Y – years eroding
γd – Soil dry weight density (tons/ft^3)
$DPS^{0.2069}$- Distance to lake or perennial stream or waterbody in ft, delivery ratio

$$TN = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times Nc\ x\ Cf$$

TN – Total nitrogen load from gully in lbs/yr
Sy – Sediment yield in tons/yr
Nc – Nitrogen concentration in soil (lbs/lb)
Cf – Correction factor, 1.0

$$TP = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times Pc\ x\ Cf$$

TP – Total nitrogen load from gully in lbs/yr
Sy – Sediment yield in tons/yr
Pc – Phosphorus concentration in soil (lbs/lb)
Cf – Correction factor, 1.0

Gully erosion is moderate to high and is generally localized to more sloping portions of the watershed, the few steep forested draws, and ephemeral water courses adjacent to major perennial drainage ways. It is extensive on crop ground and conservation practices observed in the watershed, such as terraces or grassed waterways and other grade control structures, have been implemented to address this type of erosion.

Results indicate that there are 290 miles of eroding gullies, with an average width of 1.03 ft and an average depth of 0.52 ft (Table 40 and Figure 29). These gullies are likely responsible for the annual delivery of 29,889 tons of sediment, 22,842 lbs of nitrogen and 6,114 lbs of phosphorus. The highest sediment and nutrient loads are originating from the Pleasant Ridge-North Fork Vermilion River subwatershed. This subwatershed accounts for 13% of the gully sediment, 14% of the gully nitrogen load, and 14% of the gully phosphorus load. The Indian Grove-South Fork Vermilion River subwatershed has the least sediment and nutrient loading of all subwatersheds.

Table 40 – Gully Erosion and Pollutant Loading

HUC12	Subwatershed	Gully Length Total (ft)	Gully Length Total (mi)	Average Gully Width (ft)	Average Gully Depth (ft)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)
071300020204	Belle Prairie-Indian Creek	103,558	20	1.09	0.55	1,826	496	1,955
071300020102	Bradbury Landing Strip-North Fork Vermilion River	108,699	21	1.03	0.52	1,286	340	2,119
071300020301	Fivemile Creek	163,762	31	1.01	0.5	2,095	560	3,263
071300020203	Indian Creek	168,783	32	1	0.5	3,235	862	3,376
071300020206	Indian Grove-South Fork Vermilion River	96,579	18	1.02	0.51	1,862	501	1,891
071300020104	Kelly Creek	53,645	10	1.01	0.5	833	222	1,072
071300020101	Piper City-North Fork Vermilion River	78,224	15	1.11	0.56	789	219	1,341
071300020303	Pleasant Ridge-North Fork Vermilion River	196,433	37	1.01	0.51	3,207	854	3,905
071300020105	Town of Cullom-North Fork Vermilion River	106,657	20	1.01	0.5	1,518	405	2,129
071300020205	Town of Fairbury	90,305	17	1.01	0.5	1,766	471	1,802
071300020202	Town of Forrest-South Fork Vermilion River	161,018	30	1.01	0.51	1,944	518	3,189
071300020103	Town of Kempton-Kelly Creek	103,317	20	1.02	0.51	1,452	384	2,010
071300020201	Turtle Pond-South Fork Vermilion River	99,210	19	1.07	0.54	1,028	281	1,836
	Total	**1,530,190**	**290**	**1.03**	**0.52**	**22,842**	**6,114**	**29,889**

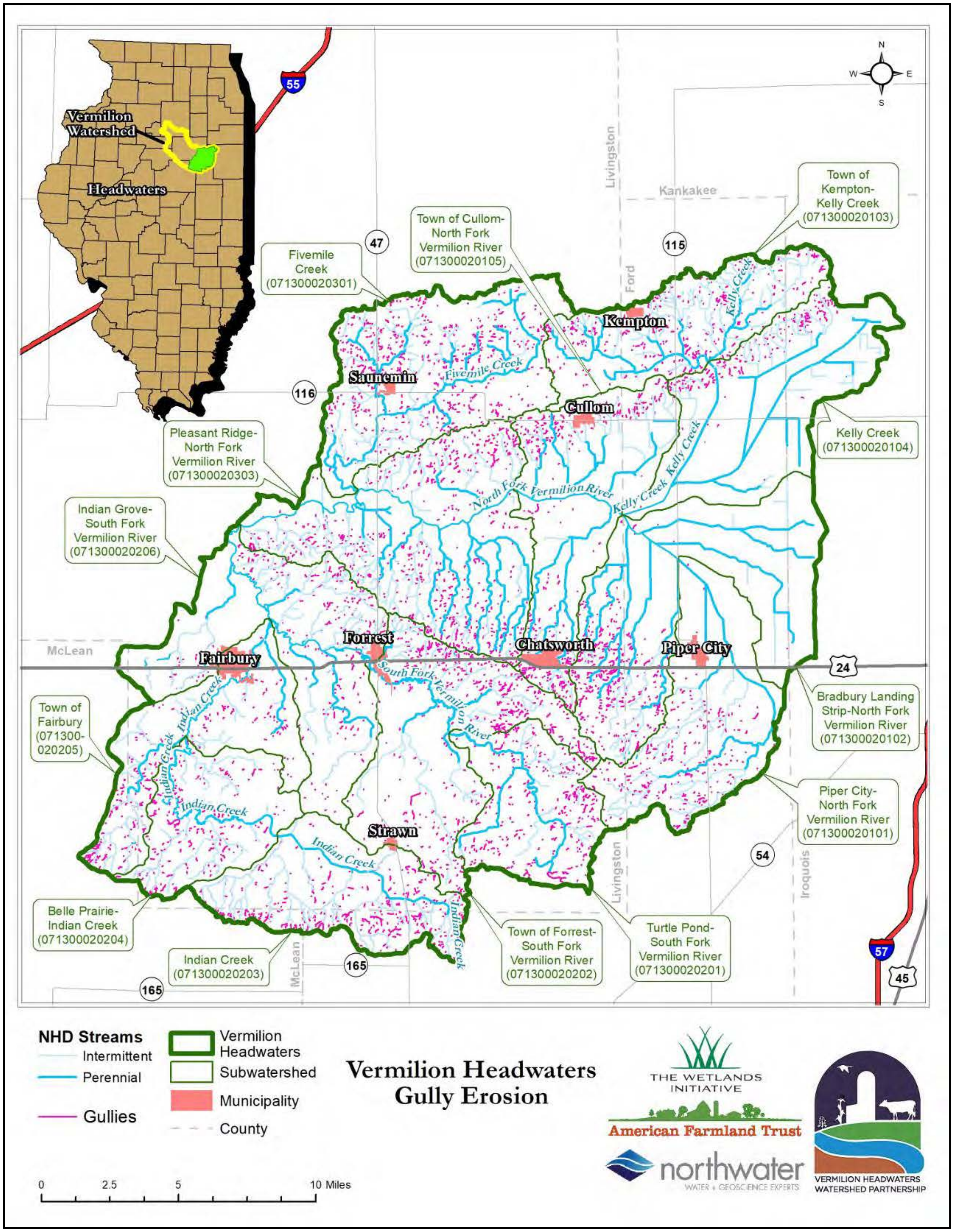

Figure 29 – Gully Erosion

3.13.2 Runoff Risk Assessment

To address agricultural fields with the most potential for direct surface runoff contribution to ditches or streams, runoff risk was assessed using ACPF. Runoff risk assessment prioritizes fields where multiple nutrient and erosion control practices, such as contour buffers, filter strips cover crops, etc. may be needed. Four vulnerability classes, based on field slope steepness (high, medium, low) and proximity to a stream (or ditch), were used to rank risk based on surface runoff potential. A sediment delivery ratio (Ouyang and Bartholic, 1997) was used as a proxy for stream proximity. The VHW Farmer Steering Committee provided feedback on the thresholds to classify the fields as high, medium, or low. Risk classification includes A (very high risk), B (high), C (moderate), and D (low) (Porter et al. 2018). Figure 30 shows the process applied in ACPF assigned run off risk classifications to fields and Table 41 lists results. Risk to agricultural fields is depicted in Figure 31.

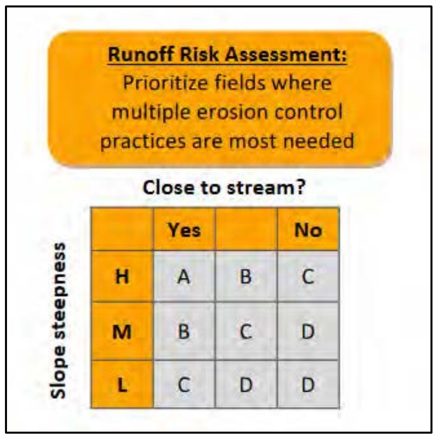

Figure 30 – Runoff Risk Assessment Matrix (Tomer et al., 2015b)

Table 41 - Sheet and Rill Erosion Pollutant Loading by Agricultural Land Runoff Risk Potential

Subwatershed	HUC 12 Code	Runoff Risk Potential (ac)			
		Very High (A)	High (B)	Moderate (C)	Low (D)
Belle Prairie-Indian Creek	071300020204	-	-	2,525	10,672
Bradbury Landing Strip-North Fork Vermilion River	071300020102	-	-	11,103	18,718
Fivemile Creek	071300020301	-	0.1	5,967	20,313
Indian Creek	071300020203	-	-	4,951	12,855
Indian Grove-South Fork Vermilion River	071300020206	-	-	5,355	19,777
Kelly Creek	071300020104	-	-	9,806	14,073
Piper City-North Fork Vermilion River	071300020101	-	-	6,526	14,544
Pleasant Ridge-North Fork Vermilion River	071300020303	80.3	195.5	8,362	23,868
Town of Cullom-North Fork Vermilion River	071300020105	-	-	7,512	14,160

Subwatershed	HUC 12 Code	Runoff Risk Potential (ac)			
		Very High (A)	High (B)	Moderate (C)	Low (D)
Town of Fairbury	071300020205	-	-	3,019	12,518
Town of Forrest-South Fork Vermilion River	071300020202	-	-	5,926	17,959
Town of Kempton-Kelly Creek	071300020103	-	-	5,695	12,331
Turtle Pond-South Fork Vermilion River	071300020201	-	-	3,797	10,367
Total	0	80.3	195.5	80,544	202,155

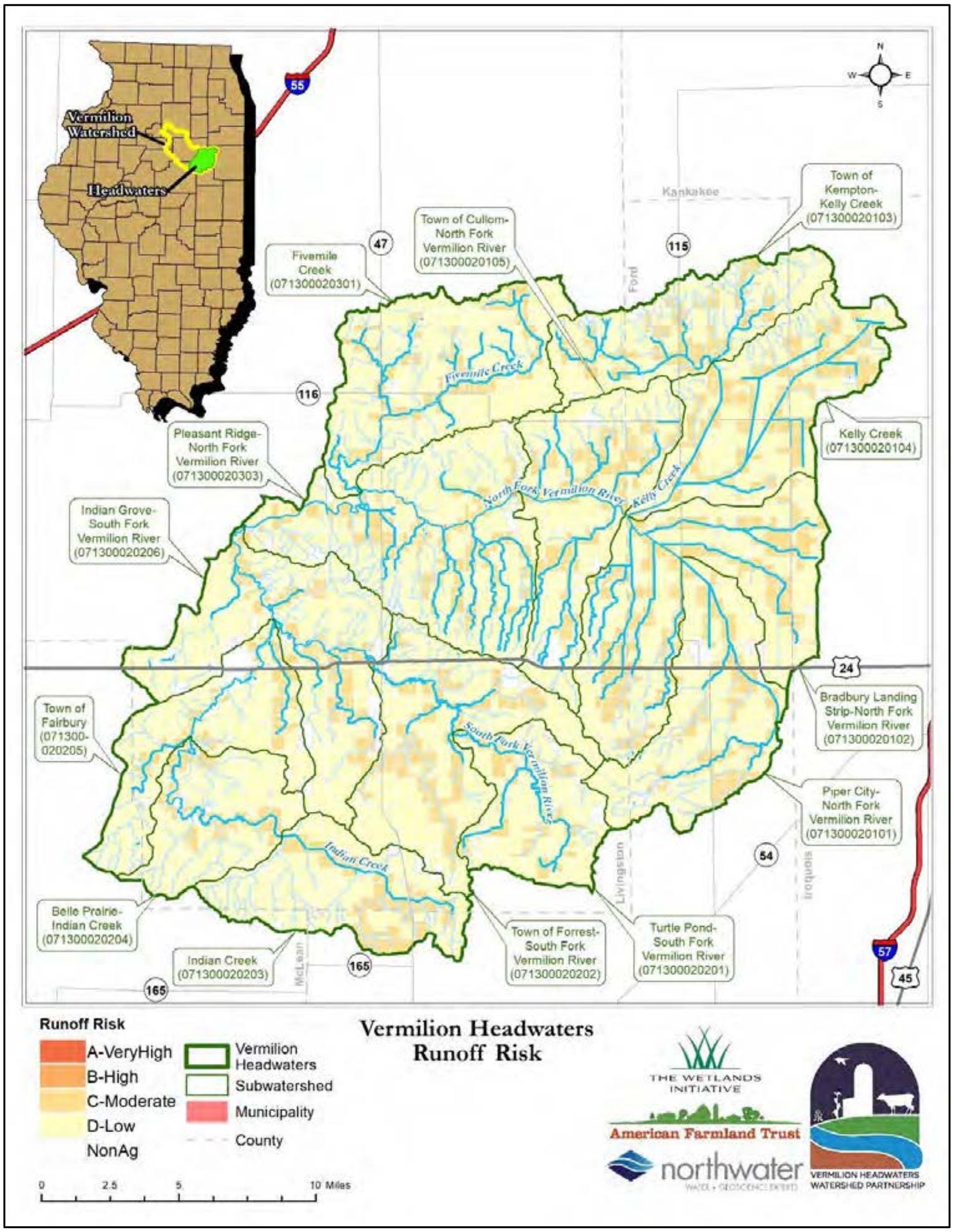

Figure 31 - Agricultural Fields with Potential of Surface Runoff Risk

Very few fields had a "very high" or "high" direct surface runoff risk potential (Table 41). Fields with "moderate" potential acres comprise 28% of the total agricultural aera and these areas are consistent with highly erodible soils (Figure 32). A majority of the watershed (71%) has low runoff risk potential. While "low" risk fields may be considered a lesser priority for erosion, it does not mean that erosion control conservation practice would not provide a benefit, but rather indicates that other fields have a greater potential to deliver sediment and nutrients to the streams via surface runoff (Porter et al. 2018).

3.13.3 Sheet and Rill Erosion

Through rain and shallow water flows, sheet erosion removes the thin layer of topsoil. When sheet flows begin to concentrate on the surface through increased water flow and velocity, rill erosion occurs. Rill erosion scours the land even more, carrying off rich nutrients and adding to the turbidity and sedimentation of waterways.

To quantify the impacts of rainfall, soil erodibility, land use cover, topography, and support practice on sediment yields, the Universal Soil Loss Equation (USLE) and the Modified Universal Soil Loss Equation (MUSLE) have been developed. The main difference between MUSLE and USLE is that USLE uses rainfall as an indicator of erosive energy, while MULSE uses the amount of runoff to simulate erosion and sediment yield.

Subwatershed sediment yield from sheet and rill erosion and by tillage type was determined with the Soil and Water Assessment Tool (SWAT+). The SWAT model comprises two phases: a land phase solved at the hydrologic response unit (HRU) level, and a stream phase solved at reach (subbasin) level. The land phase comprises the computation of HRU daily water balance and sediment yields. HRU sediment yields for non-urban land use types are estimated with the MUSLE:

$$SY = 11.8(Qq_pA)^{0.56}(C\ P\ K\ LS\ F_{CRFG})$$

where SY = HRU sediment yield (t/day); Q = daily runoff volume (mm); q_p = runoff peak discharge (m^3/s); A = HRU area (ha); C, P, K, and LS are dimensionless factors accounting for HRU crop cover, soil protection, soil erodibility, and topography as defined in the original USLE; and F_{CRFG} is a dimensionless factor to account for coarse fragment cover (stoniness).

The SWAT+ calculated that sheet and rill erosion from cropland is responsible for the annual delivery of 16,372 tons of sediment or approximately 30% of the total sediment load (Table 42). An average of 0.061 tons/ac/yr of sediment is delivered from cropland (Table 42). The modeled results indicate that the majority of sheet and rill erosion originates from conventional tilled fields (Table 43) and those areas closest to a stream or roadside ditch without significant buffers present (Figure 32).

The Pleasant Ridge-North Fork Vermilion River subwatershed contributes the highest amount of sheet and rill erosion from cropland (1,891 tons/yr) while the Belle-Prairie-Indian Creek subwatershed contributes the least amount (498 tons/yr). Conventional tillage methods represent 47% of all cropland and are responsible for the annual delivery of 61% of all the cropland sediment load (Table 43).

Table 42 - Sheet and Rill Erosion Pollutant Loading

Subwatershed	HUC12 Code	Total Sediment Load (tons/yr)	Cropland Area (ac)	Cropland Sediment Load (tons/yr)	Cropland Sediment Load (tons/yr)
Belle Prairie-Indian Creek	071300020204	1,937	12,905	498	0.034
Bradbury Landing Strip - North Fork Vermilion River	071300020102	5,123	27,543	1,804	0.060
Fivemile Creek	071300020301	5,438	24,862	1,746	0.063
Indian Creek	071300020203	3,696	17,238	1,103	0.059
Indian Grove - South Fork Vermilion River	071300020206	4,663	24,269	831	0.030
Kelly Creek	071300020104	2,958	23,016	914	0.037
Piper City - North Fork Vermilion River	071300020101	4,153	20,406	1,430	0.062
Pleasant Ridge - North Fork Vermilion River	071300020303	6,698	29,838	1,891	0.054
Town of Cullom - North Fork Vermilion River	071300020105	5,150	20,565	983	0.042
Town of Fairbury	071300020205	3,554	13,896	519	0.032
Town of Forrest - South Fork Vermilion River	071300020202	5,128	23,237	1,421	0.055
Town of Kempton - Kelly Creek	071300020103	3,682	17,474	1,487	0.077
Turtle Pond - South Fork Vermilion River	071300020201	3,280	12,657	1,747	0.117
	Total	**55,460**	**267,907**	**16,372**	**0.061**

Table 43 - Sheet and Rill Erosion Pollutant Loading by Cropland Tillage

Tillage Type	Total Area (ac)	% Cropland Area	Sediment Load (tons/yr)	% Sediment Load	Sediment Load (tons/ac/yr)
Conventional	124,919	46.6%	9,941	60.7%	0.080
Conventional Specialty	3,882	1.45%	307.5	1.88%	0.079
Reduced Till	27,639	10.3%	1,432	8.75%	0.052
Strip Till	98,164	36.6%	4,082	24.9%	0.042
Cover crops	13,303	4.97%	609.5	3.72%	0.046
Total	**267,907**	**100%**	**16,372**	**100%**	**0.061**

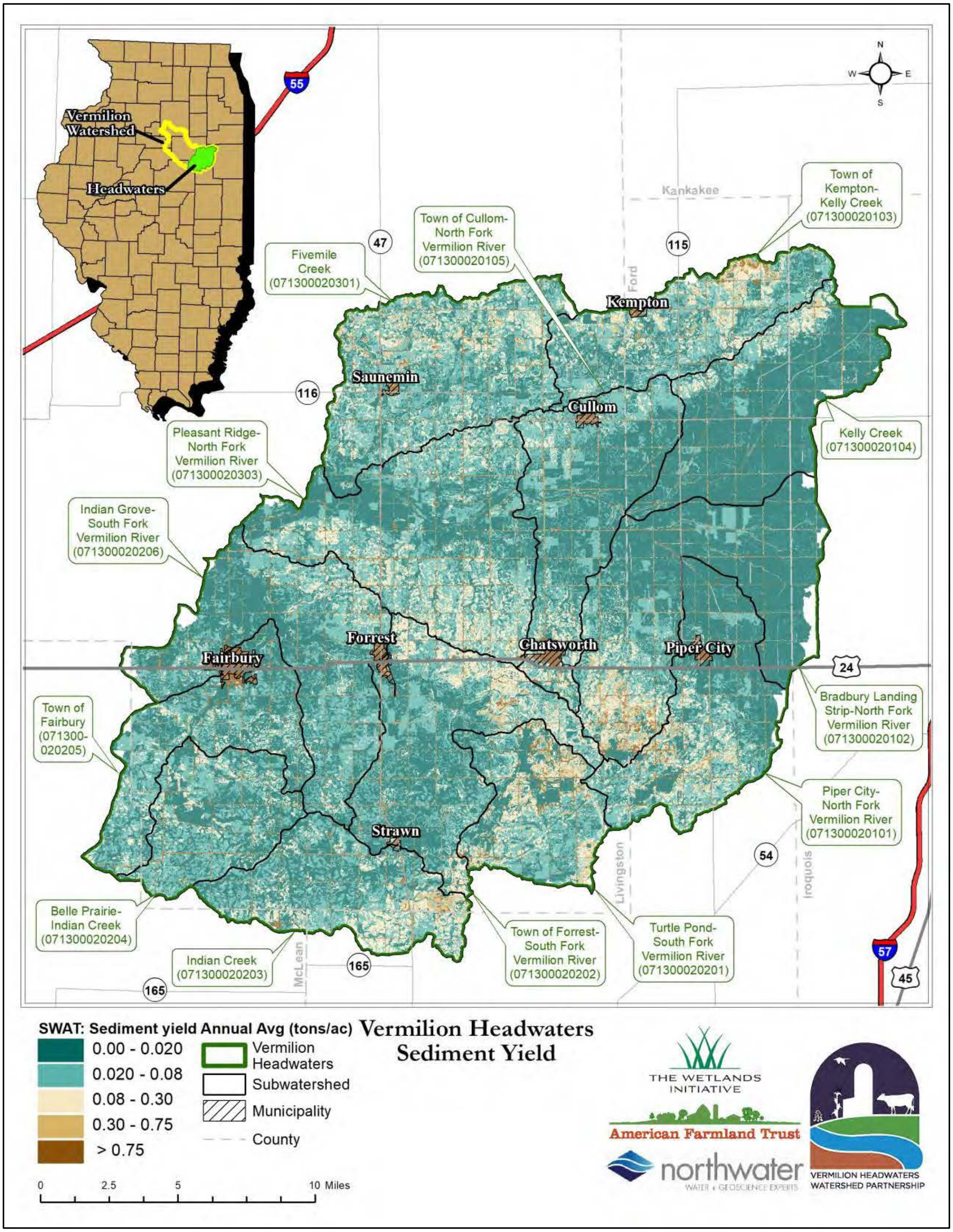

Figure 32 - Sheet and Rill Erosion Pollutant Loading

3.15 Point Source Pollution and Septic Systems

Point source pollution in the watershed comes from National Pollutant Discharge Elimination System (NPDES) permitted dischargers. Septic systems, although typically considered to be a NPS issue, exist in the watershed and may be contributing to nutrient loading in certain areas. Failing septic systems can leach wastewater into groundwater and surrounding waterways. Point source pollution is defined by the United States Environmental Protection Agency (USEPA) as “any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack” (Hill, 1997). The NPDES, a provision of the Clean Water Act, prohibits point source discharge of pollutants into waters of the U.S. unless a permit is issued by the USEPA or a state or tribal government. Individual permits are specific to individual facilities (e.g., water or wastewater treatment facilities) and general permits cover facilities with similar treatment types and effluent. Permits describe the allowed discharge of pollutant concentrations (mg/L) and loads (lbs/day).

3.15.1 NPDES Dischargers

Two limestone quarries, 5 water treatment plants (WTP), 4 Sewage Treatment Plants (STP) and a single nursing care facility are the only permitted discharges in the watershed. Except for the quarries, these permitted dischargers are in municipal areas. Annual loading was obtained from the USEPA Enforcement and Compliance History Online system or ECHO. In some cases, nutrient and sediment loads were not reported. All nitrogen loads are reported as ammonia as N.

The city of Fairbury STP is connected to a combined sewer system with one primary treated outfall and 12 secondary outfalls. Only the primary outfall is monitored and reports loading values.

Permitted NPDES dischargers account for a total of 45 tons/yr sediment, 7,846 lbs/yr phosphorus, and 6,519 lbs/yr nitrogen (Table 44). Average daily flow is 2.14 million gallons per day (MGD). The town of Fairbury subwatershed is the highest contributor of sediment (16 tons/yr), nitrogen (5,184 lbs/yr), and phosphorus (5,184 lbs/yr) from permitted discharges.

Table 44 – NPDES Facilities and Pollutant Loading

Subwatershed	NPDES Permit Number	Facility Name	Outfall Types	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Average Daily Flow (MGD)
Fivemile Creek	ILG640227, IL0075299	Illinois American Water - Saunemin WTP	Iron filter backwash	n/a	n/a	0.9	0.11
Indian Creek	IL0077569	Cropsey Mutual Water Assoc	Iron filter backwash	n/a	n/a	n/a	n/a
Indian Grove-South Fork Vermilion River	IL0028819	Village of Forrest STP	Influent monitoring, excess flow, STP outfall	288	1,626	8.8	0.25

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Subwatershed	NPDES Permit Number	Facility Name	Outfall Types	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Average Daily Flow (MGD)
Kelly Creek	ILG840145, IL0032484	VCNA Prairie Aggregates Illinois INC Yard	Runoff/pit pumpage, stormwater runoff	n/a	n/a	2.8	0.17
Piper City-North Fork Vermilion River	IL0037001	Piper City Rehab & Living Center	STP outfall, influent monitoring	48	112	0.06	0.02
	ILG840128, IL0067245	Boughton Trucking & Materials	Pit pumpage and stormwater	n/a	n/a	14	0.66
Town of Cullom-North Fork Vermilion River	ILG580091, IL0033260	Town Of Chatsworth	STP outfall, influent monitoring	1,625	787	2.2	0.12
	ILG640003, IL0052302	Village of Cullom PWS	Iron filter backwash, slow sand filter	n/a	n/a	0.01	0.001
Town of Fairbury	IL0021601	City of Fairbury STP	STP outfall, influent monitoring, CSO	4,332	5,184	16	0.78
Town of Kempton-Kelly Creek	IL0026697	Stelle Community Association STP	STP outfall, influent reporting	226	36	0.08	0.01
	ILG640007, IL0051195	WTP of Stelle Community Association	Treated iron filter backwash	n/a	n/a	0.001	0.0001
	ILG640275, IL0061867	Kempton WTP	STP outfall, influent reporting	n/a	99	0.14	0.02
			Total	**6,519**	**7,846**	**45**	**2.14**

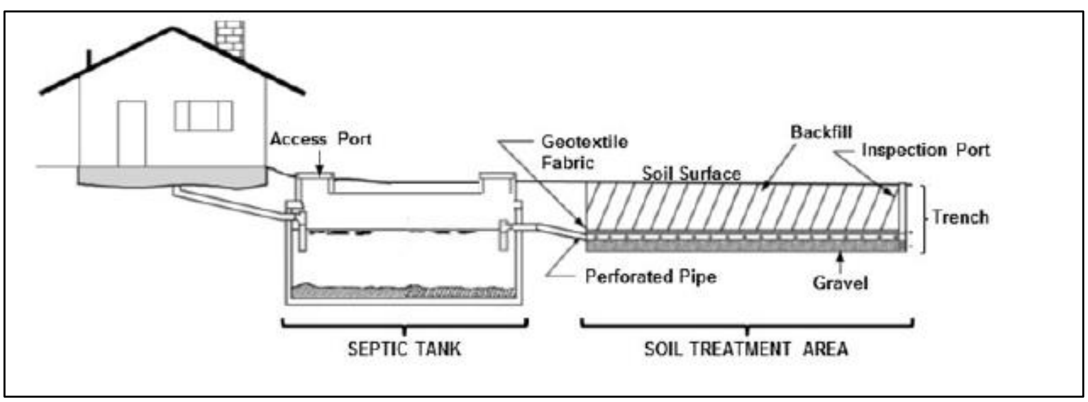
3.15.2 Septic Systems

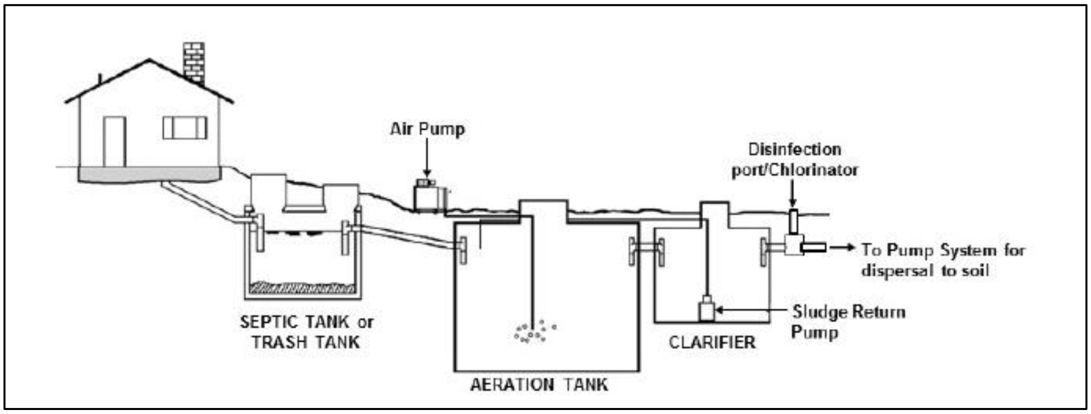
All but the municipalities of Chatsworth, Fairbury, Saunemin, and Forrest are unsewered. Failing septic systems are typically an active source of pollutants. Faulty or leaking septic systems are sources of bacteria, nitrogen, and phosphorus. Typical national septic system failure rates are 10-20% but vary widely depending on the local definition of failure; no failure rates are reported specifically for Illinois (USEPA 2002). Therefore, a 15% failure rate was used for analysis and confirmed through informal discussions with local health departments.

Every home in the watershed outside the previously mentioned municipalities were located and mapped using GIS to estimate the number of individual residential homes using septic systems (Figure 33) Corresponding nitrogen and phosphorus loads were then estimated using the Spreadsheet Tool for Estimating Pollution Loading (STEPL). Assuming a failure rate of 15%, it is possible that 309 homes have failing septic systems (Table 45); due to the planning nature of this analysis, the exact locations of these systems are unknown. Potentially failing septic systems contribute an estimated 4,147 lbs/yr of phosphorus and 10,593 lbs/yr of nitrogen. For the purposes of this report, it is assumed that these loadings do make it to waterways; however, loading is a function of location, and it is possible that septic water from a portion of failing systems may be absorbed or filtered prior to entering waterways. The greatest number of potentially failing systems (65), and ultimately loading is in the Piper City-North Fork Vermilion River subwatershed. The Turtle Pond-South Fork Vermilion River contains the least or 6.

Table 45 – Potentially Failing Septic Systems and Nutrient Loading

HUC12	Name	Septic System Count	Failing Septic Systems Count	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)
071300020204	Belle Prairie-Indian Creek	66	10	308	121
071300020102	Bradbury Landing Strip-North Fork Vermilion River	91	14	425	166
071300020301	Fivemile Creek	91	14	429	168
071300020203	Indian Creek	156	23	802	314
071300020206	Indian Grove-South Fork Vermilion River	172	26	821	321
071300020104	Kelly Creek	65	10	303	119
071300020101	Piper City-North Fork Vermilion River	434	65	2,309	904
071300020303	Pleasant Ridge-North Fork Vermilion River	127	19	607	237
071300020105	Town of Cullom-North Fork Vermilion River	366	55	1,946	762
071300020205	Town of Fairbury	111	17	551	216
071300020202	Town of Forrest-South Fork Vermilion River	129	19	653	256
071300020103	Town of Kempton-Kelly Creek	211	32	1,232	482
071300020201	Turtle Pond-South Fork Vermilion River	42	6	208	81
	Total	**2,061**	**309**	**10,593**	**4,147**





Septic Systems: Conventional (above) and Aerobic Treatment (below)
Credit: OSU 2017

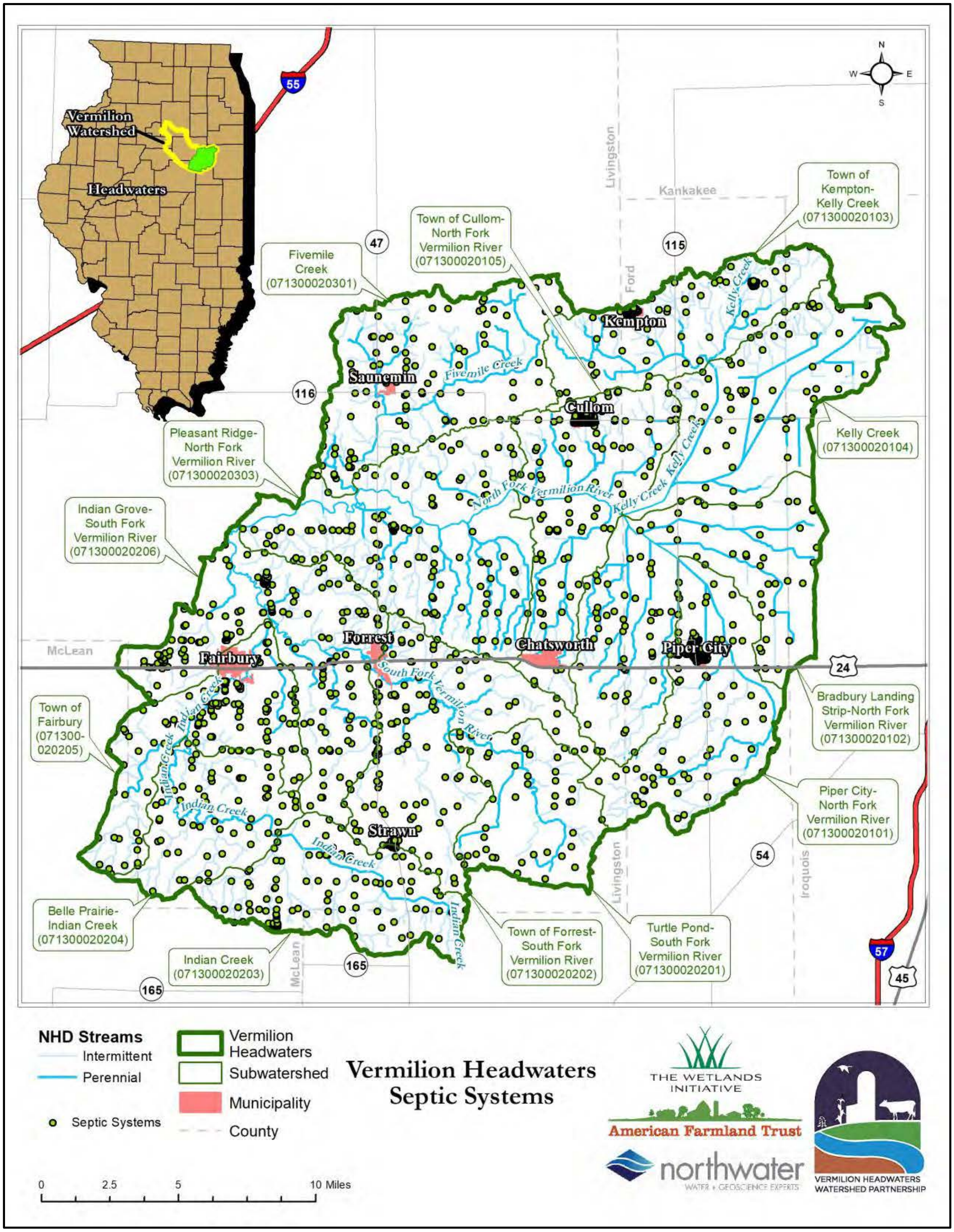


Figure 33 - Homes with Septic Systems

4.0 Pollutant Loading

4.1 Introduction and Methodology

The SWAT is a basin-scale model used to simulate the quality and quantity of surface and groundwater runoff and to predict the effects of land use, land management practices, and climate change in small to large, complex watersheds (TAMU, 2023). It is a continuous time model that operates on a daily time step to simulate the water and nutrient cycles. It incorporates weather, surface runoff, return flow, percolation, evapotranspiration, transmission losses, pond and reservoir storage, crop growth and irrigation, groundwater, and subsurface drainage flow, reach routing, nutrient and pesticide loading, and water transfer. It works on the principle of HRUs, which are areas of unique characteristics identified by land use, soil type, slope, and drainage area. Computations take place at the HRU level and results are routed through stream connections to the outlets of the designated watersheds. SWAT is commonly used to predict the impacts of agricultural practices on water quality and quantity.

SWAT+ is a revised version of the SWAT model that provides a more flexible spatial representation of interactions and processes within a watershed (TAMU, 2023). SWAT+ was used to determine the baseline hydrology and nutrient and soil runoff conditions with the existing identified structural practices, tillage management practices, etc., and to assess the effectiveness of the agricultural conservation practice opportunities that were identified by the ACPF watershed tool. Detailed information on the data sets, assumptions, and parameters used can be found in Appendix A.

4.2 Pollutant Loading

Pollutant load estimates are presented in this section. Estimates are provided for loading resulting from septic systems, NPDES dischargers, gully erosion, streambank erosion, surface runoff, and tile (subsurface) drainage. Gully and streambank erosion were observed in the field to the extent it was visible. Loading from septic systems was estimated based on those homes not connected to a wastewater treatment system, and NPDES discharge data was acquired from the USEPA. Surface runoff, tile-drainage, and groundwater was determined by the SWAT+ model.

As presented in Table 46, the total annual loading to the watershed from all point and nonpoint sources is 6,282,382 lbs of nitrogen, 84,487 lbs of phosphorus, and 89,286 tons of sediment. Cropland tile drainage is responsible for 96.2% and 45.4% of the nitrogen and phosphorus load, respectively. Surface runoff is responsible for 3% of the nitrogen load, 30% of the phosphorus, and 62% of the sediment load. All other sources combined - failing septic systems, point source discharges, streambank erosion, and gully erosion - account for 24% of the phosphorus, 38% of the sediment, and less than 1% of the nitrogen load.

Table 46 – Pollution Loading Summary

Pollution Source	Nitrogen Load (lbs/yr)	Nitrogen Load (% total)	Phosphorus Load (lbs/yr)	Phosphorus Load (% total)	Sediment Load (tons/yr)	Sediment Load (% total)
Gully Erosion	22,842	0.36%	6,114	7.2%	29,889	33.5%
Direct Surface Runoff	191,466	3.0%	25,674	30.4%	55,460	62.1%
Tile Drainage Runoff	6,045,957	96.2%	38,340	45.4%	-	-
Streambank Erosion	5,005	0.08%	2,366	2.8%	3,892	4.4%
Septic Systems	10,593	0.17%	4,147	4.9%	-	-
NPDES Discharge	6,519	0.10%	7,846	9.3%	45	0.05%
Total	**6,282,382**	**100%**	**84,487**	**100%**	**89,286**	**100%**

Modeled pollution loading from direct surface runoff and tile drainage is reported in Table 47 and depicted in **Error! Reference source not found.** (surface runoff) and Figure 35 (tile runoff) for nitrogen, Figure 36 (surface runoff) and Figure 37 (tile runoff) for phosphorus, and Figure 38 for sediment. Model results show that cropland contributes the highest annual loads of nitrogen and phosphorus at 6,094,281 lbs/yr and 43,217 lbs/yr, respectively. The urban areas combined (low, medium, and high density) contribute the highest sediment at 39,050 tons/year and second highest nitrogen and phosphorus loads in the watershed at 136,616 lbs/yr and 18,976 lbs/yr, respectively.

In terms of yield per acre, cropland contributes the most nitrogen, while the urban areas combined contribute the most phosphorus and sediment. Per-acre results are calculated by dividing the total annual load of a given land use category by the total number of ac. Cropland loss is 22.58 lbs/ac nitrogen, 0.16 lbs/ac phosphorus, and 0.06 ton/ac direct sediment runoff (sheet and rill erosion only). It should be noted that the model may be underestimating the sediment load from sheet and rill erosion due to a lack of measured water quality data needed to adequately calibrate this model parameter. Total cropland sediment loss is 0.17 tons/acre with the inclusion of gully erosion (Table 40). In comparison, urban areas deliver 1.06 lbs/ac of phosphorus and 2.2 tons/ac of sediment. Urban areas, which include roads and highways, can deliver relatively high per-acre and total sediment loads. This is primarily a function of higher runoff rates and less infiltration due to impervious surfaces. SWAT+ modeled urban high density as 60% impervious, urban medium density as 38% impervious, and urban low density as 12% impervious. Buildings for confined livestock production were categorized under urban low density, while small livestock feedlots were categorized as pasture.

Surface runoff is relatively low due to the flat topography and the prevalence of tile drainage, which can further reduce surface runoff and the loss of nutrients through runoff and erosion. While tile drainage can reduce nutrient loss via surface runoff, tile discharge can be a significant contributor to nutrient loads, particularly nitrate-nitrogen.

It is important to note that these results presented in this section represent delivered loads for all fields in the watershed combined. Individual fields deliver soil and nutrients at different rates based on tillage, cropping systems, manure application, nutrient management practices, soil and slope characteristics, proximity to a waterbody, and the use of BMPs.

Table 48 compares the loadings originating from direct runoff and subsurface (tile) runoff with the summed watershed load from all land use sources. Row crops are the greatest contributor of nutrients, being responsible for 97 % of total annual nitrogen load and 51% of the total phosphorus load. The combined urban sources contribute the highest sediment at 44% compared to 18% from cropland when excluding cropland gully erosion which is a significant source of additional sediment. Urban areas contribute the second highest amount of nitrogen at 2.2% and phosphorus at 22.5%. Pasture and forest are the third and fourth highest contributors of surface runoff nutrient loads, at 2% and 0.12% of phosphorus and 0.09% and 0.01% of nitrogen, respectively. Pasture and forest areas contribute minor amounts of nutrients and sediment as these land uses make up only 5% of the planning area.

Table 47 – Pollution Loading from Direct Surface and Subsurface Runoff by Land Use

Land use Category	Area (ac)	Nitrogen Load		Phosphorus Load		Sediment Load	
		lbs/yr	lbs/ac/yr	lbs/yr	lbs/ac/yr	tons/yr	tons/ac/yr
Forest	3,043	906	0.30	102	0.03	1	0.00027
Pasture	12,414	5,620	0.45	1,719	0.14	37	0.0030
Cropland	267,907	6,094,281	22.8	43,217	0.16	16,372	0.06
Urban high density	228	2,335	10.24	907	3.98	558	2.45
Urban low density	16,778	125,058	7.45	16,115	0.96	36,367	2.17
Urban medium density	852	9,222	10.83	1,955	2.30	2,125	2.49
Wetlands	569	0	0	0	0	0	0
Total	**301,791**	**6,237,423**	**52.07**	**64,015**	**7.57**	**55,460**	**7.17**

Note: The cropland category includes all conventional crops (corn and soybean) and specialty crops such as hay, winter wheat, alfalfa, rye, sorghum, sweet corn, potato, cabbage, etc.

Table 48 – Pollutant Loading from Direct Surface and Subsurface Runoff by Land Use as Percentage of Total Watershed Load

Land Use Category	Area (ac)	Nitrogen Load		Phosphorus Load		Sediment Load	
		lbs/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load	tons/yr	% Total Watershed Load
Forest	3,043	906	0.014%	102	0.121%	0.81	0.0009%
Pasture	12,414	5,620	0.089%	1,719	2.03%	37.4	0.042%
Cropland	267,907	6,094,281	97.0%	43,217	51.2%	16,372	18.3%
Urban high density	228	2,335	0.037%	907	1.07%	558	0.625%
Urban low density	16,778	125,058	1.99%	16,115	19.1%	36,367	40.7%
Urban medium density	852	9,222	0.147%	1,955	2.31%	2,125	2.38%
Wetlands	569	0	0%	0.0	0%	0	0%
Total	**301,791**	**6,237,423**	**99.3%**	**64,014**	**75.8%**	**55,460**	**62.1%**

Note: Percentages do not add up to 100% because direct runoff is not the only source of loading in the watershed. Streambank erosion, gully erosion, septic systems, and NPDES dischargers are responsible for the remaining percentage.

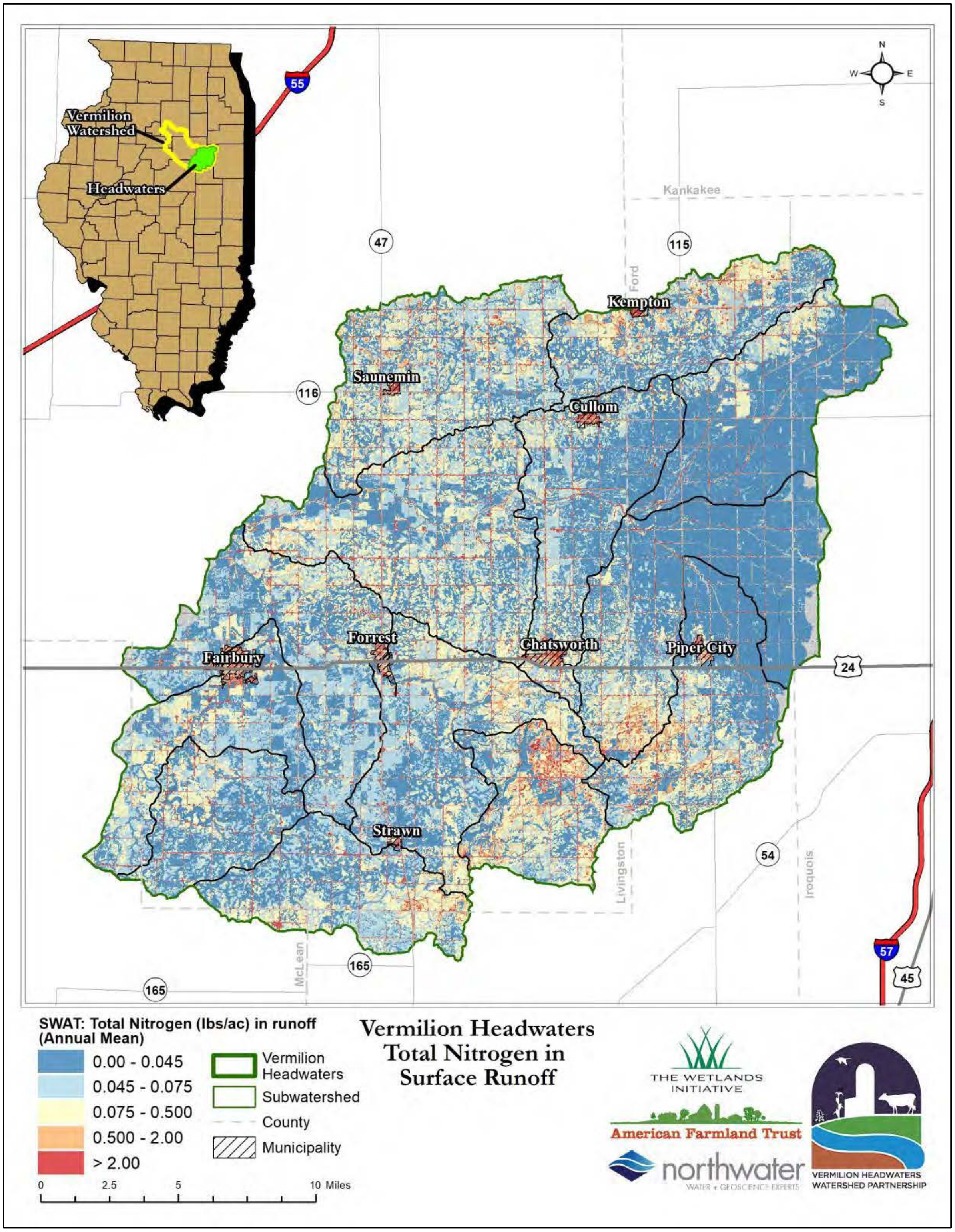


Figure 34 - Annual Total Nitrogen Loading Per Acre from Direct Surface Runoff

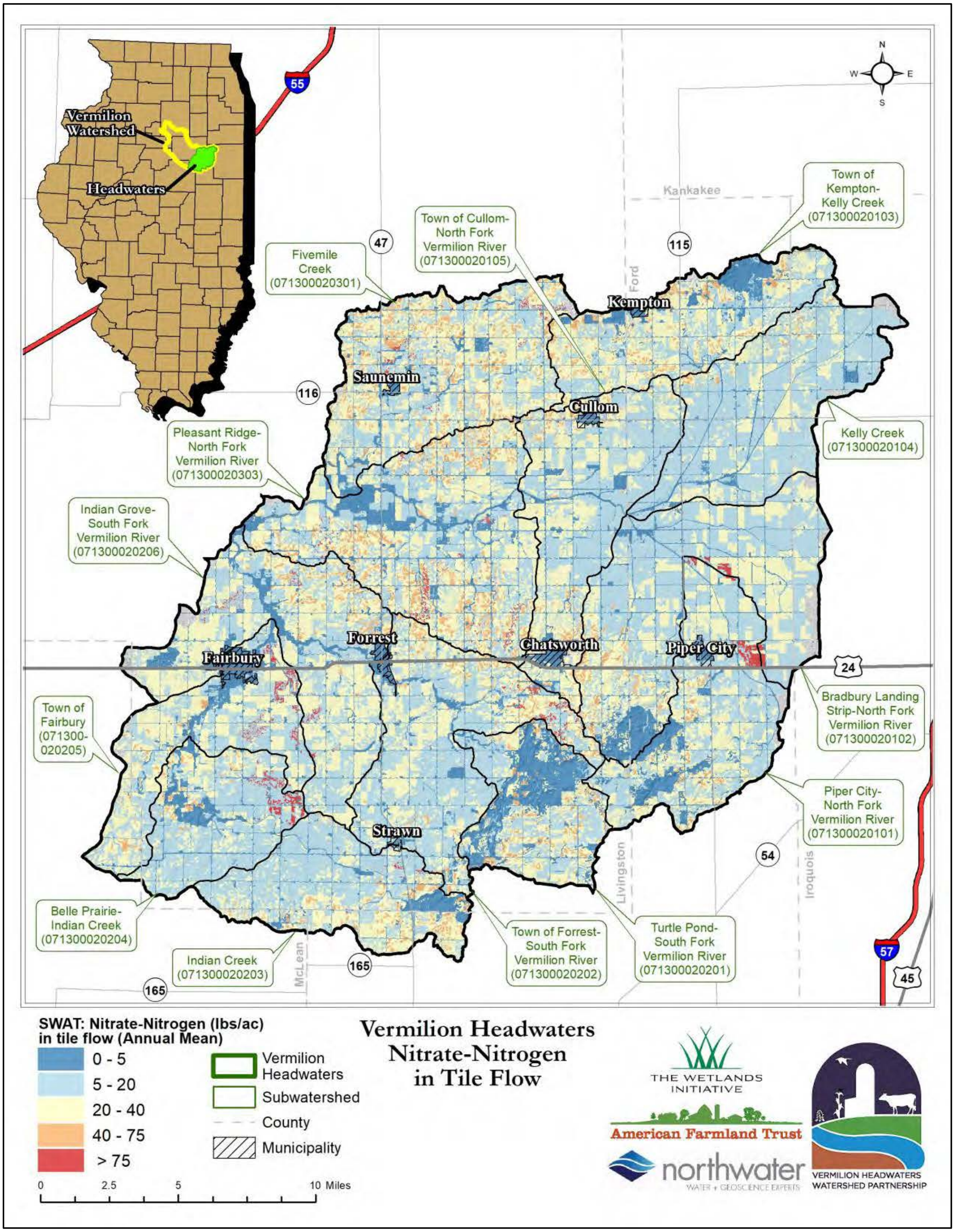


Figure 35 - Annual Nitrate-Nitrogen Loading Per Acre from Tile Drainage Runoff

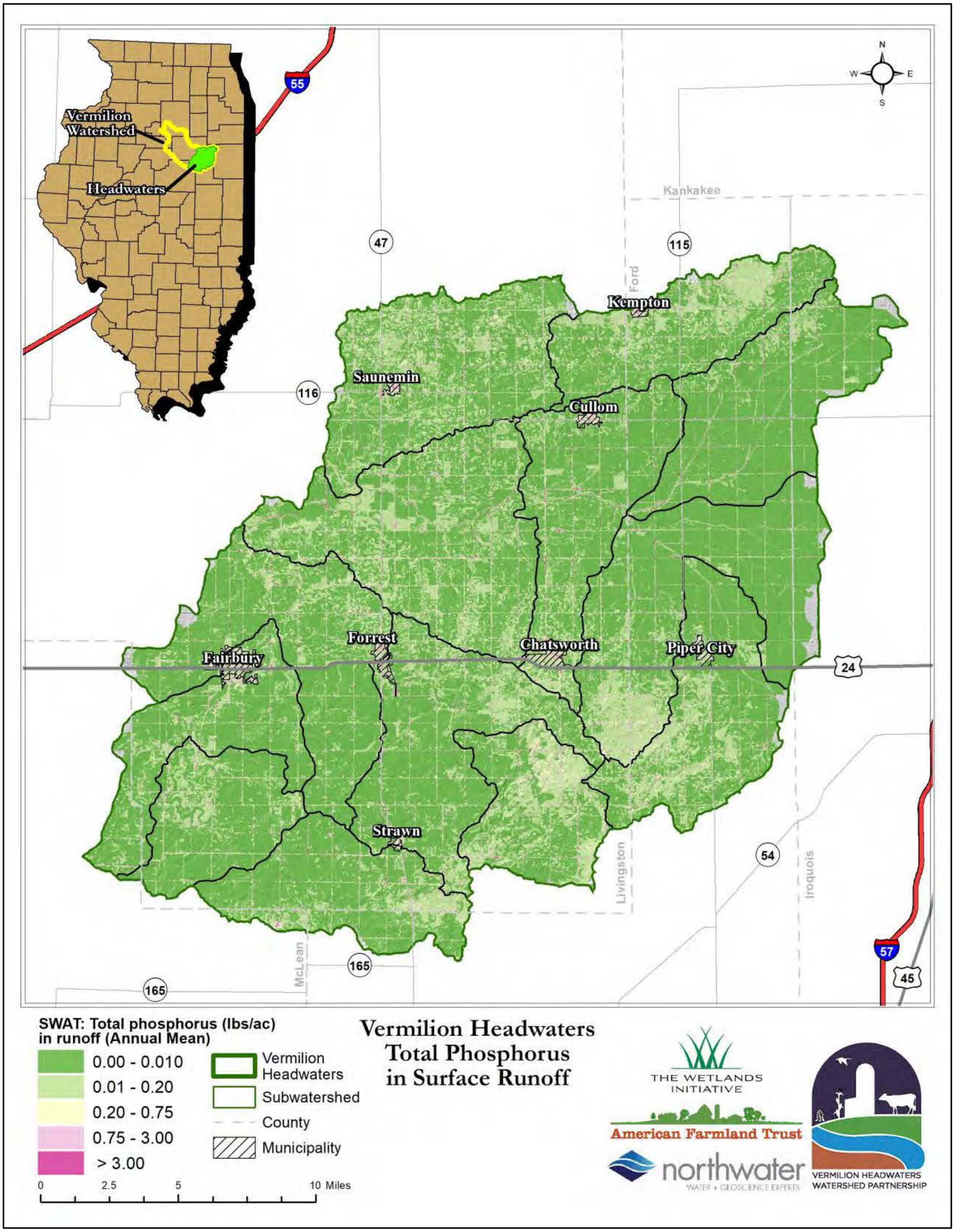


Figure 36 - Annual Total Phosphorus Loading Per Acre from Direct Surface Runoff

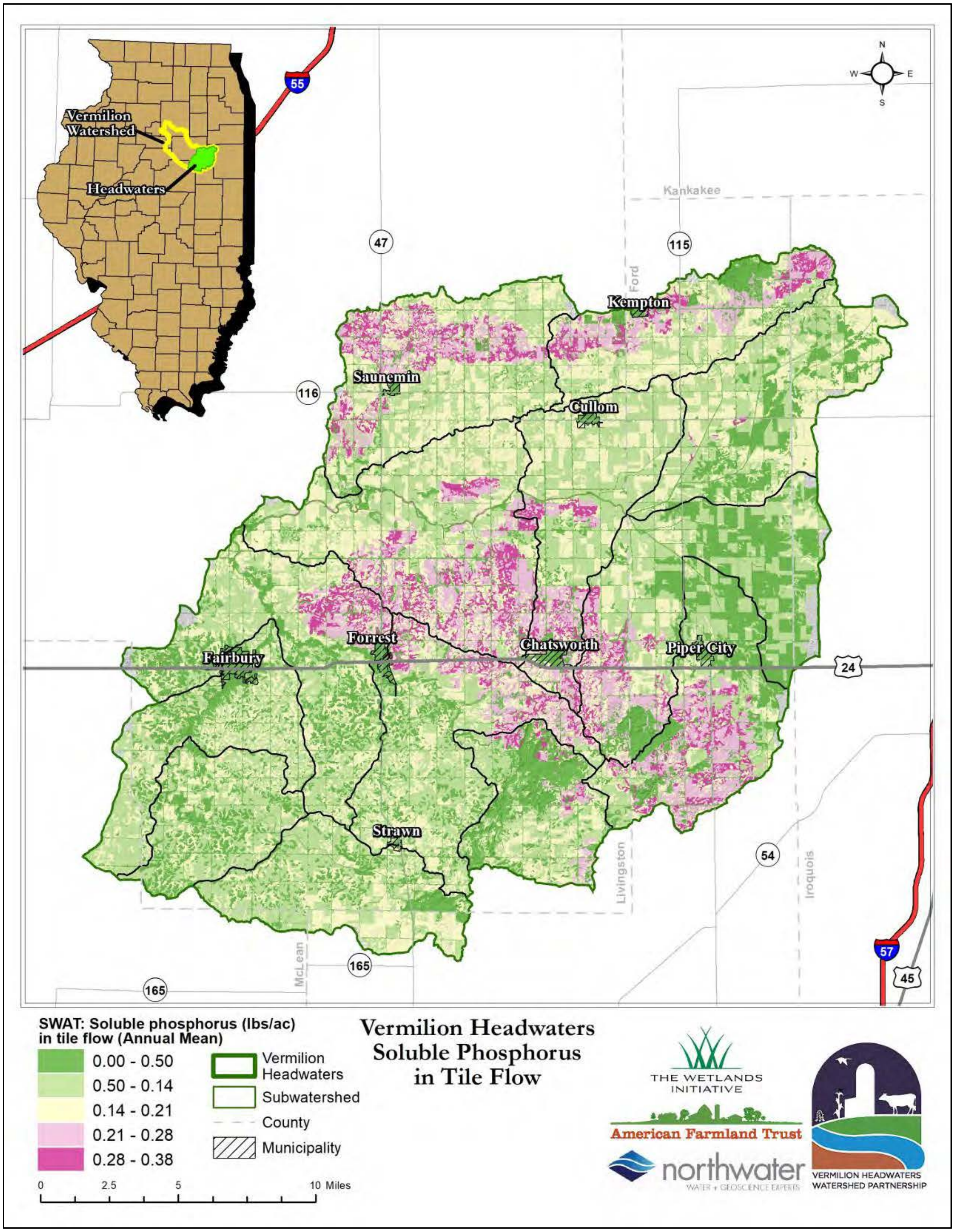


Figure 37 - Annual Soluble Phosphorus Loading Per Acre from Tile Drainage Runoff

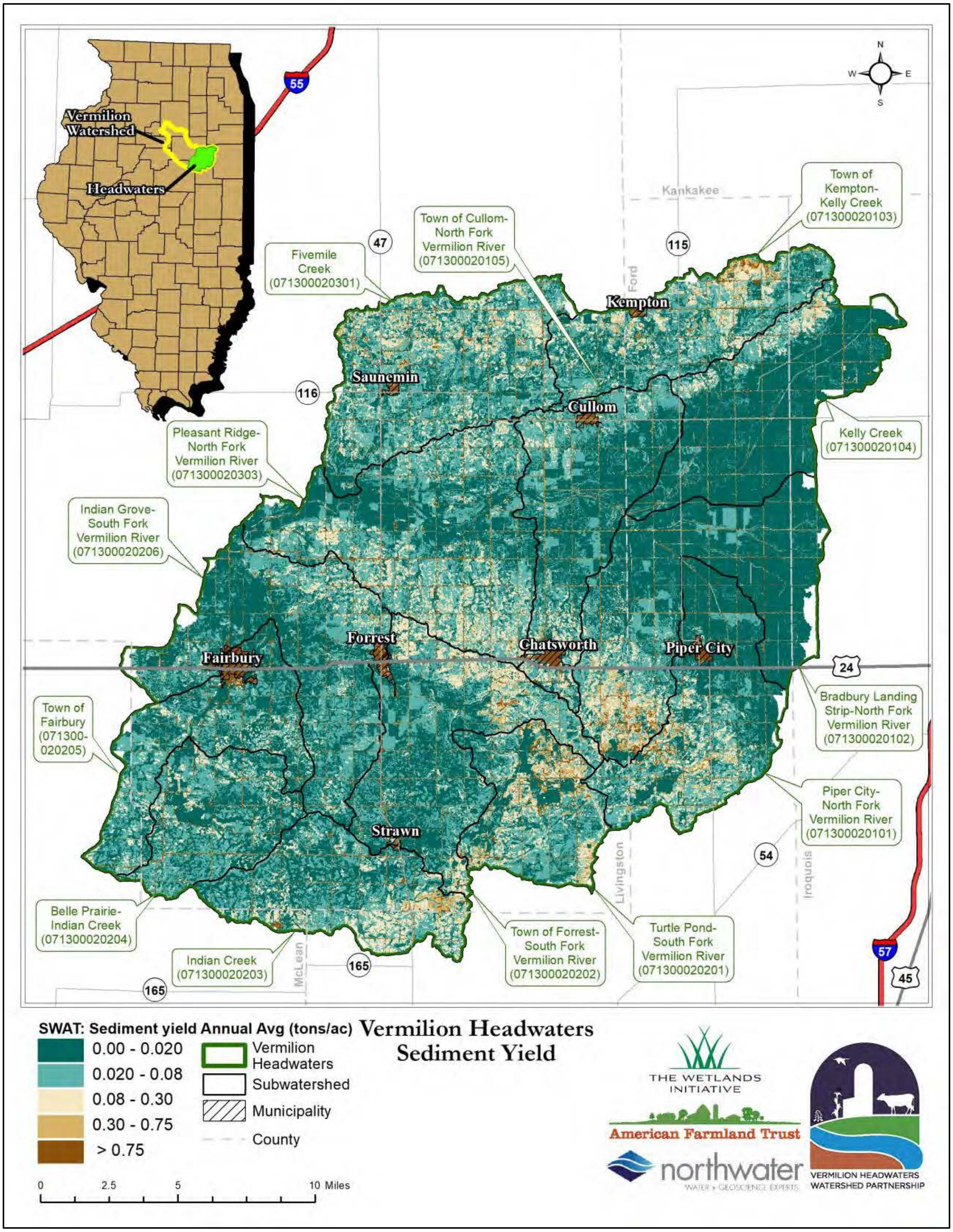


Figure 38 - Annual Sediment Loading per Acre from All Direct Surface Runoff

The largest nutrient and sediment load from cropland (surface, subsurface, and gully erosion) losses were modeled to be in the Pleasant Ridge-North Fork Vermilion River, Fivemile Creek, and Indian Grove-Sorth Fork Vermilion River subwatersheds. (Table 49).

Table 49 - Total Annual Nonpoint Source Sediment and Nutrient Loading by Subwatershed

Subwatershed	HUC12 Code	Total Nitrogen Load (lbs/yr)	Total Nitrogen Load (%)	Total Phosphorus Load (lbs/yr)	Total Phosphorus Load (%)	Total Sediment Load (tons/yr)	Total Sediment Load (%)
Belle Prairie-Indian Creek	071300020204	284,592	4.5%	2,824	4.0%	3,894	4.6%
Bradbury Landing Strip - North Fork Vermilion River	071300020102	546,215	8.7%	5,659	8.1%	7,241	8.5%
Fivemile Creek	071300020301	702,735	11.2%	7,604	10.8%	8,700	10.2%
Indian Creek	071300020203	361,782	5.8%	4,507	6.4%	7,071	8.3%
Indian Grove - South Fork Vermilion River	071300020206	619,576	9.9%	5,918	8.4%	6,556	7.7%
Kelly Creek	071300020104	411,894	6.6%	4,539	6.5%	4,030	4.7%
Piper City - North Fork Vermilion River	071300020101	480,919	7.7%	5,227	7.5%	5,496	6.4%
Pleasant Ridge - North Fork Vermilion River	071300020303	801,267	12.8%	9,576	13.6%	10,603	12.4%
Town of Cullom - North Fork Vermilion River	071300020105	463,531	7.4%	6,127	8.7%	7,279	8.5%
Town of Fairbury	071300020205	375,082	6.0%	3,379	4.8%	5,356	6.3%
Town of Forrest - South Fork Vermilion River	071300020202	557,786	8.9%	6,172	8.8%	8,321	9.7%
Town of Kempton - Kelly Creek	071300020103	412,507	6.6%	5,190	7.4%	5,692	6.7%
Turtle Pond - South Fork Vermilion River	071300020201	242,374	3.9%	3,433	4.9%	5,118	6.0%
	Total	**6,260,261**	**100%**	**70,155**	**100%**	**85,357**	**100%**

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5.0 Sources of Watershed Impairments

Watershed impairments originate from either NPS or point source pollution. A description of point source pollution is given in Section 3.15. NPS pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source." Unlike pollution from point sources like industrial and sewage treatment plants, NPS pollution comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. The runoff picks up and carries away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters, and ground waters (USEPA 2018).

In the VHW, sources of sediment and nutrients are thought to originate from cropland, gullies, and streambank erosion. Point source discharges contribute to watershed loading and leaking or improperly maintained septic systems may also be a source of nutrients.

The following section provides pollutant source descriptions identified at the significant subcategory level, along with estimates to the extent they are present in the watershed. The section looks at the greatest contributions and spatial extent of loading by each major source.

5.1 Phosphorus and Nitrogen

The primary source of both nitrogen and phosphorus is tile drainage runoff from cropland, which is responsible for 96% of the total nitrogen load and 44% of the total phosphorus load (Table 50). Secondary sources include surface runoff (cropland and non-cropland), gully erosion, septic systems, and point sources.

Table 50 – Nutrient Loading from all Sources

Pollutant Source	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)
Gully Erosion	22,842	6,114	0.36%	7.2%
Surface Runoff: Cropland	53,181	6,110	0.85%	7.2%
Tile Drainage Runoff: Cropland	6,041,100	37,107	96.2%	43.9%
Streambank Erosion	5,005	2,366	0.08%	2.8%

Pollutant Source	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)
Septic Systems	10,593	4,147	0.17%	4.9%
NPDES Discharges (point source)	6,519	7,846	0.1%	9.3%
Surface Runoff: Non-Cropland	143,142	20,797	2.28%	24.6%
Total	**6,282,382**	**84,487**	**100%**	**100%**

5.1.1 Cropland

The amount of nutrients originating from cropland depends on tillage practices, presence of subsurface (tile) drainage, proximity to a receiving waterbody, and the presence or absence of conservation practices. To better understand the extent of nutrient loading from cropland, an analysis was performed to investigate the total and per-acre loading by tillage type and soil HEL designation. Results are presented in Table 51 and Table 52.

5.1.1.1 Tillage

Strip till and conventional till have the highest annual per-acre loading of nutrients. Conventional tillage of row crop contributes 43% of the total nitrogen and 46% of the phosphorus loads from cropland (Table 51). Strip till is responsible for 36.6% of the nitrogen load and 43.8% of the phosphorus. The per-acre loadings are similar since 96% of the nitrogen and 44% of the phosphorus loss is through subsurface drainage and not surface runoff. Conventional till specialty crops and reduced-till fields combined only produce 11% of phosphorus load and 8.5% of the nitrogen. Annual per-acre nitrogen loadings from strip till fields were slightly higher at 27 lbs/ac versus conventional at 21 lbs/ac. Conventional and strip till were similar for phosphorus at 0.16 lbs/ac and 0.17 lbs/ac, respectively. Reduced till and cover crop fields have the lowest phosphorus loadings at 0.15 lbs/ac, but the cover crop fields had a slightly higher nitrogen load at 21.2 lbs/ac versus 17.2 lbs/ac for reduced. Conventionally tilled specialty crop fields had the highest phosphorus loading at 0.2 lbs/ac, but the lowest nitrogen at 11.3 lbs/ac.

Table 51 – Cropland Nutrient Loading by Tillage Type

Tillage Type	Area (ac)	Area (% cropland)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% cropland total)	Phosphorus Load (% cropland total)	Nitrogen Load per Acre (lbs/ac/yr)	Phosphorus Load per Acre (lbs/ac/yr)
Conventional	124,919	46.6%	2,623,081	19,846	43%	45.9%	21	0.16
Conventional Specialty	3,882	1.4%	43,745	771	0.72%	1.8%	11.3	0.2
Reduced Till	27,639	10.3%	475,234	4,167	7.8%	9.6%	17.2	0.15
Strip Till	98,164	36.6%	2,670,613	16,387	43.8%	37.9%	27.2	0.17
Cover Crop	13,303	5%	281,609	2,046	4.62%	4.7%	21.2	0.15
Total	**267,907**	**100%**	**6,094,281**	**43,217**	**100%**	**100%**	**22.7**	**0.2**

Tillage Type	Area (ac)	Area (% cropland)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% cropland total)	Phosphorus Load (% cropland total)	Nitrogen Load per Acre (lbs/ac/yr)	Phosphorus Load per Acre (lbs/ac/yr)
Conventional is corn and soybean fields. Conventional specialty includes hay, winter wheat, alfalfa, rye, sorghum, sweet corn, potato, cabbage, etc. fields. For the model, cover crops were implemented only on strip till fields.								

5.1.1.2 HEL Soils

An analysis was performed to better understand the extent of nutrient loading based on HEL soils in combination with tillage practices; results are presented in Table 52. Since the non-highly erodible (NHEL) soils cover 92% of the cropland area, they contribute 88% and 89% of the nitrogen and phosphorus load, respectively. Even though HEL soils make up only 8.4%, they account for 11% of the phosphorus and 12% of the nitrogen loading from cropland. These soils have much higher per-acre nutrient loading than NHEL. On average, phosphorus loading per acre is 1.4 times higher on HEL soils, and nitrogen loading is 1.5 times higher.

The annual yield of HEL soils for the various tillage practices were similar for phosphorus, except for conventional till specialty crop, which is the highest at 0.26 lbs/ac. The per-acre loadings for nitrogen ranged from 10.9 to37.5 lbs/ac with strip till the highest. Average annual per-acre yield from conventional till is 0.22 lbs/ac for phosphorus and 30.1 lbs/ac for nitrogen. Per-acre HEL soils, regardless of tillage type, yield about 1.4 to 1.7 times more nutrients than NHEL, with the exception of specialty crops on conventionally tilled ground. Nitrogen and phosphorus yield from cover crops (on strip till ground) is much lower for both NHEL and HEL soils in comparison to strip till only.

Table 52 – Cropland Nutrient Loading by HEL and Tillage Type

Tillage Type	Soil Type*	Area (ac)	Area (% cropland)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% cropland total)	Phosphorus Load (% cropland total)	Nitrogen Load per Acre (lbs/ac/yr)	Phosphorus Load per Acre (lbs/ac/yr)
Conventional	HEL	10,127	3.78%	305,300	2,211	5%	5.12%	30.1	0.22
	NHEL	114,791	42.9%	2,317,781	17,635	38%	40.8%	20.2	0.15
Conventional Specialty	HEL	750	0.28%	8,191	196	0.1%	0.45%	10.9	0.26
	NHEL	3,131	1.17%	35,554	575	0.6%	1.33%	11.4	0.18
Reduced Till	HEL	2,108	0.79%	59,634	412	1.0%	0.95%	28.3	0.20
	NHEL	25,531	9.53%	415,600	3,755	6.8%	8.69%	16.3	0.15
Strip Till	HEL	8,566	3.20%	320,942	1,775	5.3%	4.11%	37.5	0.21
	NHEL	89,598	33.4%	2,349,671	14,612	38.6%	33.8%	26.2	0.16
Cover Crop	HEL	886	0.33%	26,478	179	0.4%	0.42%	29.9	0.20
	NHEL	12,417	4.63%	255,131	1,866	4.2%	4.32%	20.5	0.15
HEL		**22,437**	**8.38%**	**720,544**	**4,773**	**11.8%**	**11.1%**	**32.1**	**0.21**
NHEL		**245,470**	**91.6%**	**5,373,737**	**38,444**	**88.2%**	**89.0%**	**21.9**	**0.16**

Tillage Type	Soil Type*	Area (ac)	Area (% cropland)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% cropland total)	Phosphorus Load (% cropland total)	Nitrogen Load per Acre (lbs/ac/yr)	Phosphorus Load per Acre (lbs/ac/yr)
Cropland, Total		**267,907**	**100%**	**6,094,281**	**43,217**	**100%**	**100%**	**22.7**	**0.16**
HEL = highly erodible soils and potentially highly erodible soils; NHEL = non-highly erodible soils. For the model, cover crops were implemented only on strip till fields.									

5.1.2 Gullies, Streambanks, Septic Systems, and Point Sources

Surface runoff from non-cropland is the second highest source of nitrogen (2.3%) and phosphorus (24.6%). Point sources (NPDES dischargers) contribute the third highest phosphorus load at 9.3%. Gully erosion delivers 0.36% of the total nitrogen and 7.2% of the total phosphorus load. Potentially failing septic systems contribute 0.17% of the nitrogen load and 4.9% of the phosphorus. Streambank erosion delivers only 0.08% of the total annual nitrogen load and 2.8% of the total phosphorus.

5.2 Sediment

The primary source sediment in the watershed is non-cropland surface runoff, as it is responsible for 44% (Table 53). Secondary sources include eroding gullies and surface runoff from cropland at 33.5% and 18.3%, respectively. It should be noted that the SWAT+ model output does not distinguish between sediment loss from surface flow versus sediment loss from subsurface (tile) runoff, so the cropland sediment load is a combination of both. There can be fine particle suspended sediment loss from tile drainage systems, particularly open systems (surface intakes), and older systems with clay tile; however, the loss of sediment through tiles comprise a small percentage of the estimated total annual sediment loading from the cropland drained by tile.

Table 53 - Sediment Loading from all Sources

Pollutant Source	Sediment Load (tons/yr)	Sediment Load (% total)
Gully Erosion	29,889	33.5%
Surface Runoff: Cropland	16,372	18.3%
Tile Drainage Runoff: Cropland	-	-
Streambank Erosion	3,892	4.4%
Septic Systems	-	-
NPDES Discharges (point source)	45	0.05%
Surface Runoff: Non-Cropland	39,088	43.8%
Total	89,286	100%

5.2.1 Cropland

The amount of sediment originating from cropland runoff depends on tillage practices, presence of tile (subsurface) drainage, proximity to a receiving waterbody, the presence or absence of conservation practices, and land slope. To better understand the extent of sediment loading from cropland, an analysis was performed to investigate the total and per-acre yield by tillage practices and soil HEL designation. Results are presented in Table 54 and Table 55. In general, the loss of sediment is low due to the use of subsurface drainage, the watershed being relatively flat with slopes between 0% to 5%, and the presence of existing practices, such as grassed waterways, terraces, and WASCOBs in areas with steeper slopes.

5.2.1.1 Tillage

Conventional till and conventional till specialty contribute the highest annual per-acre yield of direct sediment runoff (0.08 tons/ac). However, conventional contributes the largest portion (60.7%) of the total load from cropland (Table 54) as it comprises 46.6% of cropland acreage. Strip till covers 36.6% of the total cropland area but contributes a third less (24.9%) sediment than conventional. Conventional specialty, reduced, and cover crops (with strip till) together are responsible for 14%. Annual per-acre yield of strip and reduced till is 0.042 and 0.052 tons/ac, respectively. Sediment from cover crop fields is slightly higher than strip till at 0.046 tons/ac.

Table 54 – Cropland Sediment Loading by Tillage Type

Tillage Type	Area (ac)	Area (% cropland)	Sediment Load (tons/yr)	Sediment Load (% Cropland total)	Sediment Load per Acre (tons/ac/yr)
Conventional	124,919	46.6%	9,941	60.7%	0.08
Conventional Specialty	3,882	1.4%	308	1.9%	0.079
Reduced Till	27,639	10.3%	1,432	8.7%	0.052
Strip Till	98,164	36.6%	4,082	24.9%	0.042
Cover Crops	13,303	5.0%	610	3.7%	0.046
Total	**267,907**	**100%**	**16,372**	**100%**	**0.061**

Conventional is corn and soybean fields. Conventional specialty includes hay, winter wheat, alfalfa, rye, sorghum, sweet corn, potato, cabbage, etc. fields. For the model, cover crops were implemented only on strip till fields.

5.2.1.2 HEL Designation

An analysis was performed to better understand the extent of surface runoff sediment loading based on HEL soils and tillage. Results are presented in Table 55. Although HEL soils make up only 8.4% of total watershed cropland area, they account for 34.5% of its sediment load. Most (91.6%) originates from NHEL, whereas HEL soils yield the highest on a per-acre basis. On average, HEL soils have nearly six times higher annual per-acre rates than NHEL soils (0.25 tons/ac vs. 0.041 tons/ac). For example, conventional tillage of HEL soils is over five times that of NHEL or 0.321 tons/ac/yr versus 0.058 tons/ac/yr.

Conventional tillage yields 1.2 to 1.7 times more sediment than other tillage types on HEL soils. Annual per-acre yield of HEL soils from conventional specialty, reduced and strip-till range from 0.186 to0.248 tons/ac. Cover crop with strip tillage on HEL soils yields 0.2 tons/ac/yr.

Table 55 – Cropland Sediment Loading by HEL Soils and Tillage Type

Tillage Type	Soil Type*	Area (ac)	Area (% of copped soil)	Sediment Load (tons/yr)	Sediment Load (% total)	Sediment Load per Acre (tons/ac/yr)
Conventional	HEL	10,127	3.78%	3,248	19.8%	0.321
	NHEL	114,791	42.85%	6,693	40.9%	0.058
Conventional Specialty	HEL	750	0.28%	186	1.1%	0.248
	NHEL	3,131	1.17%	121	0.7%	0.039
Reduced Till	HEL	2,108	0.79%	449	2.7%	0.213
	NHEL	25,531	9.53%	983	6%	0.038
Strip Till	HEL	8,566	3.2%	1,596	9.8%	0.186
	NHEL	89,598	33.44%	2,485	15.2%	0.028
Cover Crop	HEL	886	0.33%	177	1.1%	0.2
	NHEL	12,417	4.63%	432	2.6%	0.035
HEL		**22,437**	**8.4%**	**5,657**	**34.5%**	**0.252**
NHEL		**245,470**	**91.6%**	**10,715**	**65.4%**	**0.044**
Cropland Total		**267,907**	**100%**	**16,372**	**100%**	**0.061**

HEL = highly erodible soils and potentially highly erodible soils; NHEL = non-highly erodible soils. For the model, cover crops were implemented only on strip till fields.

5.2.2 Gullies, Streambanks, and Point Sources

Gully erosion is the second highest source of sediment at 33.5% (Table 46). Streambank erosion accounts for 4.4%. Point sources contribute only 0.05% of the annual sediment load.

6.0 Nonpoint Source Management Measures and Load Reductions

This section details the recommended BMPs, their quantities and expected annual pollution load reductions. Although reductions presented include nitrogen, phosphorus and sediment, special attention is given to nitrogen as nitrate-nitrogen is the most common water quality impairment in the watershed. The VHW Steering Committee also identified sediment as a concern, so practices that reduce phosphorus and sediment are also addressed.

BMPs can be described as a practice or procedure to prevent or reduce water pollution and address stakeholder concerns. They typically include treatment requirements, operating procedures, and practices to control surface runoff and mitigate pollution loading. This section describes all site-specific BMPs needed to achieve measurable load reductions in nitrogen, phosphorous, and sediment.

Expected load reductions are calculated using average pollutant reduction percentages based on the INLRS, existing literature, and local expertise. Ranges of pollutant reduction efficiencies used to calculate expected load reductions can be found in Table 56. Those without expected removal efficiencies will still likely address the given pollutant. Given the INLRS does not list expected reductions for a subset of practices, zero values were therefore utilized in this plan.

Table 56 – Pollutant Reduction Efficiency Ranges by BMP

BMP	Nitrogen Reduction (%)	Phosphorus Reduction (%)	Sediment Reduction (%)
Bioreactors[1,3]	25-39.8	0	0
Conservation Tillage[1]	0	50	70
Constructed Wetlands[1,3]	44-50	44	51
Contour Strips/Prairie Strips[2,3]	67-85*	90	95-96
Cover Crops, grasses (tiled)[1,4]	30	30	31-100 (40)
Cover Crops, grasses (non-tiled)[1,4]	30	30	31-100 (40)
Depressions/Restored Wetlands[3]	39-50	41	27
Drainage Water Management[2,3]	33-38.5	0	0
Filter Strips/Stream Buffers - non-tiled (N reduction is for only the fraction of groundwater that makes it to the stream)[1,3]	67-90*	50-90	40-87.5 (70)
Grassed Waterways[3]	0	11	87
Nutrient Management (N: 50% fall, 50% spring; P: SPT reduction) - tiled[1]	9	7	0
Nutrient Management (N: 50% fall, 50% spring; P: SPT reduction) - non-tiled[1]	9	7	0
Nutrient Management (N: 40% fall, 10% spring pre-plant, 50% sidedress; P: SPT reduction) - tiled[1]	18	7	0
Nutrient Management (N: 40% fall, 10% spring pre-plant, 50% sidedress; P: SPT reduction) - non-tiled[1]	18	7	0
Saturated Buffers[2,3]	50-61	0	0
Terraces[2,6]	0	77	80
WASCOBs[2,5]	0	85	80

**Reduction values for only for water that interacts with active area.[1] SPT is Soil Phosphorus Test from Illinois Nutrient Loss Reduction Strategy, Biennial Report 2021 (IDOA et al., 2021), [2] Iowa Nutrient Reduction Strategy (Iowa State University, 2017), [3] Leading at the Edge: A roadmap to advance edge of field practices in agriculture (TNC et al., 2021), [4] Cover Crops at Work: Covering the soil to prevent erosion Clark (SARE), 2015),[5] Benning and Craft, 2018 (citation from NREC report),[6] NRCS Engineering Field Handbook, Part 650, Chapter 8 Terraces*

6.1 Best Management Practices and Expected Load Reductions

Load reductions were calculated for each recommended BMP using SWAT+. Nutrient and sediment loading for each practice were based on the HRU or the LSU (landscape unit). An HRU is a subdivision component of a LSU based on a particular combination of land use, soil, and slope range. Since drainage areas for the structural practices could extend beyond a HRU, the LSU was used for this BMP class. In-field practices are based on the HRU loads. Expected reductions are spatially explicit in that they represent locations in the watershed based on estimated loading but do not reflect the actual management conditions of a given field. Rather they represent percentages of a given BMP within a HRU or LSU.

There can be multiple practices located in any one HRU (or at the field level), such as cover crops with nutrient management, and a bioreactor. One or more tile-treatment practices may be located on a particular field with overlapping drainage areas. Additionally, more BMPs can be applied to the watershed than the locations identified by the model. The expected load reduction for each practice list in Table 57 does not consider the effect of multiple in-field and structural practices working as a system to treat the surface or subsurface nutrient and sediment loadings, so the total watershed reduction is overestimated as the number of ac treated can be up to four times higher than the actual cropland area.

Table 57 lists all proposed BMPs, quantities, area treated, and expected annual load reductions. Structural BMP project locations are shown in Figure 39 and in Figure 40. The in-field management practices are shown in Figure 39 through Figure 44.

All practices will require willing landowners to implement and large investments by watershed partners. Further information on BMP costs, reductions, critical practices, technical and financial assistance, and implementation goals can be found in Sections 7.0 Cost Estimates through 11.0 Implementation Milestones, Objectives and Schedule.

Table 57 – Recommended BMPs and Load Reduction Summary

BMP Class	BMP		Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
In-Field Practices	Cover Crop		28,590 (ac)	28,590	336,513	1,288	759
	Conservation Tillage		48,350 (ac)	48,350	0	940	3,509
	Nutrient Management	Split Applied	8,610 (ac)	8,610	14,873	83	0
		Split Applied with Sidedress	37,879 (ac)	37,879	326,471	405	0
In-Field Practices Subtotal				*123,428*	*677,857*	*2,715*	*4,268*
Structural Practices	Bioreactors		849 (#), 282,997 (CY)	27,442	185,405	0	0
	Constructed Wetlands		521 (#), 1,532 (ac)	49,829	494,639	2,909	4,625

BMP Class	BMP		Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
	Contour Buffer Strips (CBS)		496 (#), 332,218 (ft)	660	431	68	178
	Wetland, Depression		260 (#), 1,346 (ac)	22,400	5,274	636	814
	Drainage Water Management[1]		1,318 (#), 52,564 (ac)	52,564	352,207	0	0
	Filter Strip (FS)[2]	CZ	36(#), 239 (ac)	18,098	11,603	1,334	1,702
		DRV	291 (#), 261 (ac)	5,079	2,087	238	403
		MSB	250 (#), 234 (ac)	25,788	15,800	1,875	3,531
		SSG	634 (#), 584 (ac)	108,178	143,173	16,146	44,756
		SBS	913 (#), 827 (ac)	5,834	3,474	401	851
	Grassed Waterway		1,954 (#), 832,633 (ft)	73,804	0	61.2	9,135
	Saturated Buffer		232 (#), 192,375 (ft)	24,752	331,431	0	0
	Terrace / WASCOB		238 (#), 23,794 (ft)	3,075	0	274	620
Structural Practices Subtotal			*7,992(#), 1,381,020 (ft), 58,091 (ac)*	*417,506*	*1,545,524*	*23,943*	*66,616*
Total				**540,935**	**2,223,381**	**26,658**	**70,884**

[1] Only fields where pattern tile was visible were selected.[2] Buffer functional types: Critical Zone (CZ), Deep Rooted Vegetation (DRV), Multi-species Buffer (MSB), Stiff Stemmed Grass (SSG), and Streambank Stabilization (SBS).

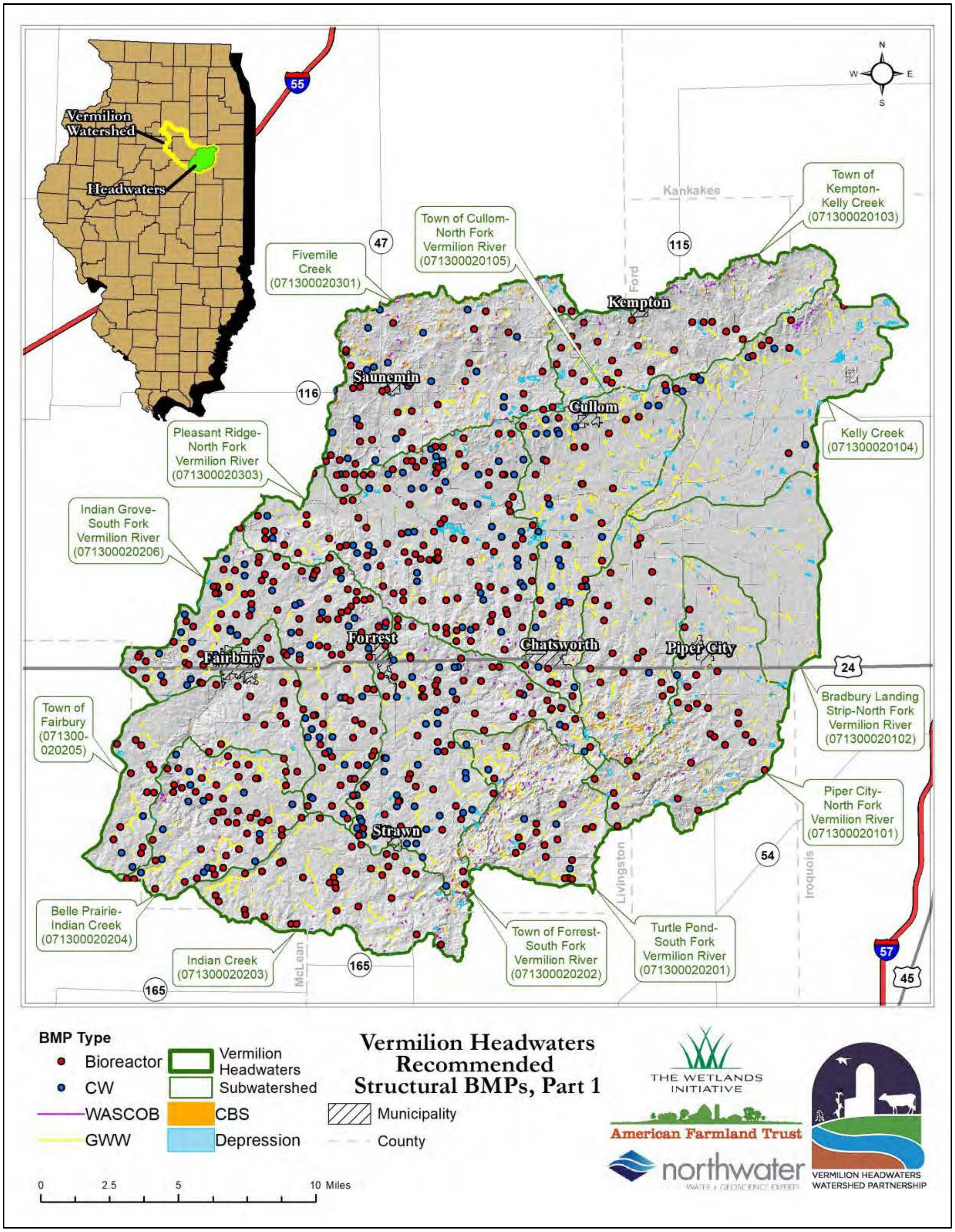


Figure 39 - Recommended Structural BMPs Part 1

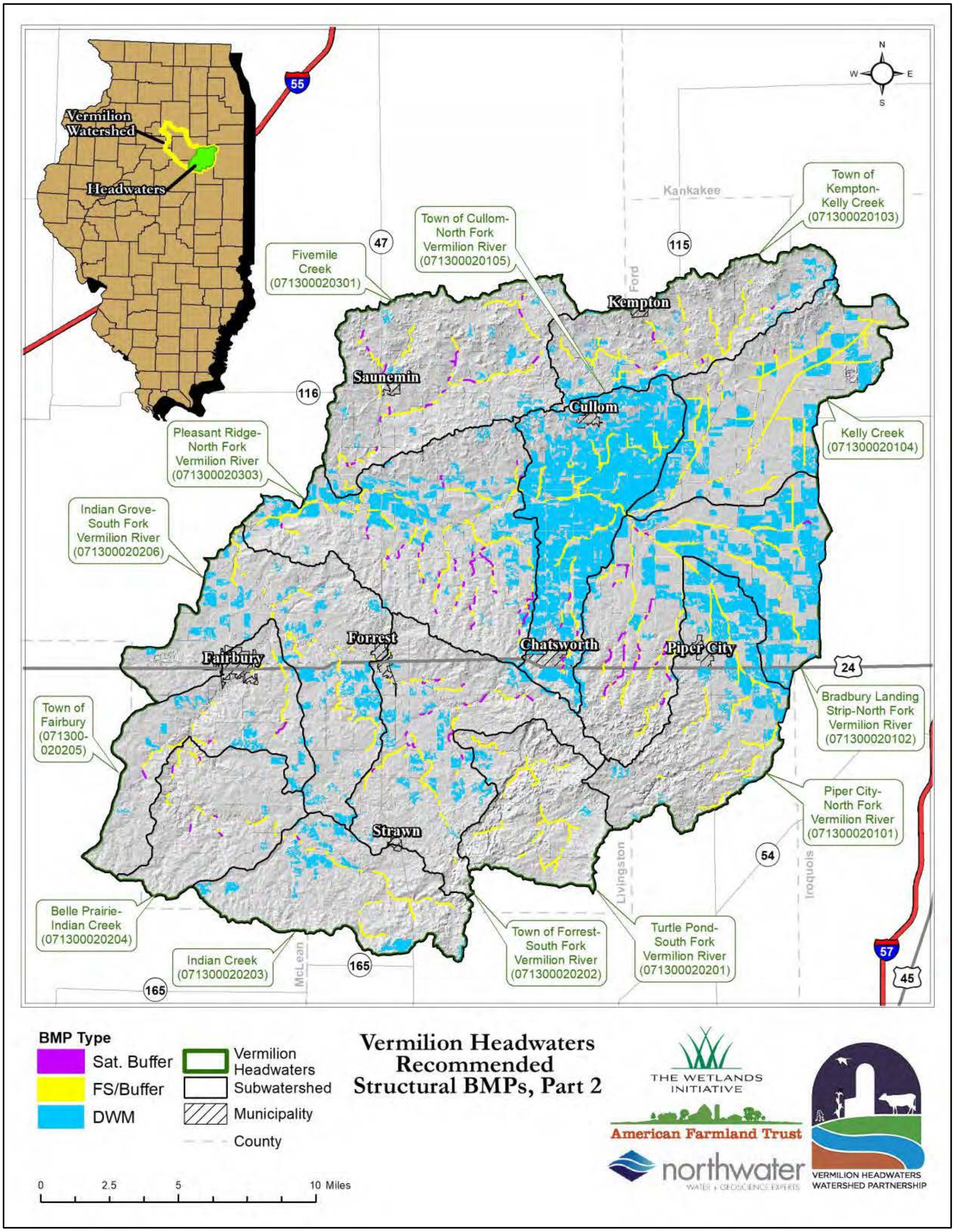


Figure 40- Recommended Structural BMPs Part 2

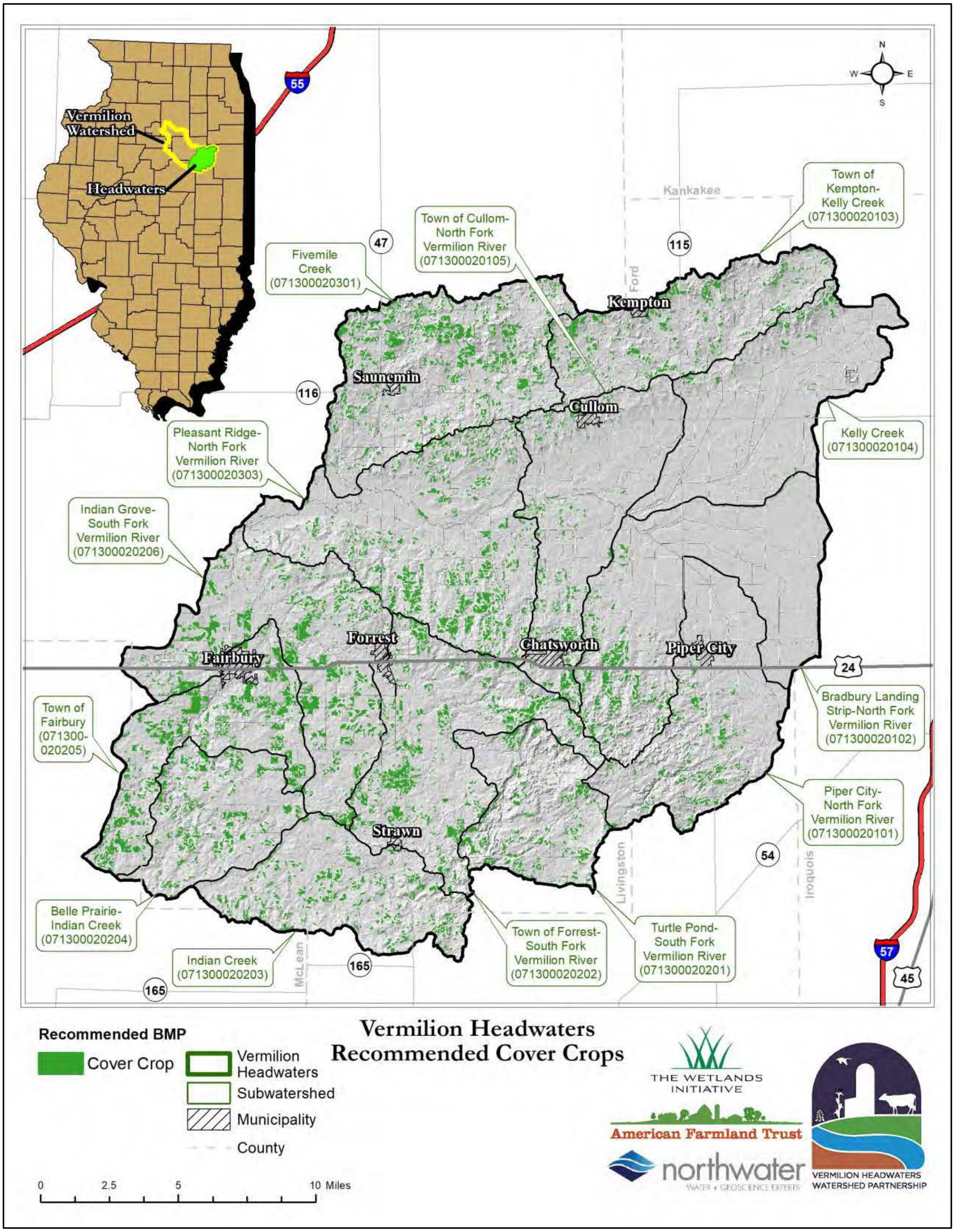


Figure 41 - Recommended In-Field BMPs: Cover Crops

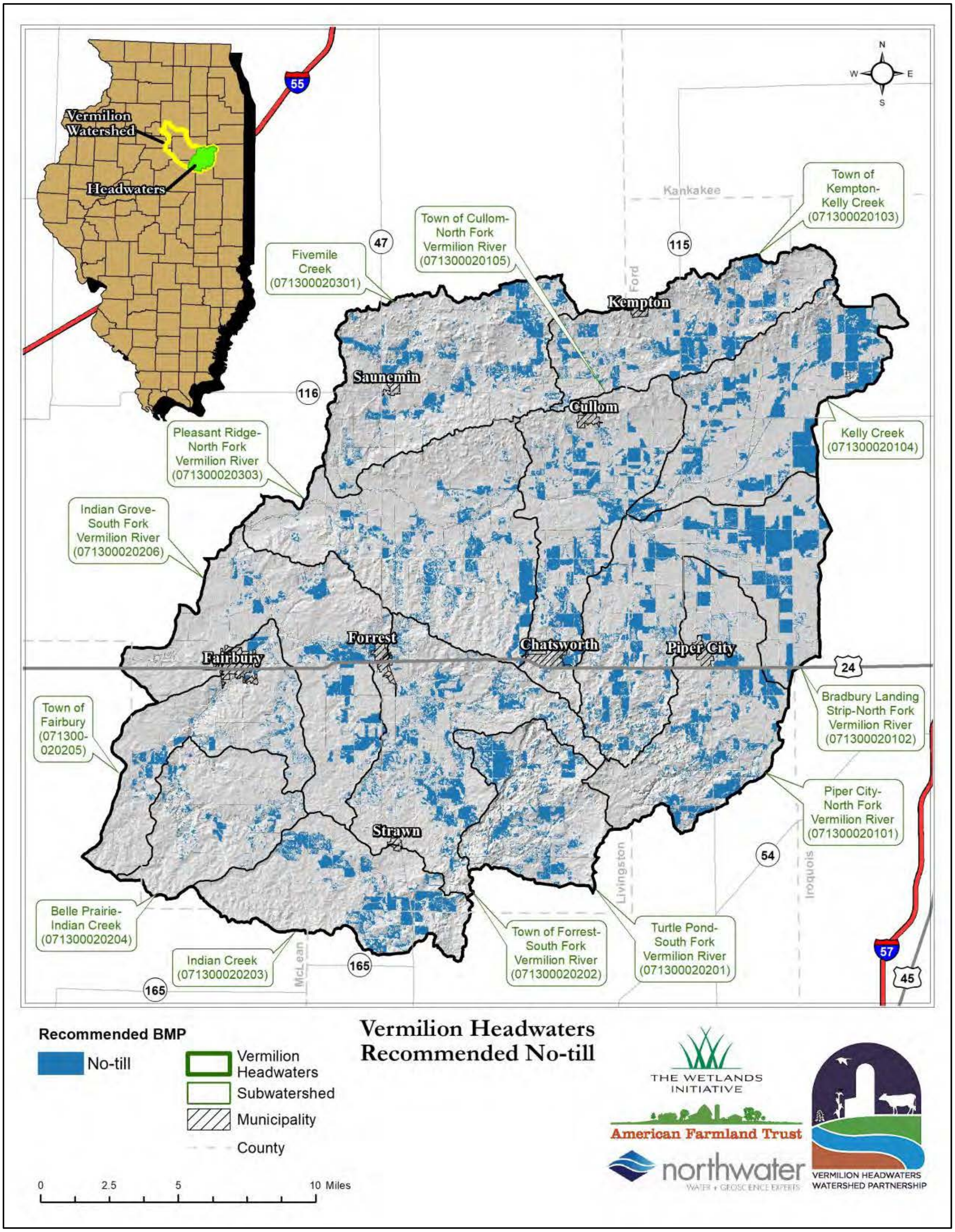


Figure 42- Recommended In-Field BMPs: No-Till

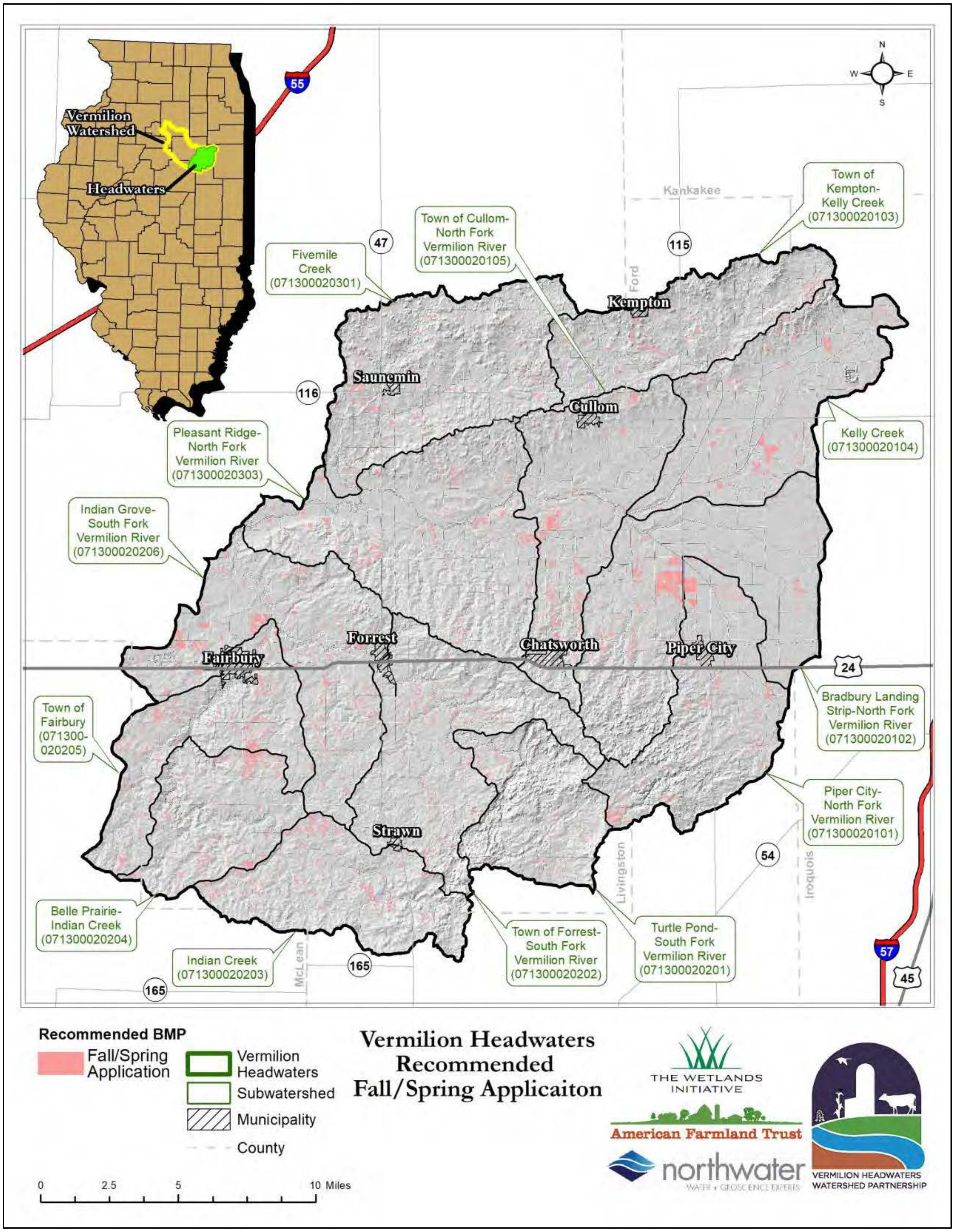


Figure 43– Recommended In-Field BMPs: Nitrogen Split Fertilizer Application

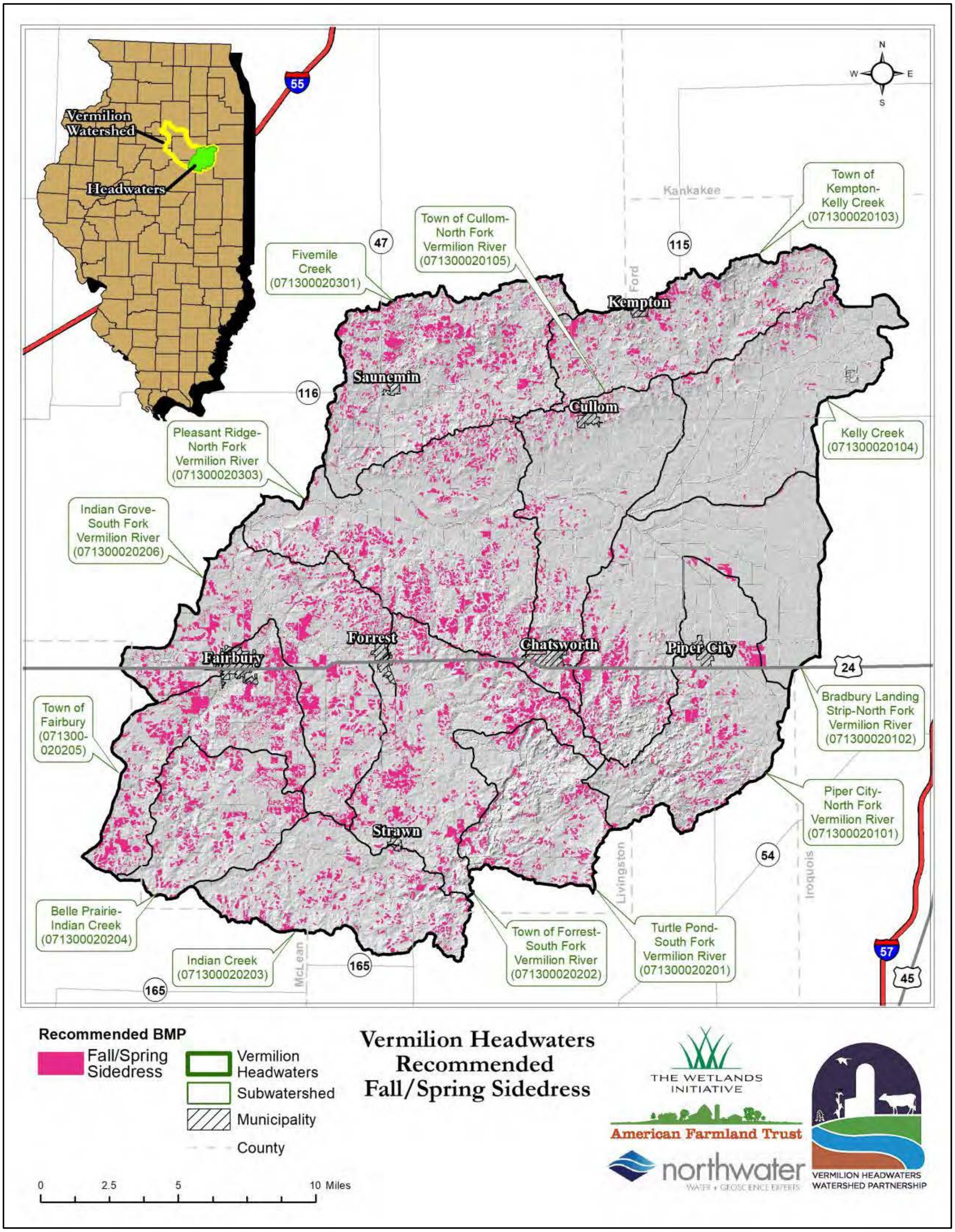
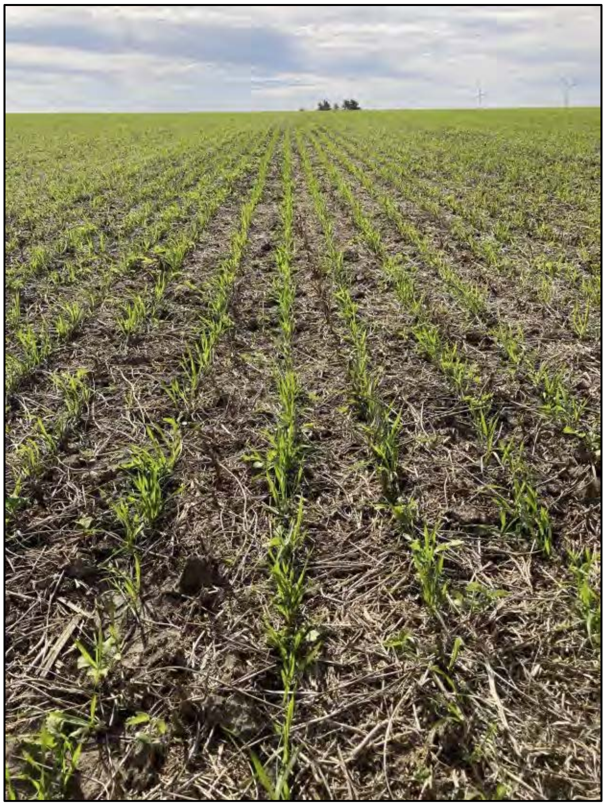


Figure 44– Recommended In-Field BMPs: Nitrogen Split Fertilizer Application with Sidedress

6.1.1 In-Field Best Management Practice Summary

In-field management measures are proposed to help achieve water quality targets and are considered a priority. These measures focus on sediment and nutrient loading coming from cropland.



6.1.1.1 Cover Crops

A cover crop is a temporary vegetative cover that is grown to provide protection for the soil and improve soil conditions. Cover crops can be applied over a broad area in the watershed on both tiled and non-tiled fields. There are many different types of cover crop. Some species terminate in the winter, such as oats, and others that are terminated in the spring using herbicide or mechanical methods such as cereal rye Fields with some type of conservation tillage system (strip-till or reduced-till) and subsurface (tile) drainage nitrate loss of greater than 30lbs/acre were selected. Cover crops are proposed for 28,590 ac across the watershed. If cover crops are planted to cereal rye on all the selected ac, load reductions are estimated to be:

- 336,513 lbs/yr of nitrogen
- 1,288 lbs/yr of phosphorus
- 759 tons/yr of sediment

6.1.1.2 Conservation Tillage

Conservation tillage consists of no-till/strip-till, mulch-till and reduced-till and can be broadly defined as farming where at least 30% of the plant residue is maintained after tillage activities. With no-till, the soil is left almost completely undisturbed from harvest to planting. Strip-till is a minimum tillage system that combines the soil drying and warming benefits of conventional tillage with the soil-protecting advantages of no-till by disturbing only the portion of the soil that is to contain the seed row. Mulch and reduced-till maintain some residue. Areas with sediment yield greater than 1 ton/acre or with high to moderate runoff risk were selected. Based on these criteria, conservation tillage is proposed on 48,530 ac. If implemented on all acres, expected reductions are:

- 940 lbs/yr phosphorus
- 3,509 tons/yr sediment

6.1.1.3 Nutrient Management

Nutrient management is the practice of using nutrients essential for plant growth such as nitrogen and phosphorus fertilizers in proper quantities and at appropriate times for optimal economic and environmental benefits. The nutrient management system now being promoted by the utilizes the approach commonly called the “4Rs”:

- Right Source: Matches fertilizer type to crop needs.
- Right Rate: Matches amount of fertilizer to crop needs.

- Right Time: Makes nutrients available when crops need them.
- Right Place: Keeps nutrients where crops can use them.

Figure 45 - 4Rs as described by Nutrient Stewardship, source: nutrientstewardship.org/4rs

Nitrogen

Several methods can be used to manage nitrogen loss from cropland. In the VHW, this includes shifting from fall application to either a 50% fall/50% spring split application or a split application with sidedress (40% fall/10% spring/50% dress).

Shifting the fall application of nitrogen fertilizer to applications in the spring can reduce tile nitrate losses up to 20% (Gentry, 2014) and 6% for surface runoff (Iowa State, 2017). Split applying nitrogen involves two or more fertilizer applications during the growing season rather than providing all the crop's nitrogen requirements with a single treatment. This makes nutrient uptake more efficient and reduces the risk of denitrification, leaching, or volatilization.

Promoting smart soil testing is also important as the spatial variability of available nutrients in a field makes soil sampling the most common and greatest source of error in a soil test (University of Illinois 2012). Proper soil testing is the foundation of good nutrient management as it relates to nitrogen and phosphorus.

Phosphorus

As described in Chapter 8 of the Illinois Agronomy Handbook, regional differences in P-supplying power were broadly defined primarily by parent material and degree of weathering factors. Within a region, variability in parent material, degree of weathering, native vegetation, and natural drainage cause differences in the soil's P-supplying power.

Minimum soil test levels required to produce optimal crop yields vary and depend on the type of crop to be grown and the soil's P-supplying power. Near maximal yields of corn and soybeans are obtained when levels of available P are maintained at 30, 40, and 45 pounds per acre for soils in the high, medium, and low P-supplying regions, respectively. Since these are minimal values, to ensure soil P availability will not restrict crop yield, it is recommended that soil test results be built up to 40, 45, and 50 pounds per acre for soils in the high, medium, and low P-supplying regions, respectively. This is a practical approach because P is not easily lost from the soil, other than through crop removal or soil erosion.

Several methods described in Chapter 8 of the Illinois Agronomy Handbook can be used to manage crop nutrient loss, including variable rate technology (VRT) and deep fertilizer placement.

VRT can improve the efficacy of fertilization and promote more environmentally sound placement of fertilizer compared to single-rate applications derived from the conventional practice of collecting a composite soil sample to represent a large area of the field. Research has shown that this technology often reduces the amount of fertilizer applied over an entire field. However, one of the drawbacks of this placement method is the expense associated with these technologies. Also, VRT can only be as accurate as the soil test information used to guide the application rate (University of Illinois, 2012).

Deep fertilizer placement is where any combination of nitrogen, phosphorus, and potassium can be injected at a depth of 4 to 8 inches. Subsurface applications may be beneficial (if the subsurface band application does not create a channel for water and soil movement) when the potential for surface water runoff is high (University of Illinois, 2012). Implementing a nutrient management plan can reduce phosphorus losses by up to 7%.

Tiled and non-tiled fields covering 8,610 ac that were modeled with only nitrogen fall fertilizer application were chosen for a nitrogen split application of 50% in the fall and 50% in the spring. The 37,879 ac that were modeled as already having a nitrogen split application were selected for the 40% in the fall, 10% spring pre-plant with 50% sidedressed nitrogen application. Phosphorus fertilizer management was selected for the same ac. If the nutrient management activities are implemented on all 46,489 ac, load reductions are estimated to be:

- 341,344 lbs/yr nitrogen
- 488 lbs/yr phosphorus

6.1.2 Structural Best Management Practice Summary

This section provides a brief description of each structural BMP and their expected load reductions. They cover both edge-of-field and in-field practices.

6.1.2.1 Water and Sediment Control Basins (WASCOB)/Terrace

Earth embankments and/or channels constructed across a slope to intercept runoff water and trap soil, WASCOBs are often constructed to mitigate gully erosion where concentrated flow is occurring and where drainage areas are relatively small. Terraces, like a WASCOB in design, are placed in areas where concentrated flow paths are less defined, such as long, wide-sloping fields. These practices are popular with landowners in the watershed and applicable, on sloping ground.

The ACPF model recommended terraces/WASCOBs at 238 locations for a total of 23,794 ft of berm. If all are installed, a total of 3,075 ac will be treated. Expected load reductions will total:

- 274 lbs/yr of phosphorus
- 620 tons/yr of sediment

6.1.2.2 Grassed Waterways

A grassed waterway is a grassed strip in a field that acts as an outlet for water to control silt, filter nutrients and limit gully formation. Grassed waterways are applicable in the watershed in areas with very large drainage areas and low to moderate slopes and are often the only feasible practice in a field that drains a very large area.

Grassed waterways are recommended at 1,954 locations for a total of 832,633 ft or 860 ac (assuming a 45 ft width). If all are installed, a total of 73,809 ac will be treated. Expected load reductions including gully stabilization are:

- 61.2 lbs/yr of phosphorus
- 9,135 tons/yr of sediment

6.1.2.3 Filter Strips/Stream Buffers & Contour/Prairie Strips

A filter strip or stream buffer is a band of grass or other permanent vegetation used to reduce sediment, nutrients, pesticides, and other contaminants. Only those areas directly adjacent to an openly flowing ditch or stream where existing buffer areas are either inadequate or nonexistent were selected for the placement of filter/buffer strips. Five different vegetated buffers designs were identified based on runoff delivery and the width of the shallow water table: critical zone/sensitive sites (CZ); multi-species buffer for water uptake, nutrient, and sediment trapping (MSB); stiff-stemmed grasses to trap runoff and sediment (SSG); deep rooted vegetation tolerant to saturated soils (DRV), and stream bank stability (SBS). The riparian buffer planning identified where opportunities exist to intercept surface runoff (SSG-type buffers), shallow groundwater (DRV-type buffers), or both runoff and groundwater (CZ and MSB type buffers). Where neither opportunity exists, riparian plantings can be designed to reduce bank erosion (SBS-type buffers)

Contour buffer/prairie strips are similar but typically located within or along field edges. Contour buffer strips are strips of perennial vegetation planted along topographic contours, which may be alternated with wider cultivated strips that are farmed on the contour. Contour buffer strips are in-field runoff control practices that use permanent vegetation to decrease the length of slopes along which runoff accumulates, and thereby reduce sheet and rill erosion. Spacing is based on field slope and NRCS recommendations. The minimum strip length is 328 ft (100 meters).

Filter strips/stream buffers are recommended at 2,124 locations for a total of 2,145 ac. If all are planted, 162,977 ac will be treated. Expected load reductions, including from gully erosion are:

- 176,137 lbs/yr of nitrogen
- 19,995 lbs/yr of phosphorus
- 51,244 tons/yr of sediment

Contour/prairie strips are recommended at 496 locations for a total of 332,218 linear ft. Assuming a width of 15 ft, total area would be 114 ac. If all are planted, they will treat 660 ac. Including reduction of gully erosion, expected load reductions are:

- 431 lbs/yr of nitrogen
- 68.2 lbs/yr of phosphorus
- 178 tons/yr of sediment

6.1.2.4 Constructed Wetlands for Subsurface Treatment

A constructed wetland for subsurface (tile) drainage treatment is a shallow water area constructed by creating an earth embankment or excavation area. Constructed wetlands include a water control structure and are designed to improve water quality by intercepting tile-drainage and slowing the water down to allow natural processes to remove nitrate-nitrogen and phosphorous. Constructed wetlands have been identified in tile-drained areas where soil conditions and contributing drainage areas support their establishment.

Constructed wetlands for tile-drainage treatment are recommended at 521 locations for a total of 1,532 ac. If all were installed, 49,829 ac of tile drained land will be treated, and the expected load reductions are:

- 494,639 lbs/yr of nitrogen
- 2,909 lbs/yr of phosphorus
- 4,625 tons/yr of sediment

Wetland Depressions

Depressions are small low-lying areas in poorly drained soils that may be suitable for wetland restoration or creation and can capture and hold surface water runoff and trap sediment-bound nutrients. Depressions are recommended at 260 locations with a footprint of 1,364 ac. If all are implemented, they will treat 22,400 ac of surface runoff and the expected load reductions, including reductions from gully erosion are:

- 5,274 lbs/yr of nitrogen
- 636 lbs/yr of phosphorus
- 814 tons/yr of sediment

6.1.2.5 Saturated Buffers

A saturated buffer is a BMP in which drainage water is diverted as shallow groundwater flow through a grass buffer specifically for nitrate removal. These systems consist of a control structure for diversion of drainage water from the outlet to lateral distribution lines that run parallel to the buffer. Tiled areas adjacent to a stable stream segment or existing grass buffer where adequate slope and ideal soil characteristics are likely to exist were chosen. The potential for saturated buffers is great in the watershed due to the high percentage of tiled crop ground.

A total of 232 prospective saturated buffer sites were identified for a total of 192,375 ft. If installed, 24,752 ac will be treated and expected load reduction are:

- 331,431 lbs/yr of nitrogen.

6.1.2.6 Denitrifying Bioreactor

A denitrifying bioreactor is a structure containing a carbon source, usually woodchips, installed to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via enhanced denitrification. One standard 15 ft by 100 ft by 6 ft deep bioreactor system can treat up to 50 ac. If the treatment area at a location was greater than 50 ac, then it was assumed two standard bioreactors would be needed. Locations were identified by an analysis of watershed soils and tile extent.

849 bioreactors with a total of 282,997 CY (covering an approximate area of 25 ac) can likely be applied effectively to treat 27,442 ac. If all bioreactors were implemented, the expected load reductions are:

- 185,405 lbs/yr of nitrogen

6.1.2.7 Drainage Water Management

Drainage water management (DWM), also known as controlled drainage, is the practice of managing water table depths in such a way that nutrient transport from agricultural tile drains is reduced during the fallow season and plant water availability is maintained during the growing season. Sites were selected by interpretation of watershed soils, slope, and tile extent. A total of 1,318 locations are recommended to treat a total of 52,564 ac. Annual expected load reductions, if all sites are implemented, will be:

- 352,207 lbs/yr of nitrogen

7.0 Cost Estimates

Costs were calculated based on professional judgment and expertise, published research articles, Illinois NRCS EQIP payments for 2023, and Illinois NRCS Practice Scenarios for 2023. The costs of any BMP can vary considerably from site to site and are largely contingent on initial site conditions, existing tile, soils, crop, practice design, and materials, labor, and machine-time costs (which can be highly variable). The costs presented here are simply baseline implementation numbers and are meant to be informative rather than prescriptive.

Cost estimates should be considered as estimates only and revisited during implementation, as required. General cost estimates and assumptions include:

1. Cover crops are assumed to be $56 per acre for 1 year of non-winter terminating crop.

2. No-Till and strip-till are assumed to be $23 per acre for 1 year.
3. Nutrient Management Plan cost is estimated to be $17 per acre for 1 year.
4. Bioreactors are estimated to be $56.85 per CY assuming 100 ft in length, 50 ft wide, and 6 ft deep and an assumed cost of $30 per CY of woodchips.
5. Constructed wetlands for subsurface drainage treatment are estimated to be $38,100 per acre. Costs include excavation, embankments, primary spillway pipe, water control structure, critical area planting, and grade stabilization for the auxiliary spillway.
6. Contour buffers are assumed to be 15 ft wide at an estimated cost of $627 per acre.
7. Wetland depressions are assumed to be restored wetlands with 1ft excavation at an estimated cost of $6,457 per acre.
8. DWM is estimated to be $241 per acre assuming one in-line water control structure (for pipe less than 10 inches in diameter) per 10 ac with manual operation.
9. Filter strips, including land prep and seeding, are estimated at $227/ac for introduced species and $273/ac for native species.
10. Grassed waterways are assumed 45 ft width at an estimated $3,530 per acre, plus 2.51 per ft of tile.
11. Saturated buffers with manual water control structure operation are assumed to be $10.30 per ft.
12. WASCOBs/Terraces with topsoiling with grass, 400 ft of tile, and a riser are estimated to be $5 per ft of length.

Table 58 below provides a detailed breakdown of cost estimates for each BMP type and the cost per unit of loading reduced. The total cost of implementing all the modeled BMPs is estimated to be **$97,241,137**. The average cost per pound of nitrogen removed is $43.74, the average cost per pound of phosphorus removed is $3,647 and the average cost for a ton of sediment removed is $1,372. Per pound of nitrogen reduction, nutrient management of split application with sidedress is the most effective in-field practice, followed by cover crops and then nutrient management split application. For structural practices, several types of filter strips were the most cost-effective. However, they only treat nitrogen in surface runoff. For treating nitrate-nitrogen in tile drainage, saturated buffers are the most cost-effective, followed by DWM, bioreactors, and constructed wetlands. Overall, in-field management practices are the most cost effective per pound of nitrogen given the capital cost of implementing tile-treatment practices.

Table 58 – BMP Cost Summary by BMP Type

BMP Class	BMP		Quantity	Total Cost (USD)	Cost/lb Nitrogen Reduction	Cost/lb Phosphorus Reduction	Cost/ton Sediment Reduction
In-Field Practices	Cover Crop		28,590 (ac)	$1,601,040	$4.76	$1,243.04	$2,109.41
	Conservation Tillage		48,350 (ac)	$1,112,050	-	$1,183.03	$316.91
		Split Applied	8,610 (ac)	$146,370	$9.84	$1,763.49	-

BMP Class	BMP		Quantity	Total Cost (USD)	Cost/lb Nitrogen Reduction	Cost/lb Phosphorus Reduction	Cost/ton Sediment Reduction
	Nutrient Management	Split Applied with Sidedress	37,879 (ac)	$643,943	$1.97	$1,589.98	-
In-Field Practices Subtotal				*$3,503,403*	$5.17	$1,289.91	$820.85
Structural Practices	Bioreactors		849 (#), 282,997 (CY)	$16,088,379	$86.77	-	-
	Constructed Wetlands		521 (#), 1,532 (ac)	$48,564,400	$98.18	$16,696.61	$10,501.06
	Contour Buffer Strips (CBS)		496 (#), 332,218 (ft)	$71,729	$166.50	$1,051.33	$402.40
	Wetland, Depression		260 (#), 1,346 (ac)	$ 8,691,122	$1,647.82	$13,658.14	$10,678.06
	Drainage Water Management[1]		1,318 (#), 52,564 (ac)	$12,562,796	$35.67	-	-
	Filter Strip	CZ	36(#), 239 (ac)	$ 54,253	$4.68	$40.66	$31.87
		DRV	291 (#), 261 (ac)	$71,253	$34.14	$299.18	$176.99
		MSB	250 (#), 234 (ac)	$63,882	$4.04	$34.06	$18.09
		SSG	634 (#), 584 (ac)	$132,568	$0.93	$8.21	$2.96
		SBS	913 (#), 827 (ac)	$187,729	$54.04	$467.66	$220.50
	Grassed Waterway		1,954 (#), 832,633 (ft)	$5,149,191	-	$84,137	$563.68
	Saturated Buffer		232 (#), 192,375 (ft)	$1,981,463	$5.98	-	-
	Terrace / WASCOB		238 (#), 23,794 (ft)	$118,970	-	$434.74	$191.87
Structural Practices Subtotal			*7,992(#), 1,381,020 (ft), 58,091 (ac)*	*$93,737,734*	*$60.65*	*$3,915.00*	*$1,407.14*
Total				**$97,241,137**	**$43.74**	**$3,647.56**	**$1,371.84**

*[1] **Only fields where pattern tile was visible were selected.** Buffer functional types: Critical Zone (CZ), Deep Rooted Vegetation (DRV), Multi-species Buffer (MSB), Stiff Stemmed Grass (SSG), and Streambank Stabilization (SBS).*

If the capital costs of the structural practices were annualized, they would be more cost-effective given their expected life (Table 59). All practices were assumed to have a practice life of 30 years with an interest rate of 6%. The annual cost is based solely on the costs presented in Table 59 and does not include additional operation and maintenance costs, such as prescribed burning, invasive management, and woodchip removal and replacement. The structural practices, in terms of annual costs, have cost-effectiveness in the same range as the in-field management practices. The tile-treatment practices range from $0.43/lb nitrogen for saturated buffers to $7.13/lb for constructed wetlands. The annual cost to implement all the practices would be **$10.1 million**.

Table 59 – BMP Annualized Cost Summary by BMP Type

BMP Class	BMP		Quantity	Total Cost (USD)	Annual Cost/lb Nitrogen Reduction	Annual Cost/lb Phosphorus Reduction	Annual Cost/ton Sediment Reduction
In-Field Practices	Cover Crop		28,590 (ac)	$1,601,040	$4.76	$1,243.04	$2,109.41
	Conservation Tillage		48,350 (ac)	$1,112,050	-	$1,183.03	$316.91
	Nutrient Management	Split Applied	8,610 (ac)	$146,370	$9.84	$1,763.49	-
		Split Applied with Sidedress	37,879 (ac)	$643,943	$1.97	$1,589.98	-
In-Field Practices Subtotal				*3,503,403*	*$5.17*	*$1,289.91*	*$820.85*
Structural Practices	Bioreactors		849 (#), 282,997 (CY)	$1,168,016	$6.30	-	-
	Constructed Wetlands		521 (#), 1,532 (ac)	$3,525,775	$7.13	$1,212.17	$762.38
	Contour Buffer Strips (CBS)		496 (#), 332,218 (ft)	$5,208	$12.09	$76.33	$29.21
	Wetland, Depression		260 (#), 1,346 (ac)	$630,975	$119.63	$991.58	$775.23
	Drainage Water Management[1]		1,318 (#), 52,564 (ac)	$912,059	$2.59	-	-
	Filter Strip[2]	CZ	36(#), 239 (ac)	$3,939	$0.34	$2.95	$2.31
		DRV	291 (#), 261 (ac)	$5,173	$2.48	$21.72	$12.85
		MSB	250 (#), 234 (ac)	$4,638	$0.29	$2.47	$1.31
		SSG	634 (#), 584 (ac)	$9,624	$0.07	$0.60	$0.22
		SBS	913 (#), 827 (ac)	$13,629	$3.92	$33.95	$16.01
	Grassed Waterway		1,954 (#), 832,633 (ft)	$220,440	-	$3,601.95	$24.13
	Saturated Buffer		232 (#), 192,375 (ft)	$143,854	$0.43	-	-
	Terrace / WASCOB		238 (#), 23,794 (ft)	$8,637	-	$31.56	$13.93
Structural Practices Subtotal			*7,695(#), 1,390,153 (ft), 58,091 (ac)*	*$6,651,968*	*$4.30*	*$277.82*	*$99.86*
Total				**$10,155,371**	**$4.57**	**$380.93**	**$143.27**

[1] Only fields where pattern tile was visible were selected. [2] Buffer functional types: Critical zone (CZ), Deep rooted vegetation (DRV), Multi-species buffer (MSB), Stiff stemmed grass (SSG), and Stream bank stabilization (SBS). The practice life for all structural practices was assumed to be 30 years with an interest rate of 6%.

In addition to the costs presented in this section for BMP implementation, there will be those associated with education and outreach. For example, it is estimated that costs for education and outreach could range from $30,000 – $50,000 per year, including staff time to contact and educate landowners, organize workshops, and develop grant applications.

8.0 Water Quality Targets

This section describes water quality targets and implementation actions required to meet them. The primary pollutant of concern in the VHW watershed is nitrate-nitrogen. Therefore, the nitrate-nitrogen reduction target is set at 15% and aligned with INLRS goals. If all practices are installed, the nitrogen target reduction will be exceeded (Table 60). The phosphorus reduction would exceed the INLRS goal of a 45% reduction at 57.3%. Reductions were based on individual practices and not the additive effect of multiple practices. Therefore, in the case of sediment recommended practices remove more sediment than is being lost, as multiple practices on a field that can address surface and gully erosion issues resulting in double counting. Since this watershed plan focuses on the reduction of NPS from cropland areas, point sources and streambank erosion were omitted from the analysis.

Results indicate that implementation of both in-field and structural practices can achieve the targets for nitrogen as well as reduce phosphorus and sediment. Additional reductions will be achieved over time as in-field management becomes more widespread.

Cover crops and split fertilizer application with sidedress will likely provide the greatest in-field total nitrogen reduction at 5.5%, while the conversion to no-till and strip-till (conservation tillage) methods will likely provide the greatest potential total reductions of sediment at 4.1%. Cover crops and conservation tillage will provide a reduction of 4.5% for phosphorus. Overall, the in-field management BMPs will achieve an 11% nitrogen, a 5.5% phosphorus, and a 5% sediment reduction. In-field management is less costly on an annual basis but requires a long-term commitment to ensure reductions are realized consistently over multiple years.

Combined, structural practices will provide a 25% nitrogen and a 48.5% phosphorus reduction and will remove area substantial amount of sediment. Constructed wetlands for tile-drainage treatment will generate the highest nitrogen load reduction at 8.1%, with DWM and saturated buffers providing around 5%. Filter strips are expected to generate highest phosphorus removal at 40%. Constructed wetlands and depressions will provide 5.9% and 1.3% phosphorus removal, respectively and filter strips and WASCOBs will likely provide the greatest potential for sediment removal.

Table 60 – Water Quality Targets and Load Reductions

BMP Class	BMP		Quantity	Nitrogen Reduction (% of total load)	Phosphorus Reduction (% of total load)	Sediment Reduction (% of total load)
In-Field Practices	Cover Crop		28,590 (ac)	5.5%	2.61%	0.89%
	Conservation Tillage		48,350 (ac)	0.00%	1.91%	4.11%
	Nutrient Management	Split Applied	8,610 (ac)	0.24%	0.17%	0%
		Split Applied with Sidedress	37,879 (ac)	5.34%	0.82%	0%

BMP Class	BMP		Quantity	Nitrogen Reduction (% of total load)	Phosphorus Reduction (% of total load)	Sediment Reduction (% of total load)
In-Field Practices Subtotal				11.08%	5.51%	5.0%
Structural Practices	Bioreactors		849 (#), 282,997 (CY)	3%	0%	0%
	Constructed Wetlands		521 (#), 1,532 (ac)	8.1%	5.9%	10%
	Contour Buffers		496 (#), 332,218 (ft)	0%	0.1%	0.4%
	Wetland, Depression		260 (#), 1,346 (ac)	0.1%	1.3%	1.8%
	Drainage Water Management[1]		1,318 (#), 52,564 (ac)	5.8%	0%	0%
	Filter Strip[2]	CZ	36(#), 239 (ac)	0.2%	2.7%	2%
		DRV	291 (#), 261 (ac)	0.01%	0.5%	0.5%
		MSB	250 (#), 234 (ac)	0.3%	3.8%	4.1%
		SSG	634 (#), 584 (ac)	2.3%	32.7%	52.4%
		SBS	913 (#), 827 (ac)	0.1%	0.8%	1%
	Grassed Waterway		1,954 (#), 832,633 (ft)	0%	0.1%	10.7%
	Saturated Buffer		232 (#), 192,375 (ft)	5.4%	0%	0%
	Terrace / WASCOB		238 (#), 23,794 (ft)	0%	0.6%	1.3%
Structural Practices Subtotal				25.3%	48.5%	78.0%
			Total Reductions and Targets	**36.3% (target exceeded)**	**54.0% (target exceeded)**	**83.0% (target exceeded)**

[1] Only fields where pattern tile was visible were selected. [2] Buffer functional types: Critical zone (CZ), Deep rooted vegetation (DRV), Multi-species buffer (MSB), Stiff stemmed grass (SSG), and Stream bank stabilization (SBS).

Load reductions were calculated for each subwatershed based on practice location and nutrient and sediment yield (Table 61). Relative percentages are listed in Table 62. The largest potential nitrogen load reductions are likely generated from the Pleasant Ridge-North Fork Vermilion River (6%), Indian Grove-South Fork Vermilion River (4.5%), and Fivemile Creek (4.3%) subwatersheds. Bradbury Landing Strip-North Fork Vermilion River has the highest potential phosphorus (10.2%) and sediment load reduction by subwatershed (20.6%).

Table 61 –Load Reductions by Subwatershed

Subwatershed	HUC12 Code	Total Nitrogen Load Reduction (lbs/yr)	Total Phosphorus Load Reduction (lbs/yr)	Total Sediment Load Reduction (tons/yr)
Belle Prairie-Indian Creek	071300020204	105,398	364	1,397

Subwatershed	HUC12 Code	Total Nitrogen Load Reduction (lbs/yr)	Total Phosphorus Load Reduction (lbs/yr)	Total Sediment Load Reduction (tons/yr)
Bradbury Landing Strip - North Fork Vermilion River	071300020102	223,345	5,035	17,616
Fivemile Creek	071300020301	262,418	2,255	4,076
Indian Creek	071300020203	92,201	2,958	12,503
Indian Grove - South Fork Vermilion River	071300020206	273,797	1,908	5,068
Kelly Creek	071300020104	68,517	2,199	3,193
Piper City - North Fork Vermilion River	071300020101	125,617	2,880	8,867
Pleasant Ridge - North Fork Vermilion River	071300020303	366,793	3,091	4,915
Town of Cullom - North Fork Vermilion River	071300020105	220,271	2,083	4,349
Town of Fairbury	071300020205	115,176	489	1,446
Town of Forrest - South Fork Vermilion River	071300020202	225,281	1,311	3,061
Town of Kempton - Kelly Creek	071300020103	93,250	1,126	2,227
Turtle Pond - South Fork Vermilion River	071300020201	51,318	960	2,165
	Total	**2,223,382**	**26,659**	**70,884**

Table 62 – Water Quality Targets and Load Reductions by Subwatershed

Subwatershed	HUC12 Code	Nitrogen Load Reduction		Phosphorus Load Reduction		Sediment Load Reduction	
		% Load	% Total Watershed	% Load	% Total Watershed	% Load	% Total Watershed
Belle Prairie-Indian Creek	071300020204	63.0%	1.7%	12.9%	0.7%	35.9%	1.6%
Bradbury Landing Strip - North Fork Vermilion River	071300020102	59.1%	3.7%	89.0%	10.2%	243.3%	20.6%
Fivemile Creek	071300020301	62.7%	4.3%	29.7%	4.6%	46.9%	4.8%
Indian Creek	071300020203	74.5%	1.5%	65.6%	6.0%	176.8%	14.6%
Indian Grove - South Fork Vermilion River	071300020206	55.8%	4.5%	32.2%	3.9%	77.3%	5.9%
Kelly Creek	071300020104	83.4%	1.1%	48.5%	4.5%	79.2%	3.7%
Piper City - North Fork Vermilion River	071300020101	73.9%	2.1%	55.1%	5.8%	161.3%	10.4%
Pleasant Ridge - North Fork Vermilion River	071300020303	54.2%	6.0%	32.3%	6.3%	46.4%	5.8%
Town of Cullom - North Fork Vermilion River	071300020105	52.5%	3.6%	34.0%	4.2%	59.7%	5.1%
Town of Fairbury	071300020205	69.3%	1.9%	14.5%	1.0%	27.0%	1.7%

Subwatershed	HUC12 Code	Nitrogen Load Reduction		Phosphorus Load Reduction		Sediment Load Reduction	
		% Load	% Total Watershed	% Load	% Total Watershed	% Load	% Total Watershed
Town of Forrest - South Fork Vermilion River	071300020202	59.6%	3.7%	21.2%	2.7%	36.8%	3.6%
Town of Kempton - Kelly Creek	071300020103	77.4%	1.5%	21.7%	2.3%	39.1%	2.6%
Turtle Pond - South Fork Vermilion River	071300020201	78.8%	0.8%	28.0%	1.9%	42.3%	2.5%
Total Reductions and Targets			**36.3% (target exceeded)**		**54.0% (target exceeded)**		**83.0% (target exceeded**

9.0 Critical Areas

Critical areas are those locations throughout the watershed where implementation activities should be focused. This includes subwatersheds with the greatest potential for loading as well individual in-field and structural practices that can be applied broadly to maximize reductions. In-field practices will improve soil structure and health and overall farm profitability by reducing input costs. While In-field practices may provide the biggest "bang-for-the-buck" regarding nitrogen loss reduction, they are management practices that must occur every year to achieve the desired reduction in nutrient and sediment loss. Structural practices have a higher capital cost associated with implementation, but they will provide benefits over 15 to 30 years. Structural practices, particularly those that treat tile flow, will provide additional removal in high nitrate-nitrogen loss areas, and maximize opportunities where other measures may be infeasible. The critical areas in the VHW focus on maximizing reductions in nitrate-nitrogen and achieving the Partnership Steering Committee's stated goals.

9.1 Entire Vermilion Headwaters Watershed: In-Field Management

Critical in-field practices recommended are nutrient management, no-till, strip-till, and cover crops (**Error! Reference source not found.** and Figure 47). Critical areas are primarily based on total per-acre nitrogen yield or those HRU areas with losses greater than 30 lbs/ac. Additional considerations are provided by management practice type and are discussed in the following subsections. Critical areas represent all categories of recommended in-field practices listed in Section 6.1.1 and are needed to meet water quality targets listed in Section 8.0. Field locations represent those areas with high predicted nitrogen loss. Since field-specific conditions are unknown, the model utilized simulates -practices based on estimated percentages within a HRU to determine reductions for cover crops, tillage, and nutrient management within each subwatershed.

9.1.1 Nutrient Management

All area with a subsurface (tile) nitrate-nitrogen load greater than 30 lbs/acre are critical and well-suited for nutrient management, either split applied or split applied with sidedress. A total of 46,489 ac is recommended (Table 63). If implemented, annual reductions of 341,344 lbs of nitrate-nitrogen and 487 lbs of phosphorous are expected. This represents 5.58% and 1% of total NPS load, respectively.

Table 63 – Total Critical Area of Nutrient Management

HUC12	Name	Split Apply (ac)	Split Apply with Sidedress (ac)	Total (ac)
071300020204	Belle Prairie-Indian Creek	701	2,359	3,060
071300020102	Bradbury Landing Strip-North Fork Vermilion River	962	1,937	2,899
071300020301	Fivemile Creek	567	4,427	4,994
071300020203	Indian Creek	618	2,143	2,761
071300020206	Indian Grove-South Fork Vermilion River	1,070	5,200	6,269
071300020104	Kelly Creek	758	558	1,316
071300020101	Piper City-North Fork Vermilion River	724	2,095	2,819
071300020303	Pleasant Ridge-North Fork Vermilion River	869	5,239	6,108
071300020105	Town of Cullom-North Fork Vermilion River	685	1,722	2,407
071300020205	Town of Fairbury	650	3,953	4,603
071300020202	Town of Forrest-South Fork Vermilion River	445	4,200	4,645
071300020103	Town of Kempton-Kelly Creek	365	2,295	2,660
071300020201	Turtle Pond-South Fork Vermilion River	197	1,752	1,949
	Total	**8,611**	**37,880**	**46,490**

9.1.2 Conservation Tillage (no-till or strip-till)

No-till or strip-till critical areas represent areas where sediment yields greater than 1 ton/acre or with high to moderate runoff risk. Based on these criteria, 48,350 ac were selected (Table 64). If implemented, annual reductions of 940 lbs of phosphorus and 3,509 tons sediment are expected, representing 1.9% and 4.1% of the total NPS pollution load, respectively.

Table 64 – Total Critical Area of No-Till or Strip-Till

HUC12	Name	Area (ac)
071300020204	Belle Prairie-Indian Creek	826
071300020102	Bradbury Landing Strip-North Fork Vermilion River	7,447
071300020301	Fivemile Creek	3,785
071300020203	Indian Creek	3,055
071300020206	Indian Grove-South Fork Vermilion River	2,698
071300020104	Kelly Creek	6,459
071300020101	Piper City-North Fork Vermilion River	4,030
071300020303	Pleasant Ridge-North Fork Vermilion River	3,864
071300020105	Town of Cullom-North Fork Vermilion River	4,143
071300020205	Town of Fairbury	1,356
071300020202	Town of Forrest-South Fork Vermilion River	4,029
071300020103	Town of Kempton-Kelly Creek	3,721
071300020201	Turtle Pond-South Fork Vermilion River	2,938
	Total	**48,351**

9.1.3 Cover Crops

Cover crop critical areas were identified based on areas with some type of conservation tillage system (strip-till or reduced-till) and subsurface (tile) drainage nitrate loss of greater than 30lbs/acre. Generally, producers who have had success integrating cover crops into their management operations already utilize some form of reduced tillage and are therefore good candidate sites. A total of 28,590 ac were selected for cover crops (Table 65). If implemented, annual reductions of 336,513 lbs/yr of nitrogen, 1,288 lbs/yr of phosphorus, and 759 tons/yr of sediment are expected. This represents 5.5%, 2.6%, and 0.9% of the total NPS pollution load, respectively.

Table 65 – Total Critical Area of Cover Crops

HUC12	Name	Area (ac)
071300020204	Belle Prairie-Indian Creek	1,661
071300020102	Bradbury Landing Strip-North Fork Vermilion River	1,447
071300020301	Fivemile Creek	3,655
071300020203	Indian Creek	1,806
071300020206	Indian Grove-South Fork Vermilion River	3,964

HUC12	Name	Area (ac)
071300020104	Kelly Creek	408
071300020101	Piper City-North Fork Vermilion River	1,039
071300020303	Pleasant Ridge-North Fork Vermilion River	3,645
071300020105	Town of Cullom-North Fork Vermilion River	1,312
071300020205	Town of Fairbury	3,281
071300020202	Town of Forrest-South Fork Vermilion River	3,122
071300020103	Town of Kempton-Kelly Creek	1,836
071300020201	Turtle Pond-South Fork Vermilion River	1,415
	Total	**28,591**

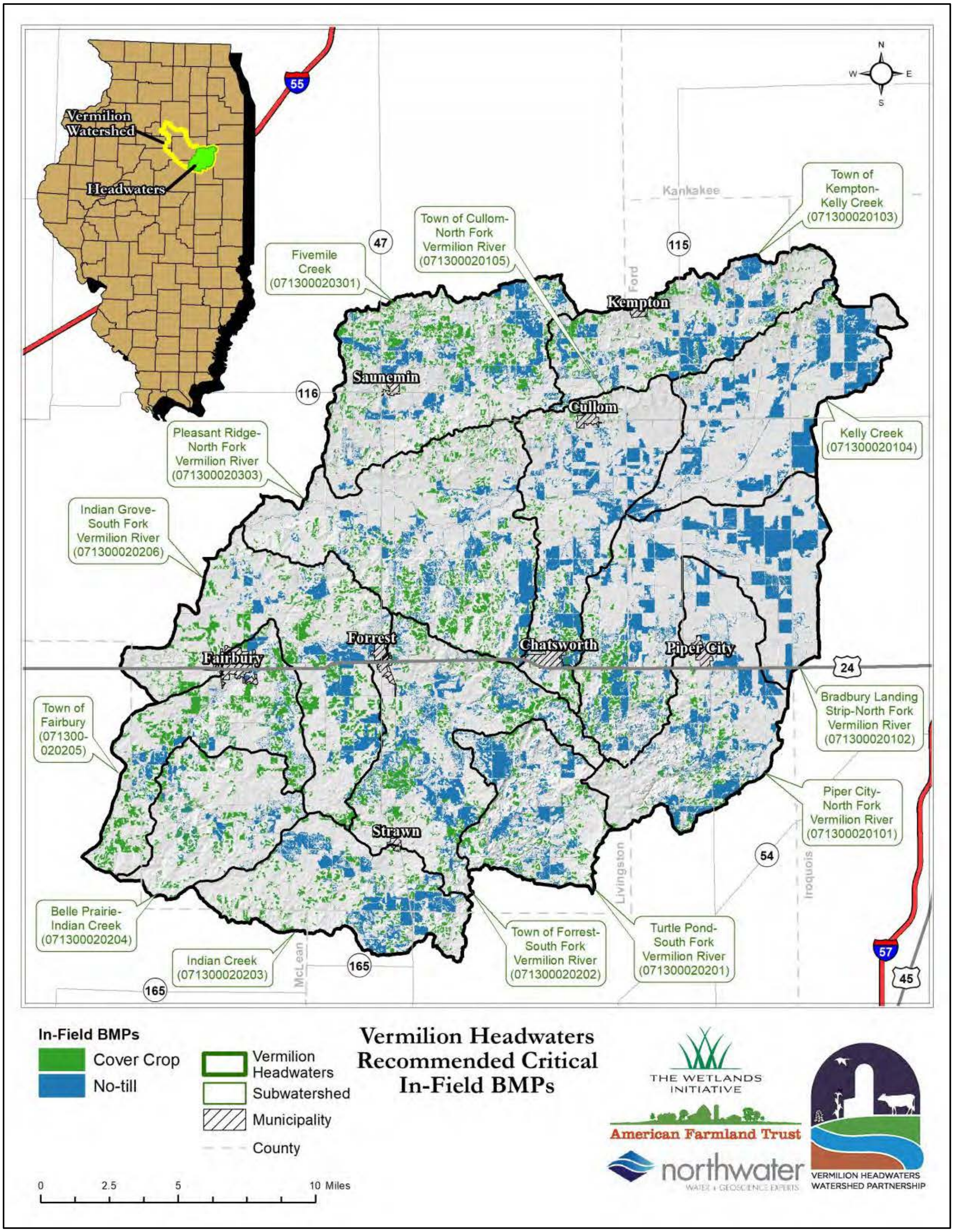


Figure 46 – Recommended Critical In-Field BMPs: Cover Crop and No-Till

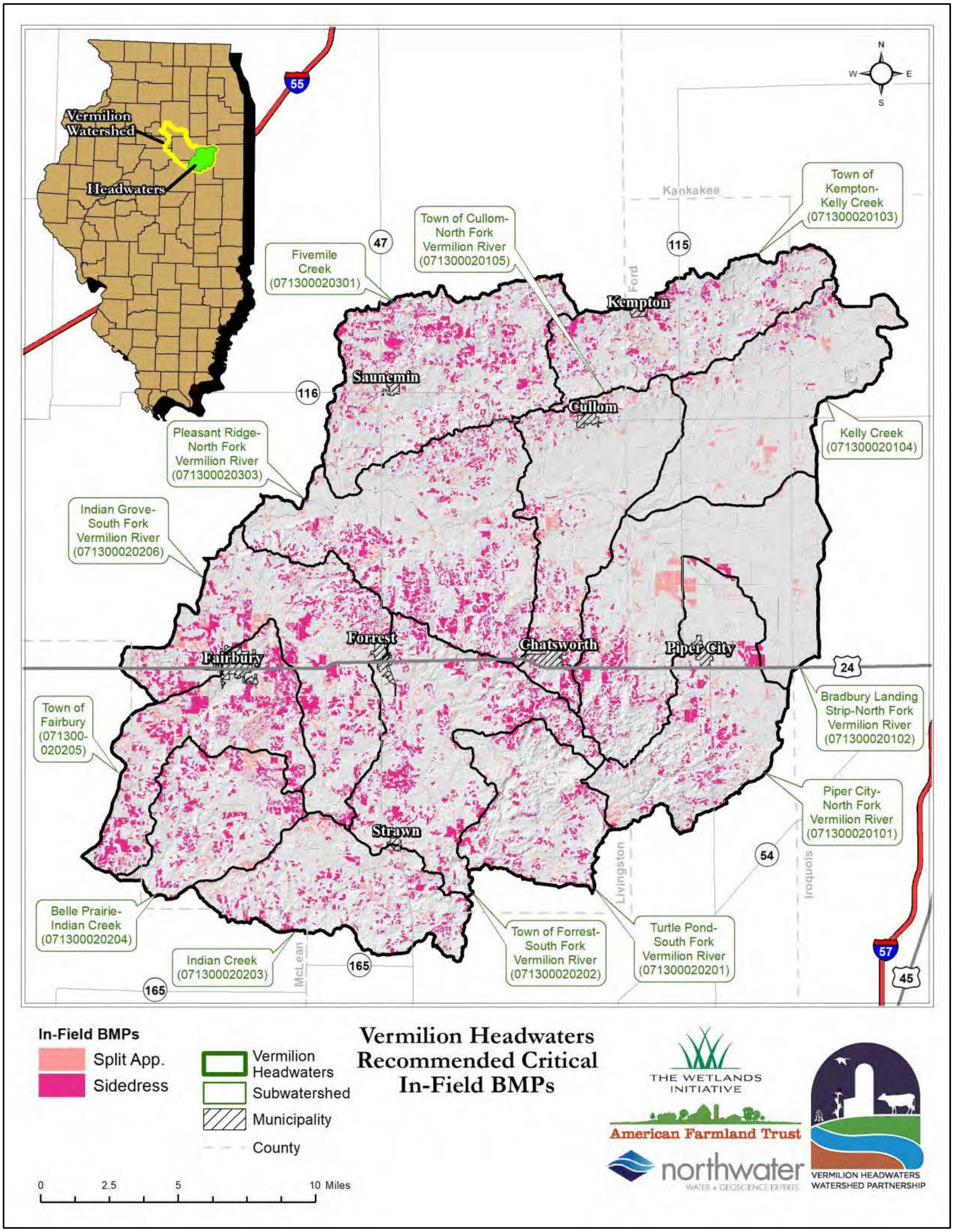


Figure 47– Recommended Critical In-Field BMPs: Split Applied and Sidedress Fertilizer

9.2 Critical Structural BMPs

Critical structural BMPs are those that can be implemented in the short-term (less than 10 years). A total of 752 projects are considered critical (Figure 46 and Figure 47). If all 752 practices are installed, annual reductions of 219,195 lbs of nitrogen, 1,244 lbs of phosphorus, and 3,236 tons of sediment are expected (Table 66). This represents total practice reductions of 3.6% for nitrogen, 2.5% for phosphorus, and 3.8% for sediment. Total cost is $8,402,274 and treated area is 12.8% of the row crop acreage (39,090 ac). If only tile-treatment practices were considered, then 14,580 ac would be addressed, which represents 4.8% of all cropland. Critical tile-treatment practices could remove 212,247 lbs of nitrogen or 3.47% of total reductions for a cost of $6,831,631. The Pleasant Ridge – North Fork Vermilion River and Fivemile Creek subwatersheds contain the most potential critical structural practices (Table 67) and will generate the highest annual nitrogen, phosphorus, and sediment reductions as a percentage of the total.

Structural practices for tile treatment were categorized as high priority for implementation if they were located in areas with subsurface (tile) drainage losses greater than 25 lbs/acre, or the 3rd quartile of all the HRUs (25.9 lbs/acre). Tile-treatment practices located on fields with less than 25 lbs/acre of nitrate loss were categorized as lower priority projects and should be considered for long-term (10+ years) implementation.

For sediment reduction, those practices that address erosion or surface runoff were categorized as critical if they were located in areas with a sediment loss of greater than 0.09 tons/acre (the 3rd quartile of all the HRUs). If a grassed waterway and a contour buffer were treating the same flow path, then the grassed waterway was selected gully erosion exceeded rates of sheet or rill erosion.

It is important to note that to meet the objective of 15% nitrate-nitrogen reduction, there are substantial amounts of BMPs that need to be implemented. Potential challenges with implementing proposed BMPs include lack of funding, limited NRCS state capacity to handle the engineering component of structural BMPs in a timely fashion, and the voluntary nature of implementing these BMPs.

Table 66 – Structural BMP Priority and Pollutant Reductions

BMP	Critical Structural BMPs Count	Practice Quantity	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Practice Cost ($)
			lbs/yr	% Load	lbs/yr	% Load	tons/yr	% Load	
Bioreactors	58	19,314 (CY)	22,354	0.37%	0	0.00%	0	0%	$1,098,001
Constructed Wetlands	43	124 (ac)	72,778	1.19%	337.3	0.68%	401.8	0.47%	$3,930,800
Contour Buffers	88	35.8 (ac)	68.00	0%	10.4	0.02%	25.3	0.03%	$22,447
Wetland, Depression	27	76.9 (ac)	879.7	0.01%	103.9	0.21%	163.2	0.19%	$496,543

BMP	Critical Structural BMPs Count	Practice Quantity	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Practice Cost ($)
			lbs/yr	% Load	lbs/yr	% Load	tons/yr	% Load	
Drainage Water Management	88	2,506 (ac)	31,052	0.51%	0	0.00%	0	0%	$598,934
Filter Strip - CZ	5	15.8 (ac)	1,096	0.02%	130.2	0.26%	215.9	0.25%	$3,587
Filter Strip - DRV	25	79.2 (ac)	92.30	0%	10.8	0.02%	21.9	0.03%	$21,622
Filter Strip - MSB	33	193 (ac)	1,355	0.02%	159.2	0.32%	354.2	0.41%	$52,689
Filter Strip - SSG	75	285 (ac)	3,048	0.05%	355.9	0.72%	840.4	0.98%	$64,695
Filter Strip - SBS	102	162 (ac)	409.8	0.01%	48.9	0.1%	112.4	0.13%	$36,774
Grassed Waterway	109	187,119 (ft)	0	0%	55.6	0.11%	1,034	1.21%	$682,366
Saturated Buffer	48	126,824 (ft)	86,063	1.41%	0	0.00%	0	0%	$1,306,287
Terrace / WASCOB	52	17,056 (ft)	0	0%	32.3	0.07%	66.9	0.08%	$87,530
Total	**752**		**219,196**	**3.58%**	**1,244**	**2.5%**	**3,236**	**3.8%**	**$8,402,274**
Buffer functional types: Critical zone (CZ), Deep rooted vegetation (DRV), Multi-species buffer (MSB), Stiff stemmed grass (SSG), and Stream bank stabilization (SBS).									

Table 67 - Critical BMP Structural Load Reductions by Subwatershed

HUC12	Name	Critical Structural BMPs Count	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
071300020204	Belle Prairie-Indian Creek	6	3,305	10.3	59.1
071300020102	Bradbury Landing Strip-North Fork Vermilion River	55	30,457	52.5	285.0
071300020301	Fivemile Creek	175	35,944	304.6	647.7
071300020203	Indian Creek	51	3,553	51.7	338.3
071300020206	Indian Grove-South Fork Vermilion River	37	7,574	82.8	141.7
071300020104	Kelly Creek	0	0	0	-
071300020101	Piper City-North Fork Vermilion River	15	9,582	58.5	92.0
071300020303	Pleasant Ridge-North Fork Vermilion River	190	73,751	361.9	844.5

HUC12	Name	Critical Structural BMPs Count	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
071300020105	Town of Cullom-North Fork Vermilion River	44	10,351	40.1	89.7
071300020205	Town of Fairbury	35	7,350	68.5	176.0
071300020202	Town of Forrest-South Fork Vermilion River	55	29,076	88.6	319.9
071300020103	Town of Kempton-Kelly Creek	74	7,607	72.8	168.3
071300020201	Turtle Pond-South Fork Vermilion River	16	644	52.2	74.5
	Total	**753**	**219,195**	**1,245**	**3,237**

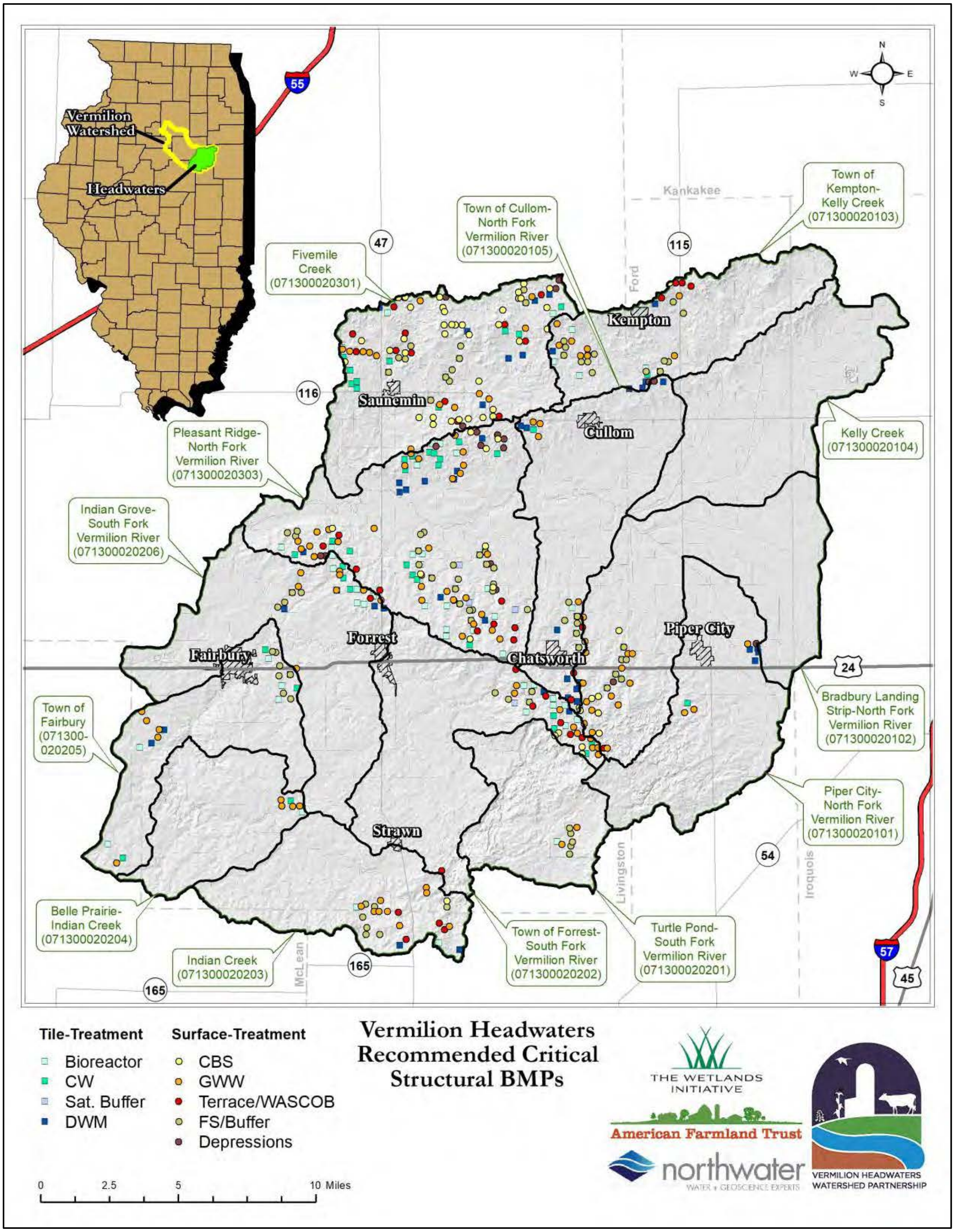


Figure 48– Recommended Critical BMP Structural Practices for the Entire VHW

9.3 Critical Areas for Fivemile Creek and Pleasant Ridge Subwatersheds

Fivemile Creek and Pleasant Ridge–North Fork Vermilion River are the two subwatersheds that were modeled to have the highest nitrate-nitrogen loads. Therefore, they were selected as critical drainages to achieve an estimated 15% nitrate-nitrogen reduction through short-term (less than 10 years) cost-effective in-field and structural practice implementation.

9.3.1 Fivemile Creek Critical Subwatershed In-field Practices

Targeted in-field management practices can reduce nitrogen loading by 12.8% (Table 68 and Figure 49). Practices selected include cover crops, conservation tillage, and nutrient management. It is estimated that cover crops and conservation tillage could be applied over approximately 15% of subwatershed row crop acreage. Modeling indicates cover crops and nutrient management could address nitrogen loads most efficiently versus conservation tillage that best mitigates sediment and phosphorus. Nutrient management applied to 4,994 ac is expected to reduce the nitrogen loading by 6.2%. Cover crops applied in this critical subwatershed are expected to reduce 6.6% of subwatershed nitrogen loads and conservation tillage is estimated to reduce 1% of the phosphorus and 2.9% of the annual sediment. The combined annual cost of all practices is $376,600.

Table 68 – In-field Management Practice Load Reductions for Fivemile Creek Subwatershed

BMP	Practice Acres (ac)	% Row Crop Area Treated	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Annual Cost ($)
			lbs/yr	% NPS Load	lbs/yr	% NPS Load	tons/yr	% NPS Load	
Cover Crop	3,655	14.7%	46,657	6.6%	225	3%	146	1.7%	$204,663
Conservation Tillage	3,785	15.2%	0	0%	76	1%	254	2.9%	$87,050
Split Applied	567	2.3%	1,158	0.16%	8	0.1%	0	0%	$9,634
Split Applied with Sidedress	4,427	17.8%	41,822	6%	64	0.8%	0	0%	$75,264
Total	**12,434**	**50.0%**	**89,637**	**12.8%**	**373**	**4.9%**	**400**	**4.6%**	**$376,612**

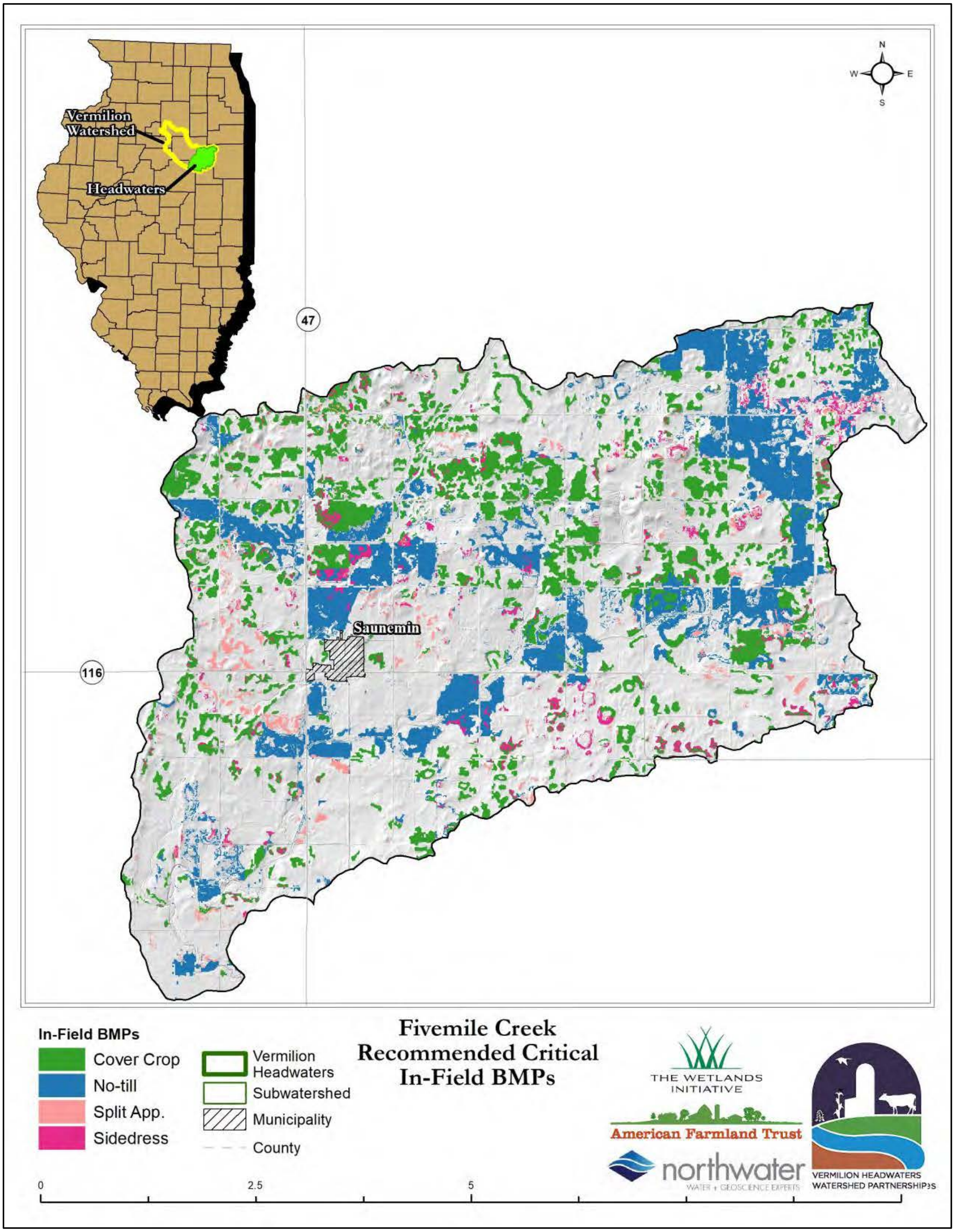


Figure 49 – Critical Areas for In-Field Management in the Fivemile Creek Subwatershed

9.3.2 Fivemile Creek Critical Subwatershed Structural Practices

Structural BMPs applied to the Fivemile Creek subwatershed have a short-term (less than 10 years) implementation goal. A total of 172 potential projects were identified to treat 8,209 ac and reduce 5.4% of the total subwatershed nitrogen load originating primarily from tile flow (Table 69 and Figure 50). Combined with those in-field practices described in the previous section, structural practices are expected to reduce nitrogen by almost 18%, exceeding the 15% target.

Structural practices to address tile loading include bioreactors, constructed wetlands for tile drainage treatment, drainage water management, and saturated buffers and can be applied to treat 2,433 ac and remove 34,120 lbs of nitrogen or 4.9% of the annual subwatershed NPS nitrogen load at a cost of $1,396,150. All other structural practices are expected to reduce an additional 0.5% of the nitrogen and approximately 4% of the annual phosphorus and 7.4% of the sediment load from this critical subwatershed.

Combined, all structural practices are estimated to cost $1,733,680.

Table 69 - Critical BMP Structural Load Reductions for Fivemile Creek Subwatershed

BMP	Critical Structural BMP Count	Practice Quantity	Treatment Area (ac)	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Practice Cost ($)
				lbs/yr	% NPS Load	lbs/yr	% NPS Load	tons/yr	% NPS Load	
Bioreactors	3	999 (CY)	118	1,396	0.20%	0	0.00%	0	0%	$56,793
Constructed Wetlands	10	31.9 (ac)	943	14,060	2.00%	72.1	0.95%	84.2	0.97%	$1,011,230
Contour Buffers	59	4.20 (ac)	96.5	49.5	0.01%	7.5	0.10%	17.4	0.20%	$2,633
Wetland, Depression	10	34.5 (ac)	2,637	596	0.08%	70.4	0.93%	118.7	1.36%	$222,767
Drainage Water Management	10	256.8 (ac)	256.8	2,910	0.41%	0	0.00%	0	0%	$61,375
Filter Strip - CZ	1	3.1 (ac)	325	247.1	0.04%	27.6	0.36%	39.3	0.45%	$710
Filter Strip - DRV	5	14.1 (ac)	29.0	11.0	0.002%	1.3	0.02%	3.6	0.04%	$3,862
Filter Strip - MSB	10	83.8 (ac)	807	360.1	0.05%	41.4	0.54%	105	1.21%	$22,881
Filter Strip - SSG	6	25.5 (ac)	492	303.6	0.04%	36.3	0.48%	75.6	0.87%	$5,794
Filter Strip - SBS	16	52.1 (ac)	403	252.6	0.04%	30.2	0.40%	62.3	0.72%	$11,816
Grassed Waterway	12	20.9 (ac)	872	0	0.00%	8.0	0.11%	123	1.41%	$73,871

BMP	Critical Structural BMP Count	Practice Quantity	Treatment Area (ac)	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Practice Cost ($)
				lbs/yr	% NPS Load	lbs/yr	% NPS Load	tons/yr	% NPS Load	
Saturated Buffer	11	25,898 (ft)	1,116	15,755	2.24%	0	0%	0	0%	$266,749
Terrace / WASCOB	19	6,232 (ft)	113	0.0	0.00%	9.3	0.12%	17.7	0.20%	$31,161
Total	**172**	**-**	**8,209**	**35,941**	**5.11%**	**304**	**4.00%**	**647**	**7.43%**	**$1,771,641**
Buffer functional types: Critical zone (CZ), Deep rooted vegetation (DRV), Multi-species buffer (MSB), Stiff stemmed grass (SSG), and Stream bank stabilization (SBS).										

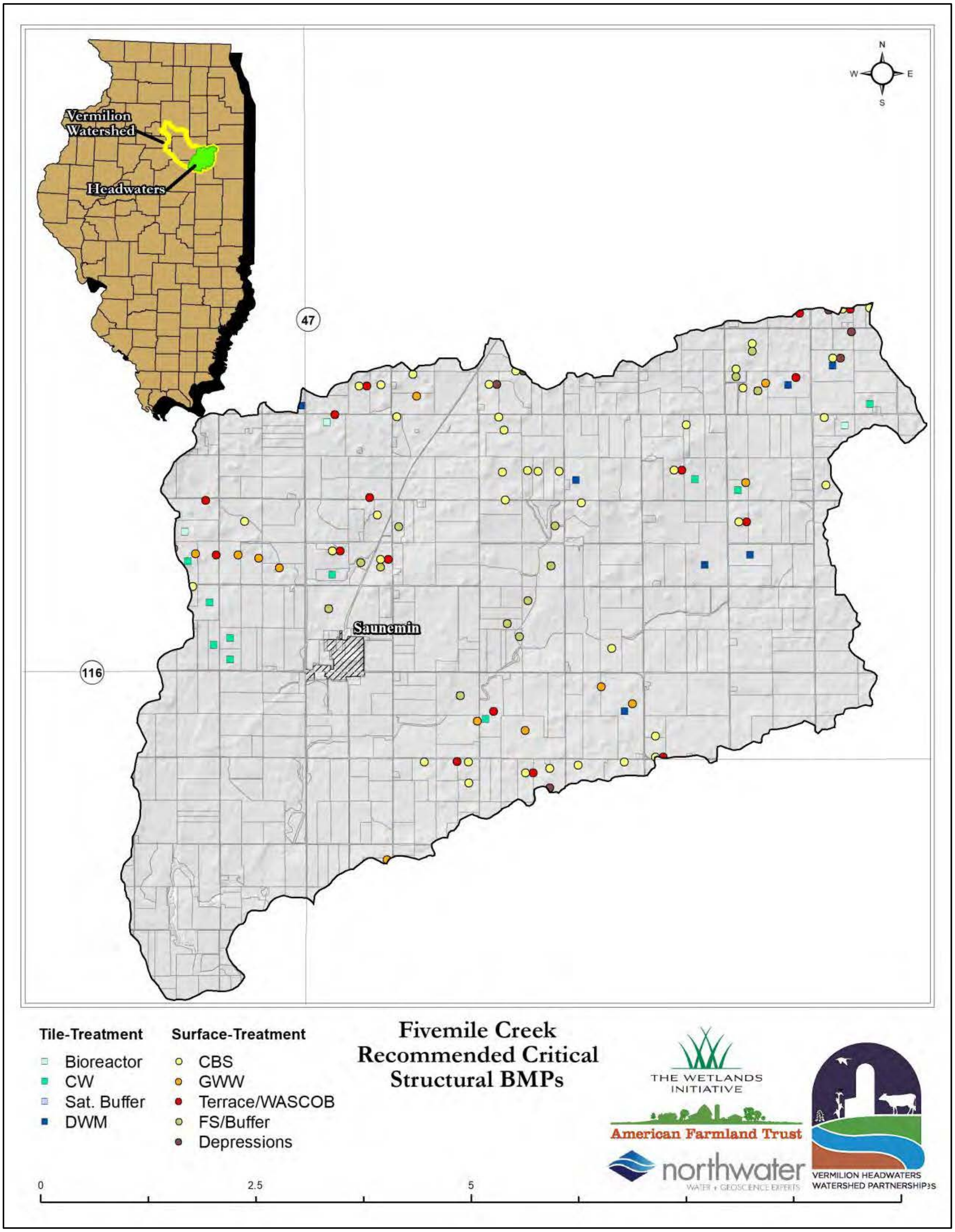


Figure 50- Critical Structural BMPs for Fivemile Creek Subwatershed

9.3.3 Pleasant Ridge – North Fork Vermilion River Critical Subwatershed In-Field Practices

Targeted in-field management practices can reduce nitrogen loading by 12.2% (Table 70 and Figure 51). Practices selected include cover crops, conservation tillage, and nutrient management. It is estimated that cover crops and conservation tillage could be applied over approximately 12% of subwatershed row crop acreage. Modeling indicates cover crops and nutrient management could address nitrogen loads most efficiently versus conservation tillage that best mitigates sediment and phosphorus. Nutrient management applied to 6,108 ac is expected to reduce the nitrogen loading by 6.5%. Cover crops applied in this critical subwatershed are expected to reduce 5.7% of subwatershed nitrogen loads and conservation tillage is estimated to reduce 1.3% of the phosphorus and 2.7% of the annual sediment. The combined annual cost of all practices is $396,790.

Table 70 – In-field Management Practice Load Reductions for Pleasant Ridge – North Fork Vermilion River Subwatershed

BMP	Practice Acres (ac)	% Row Crop Area Treated	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Annual Cost ($)
			lbs/yr	% NPS Load	lbs/yr	% NPS Load	tons/yr	% NPS Load	
Cover Crop	3,645	12.2%	45,808	5.7%	205.0	2.1%	99.5	0.9%	$204,092
Conservation Tillage	3,864	12.9%	0	0%	124.5	1.3%	284	2.7%	$88,861
Split Applied	869	2.9%	1,636	0.2%	10.3	0.1%	0	0%	$14,776
Split Applied with Sidedress	5,239	17.6%	50,493	6.3%	69.6	0.7%	0	0%	$89,058
Total	**13,616**	**45.6%**	**97,937**	**12.2%**	**409.4**	**4.3%**	**383.5**	**3.6%**	**$396,787**

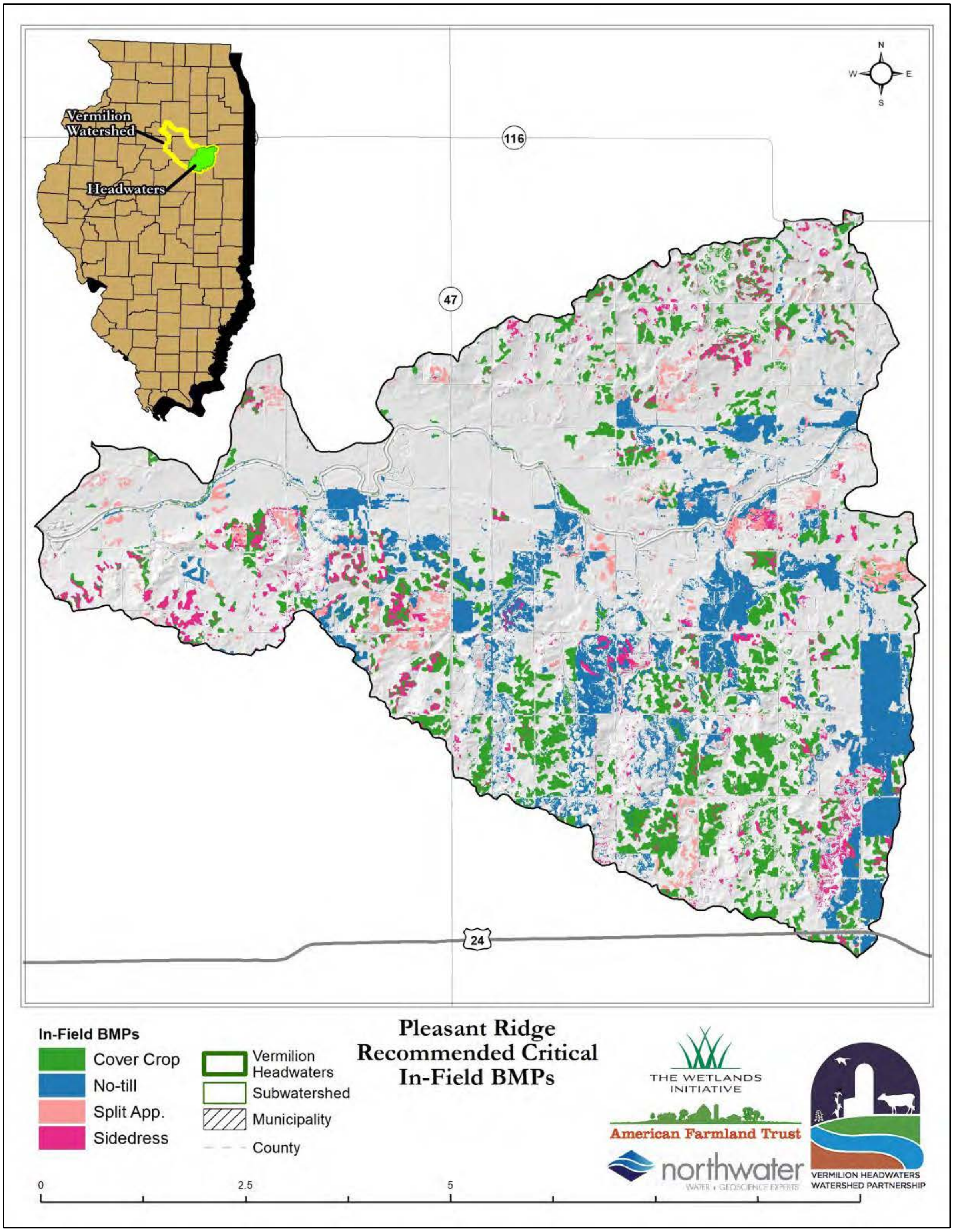


Figure 51 - Recommended Critical Areas for In-Field Management for Pleasant Ridge – North Fork Vermilion River Subwatershed

9.3.4 Pleasant Ridge – North Fork Vermilion River Critical Subwatershed Structural Practices

Structural BMPs applied to the Pleasant Ridge – North Fork Vermilion River subwatershed have a short-term (less than 10 years) implementation goal. A total of 190 potential projects were identified to treat 10,686 ac and reduce 9.18% of the total subwatershed nitrogen load originating primarily from tile flow (Table 71 and Figure 52). Combined with those in-field practices described in the previous section, structural practices are expected to reduce nitrogen by almost 21%, exceeding the 15% target.

Structural practices to address tile loading include bioreactors, constructed wetlands for tile drainage treatment, drainage water management, and saturated buffers and can be applied to treat 4,749 ac and remove 71,887 lbs of nitrogen or 9.0% of the annual subwatershed NPS nitrogen load at a cost of $2,195,090. All other structural practices are expected to reduce an additional 0.2% of the nitrogen and approximately 3.8% of the annual phosphorus and 8% of the sediment load from this critical subwatershed.

Combined, all structural practices are estimated to cost $2,635,009.

Table 71 - Critical BMP Structural Load Reductions for Pleasant Ridge – North Fork Vermilion River Subwatershed

BMP	Critical Structural BMPs Count	Practice Quantity	Treatment Area (ac)	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Practice Cost ($)
				lbs/yr	% NPS Load	lbs/yr	% NPS Load	tons/yr	% NPS Load	
Bioreactors	18	5,994 (CY)	664	6,780	0.85%	0	0.00%	0	0%	$340,759
Constructed Wetlands	17	47.3 (ac)	2,166	31,206	3.89%	144.6	1.51%	183.7	1.73%	$1,499,410
Contour Buffers	13	27.14 (ac)	25	12.1	0%	1.9	0.02%	4.8	0.05%	$17,017
Wetland, Depression	11	29.8 (ac)	1,056	268	0.03%	31.6	0.33%	42	0.4%	$192,419
Drainage Water Management	16	365 (ac)	365	3,673	0.46%	0	0.00%	0	0%	$87,235
Filter Strip - CZ	2	6.40 (ac)	1,116	586	0.07%	72.8	0.76%	134	1.26%	$1,453
Filter Strip - DRV	9	38.6 (ac)	90	42.3	0.01%	5.1	0.05%	11.5	0.11%	$10,538
Filter Strip - MSB	9	61.7 (ac)	506	180	0.02%	21.7	0.23%	54.4	0.51%	$16,844
Filter Strip - SSG	15	34 (ac)	1,396	516	0.06%	60.5	0.63%	163.2	1.54%	$7,718
Filter Strip - SBS	26	52.3 (ac)	107	35.1	0.004%	4.2	0.04%	14.7	0.14%	$11,872
Grassed Waterway	30	48.3 (ac)	1,566	0	0%	14.3	0.15%	227	2.14%	$170,578

BMP	Critical Structural BMPs Count	Practice Quantity	Treatment Area (ac)	Nitrogen Reduction		Phosphorus Reduction		Sediment Reduction		Practice Cost ($)
				lbs/yr	% NPS Load	lbs/yr	% NPS Load	tons/yr	% NPS Load	
Saturated Buffer	17	25,898 (ft)	1,554	30,228	3.77%	0	0.00%	0	0.00%	$267,687
Terrace / WASCOB	7	2,296	74	0	0%	5.5	0.06%	10	0.09%	$11,480
Total	**190**	**-**	**10,686**	**73,527**	**9.18%**	**362**	**3.78%**	**845**	**7.97%**	**$2,635,009**

Buffer functional types: Critical zone (CZ), Deep rooted vegetation (DRV), Multi-species buffer (MSB), Stiff stemmed grass (SSG), and Stream bank stabilization (SBS).

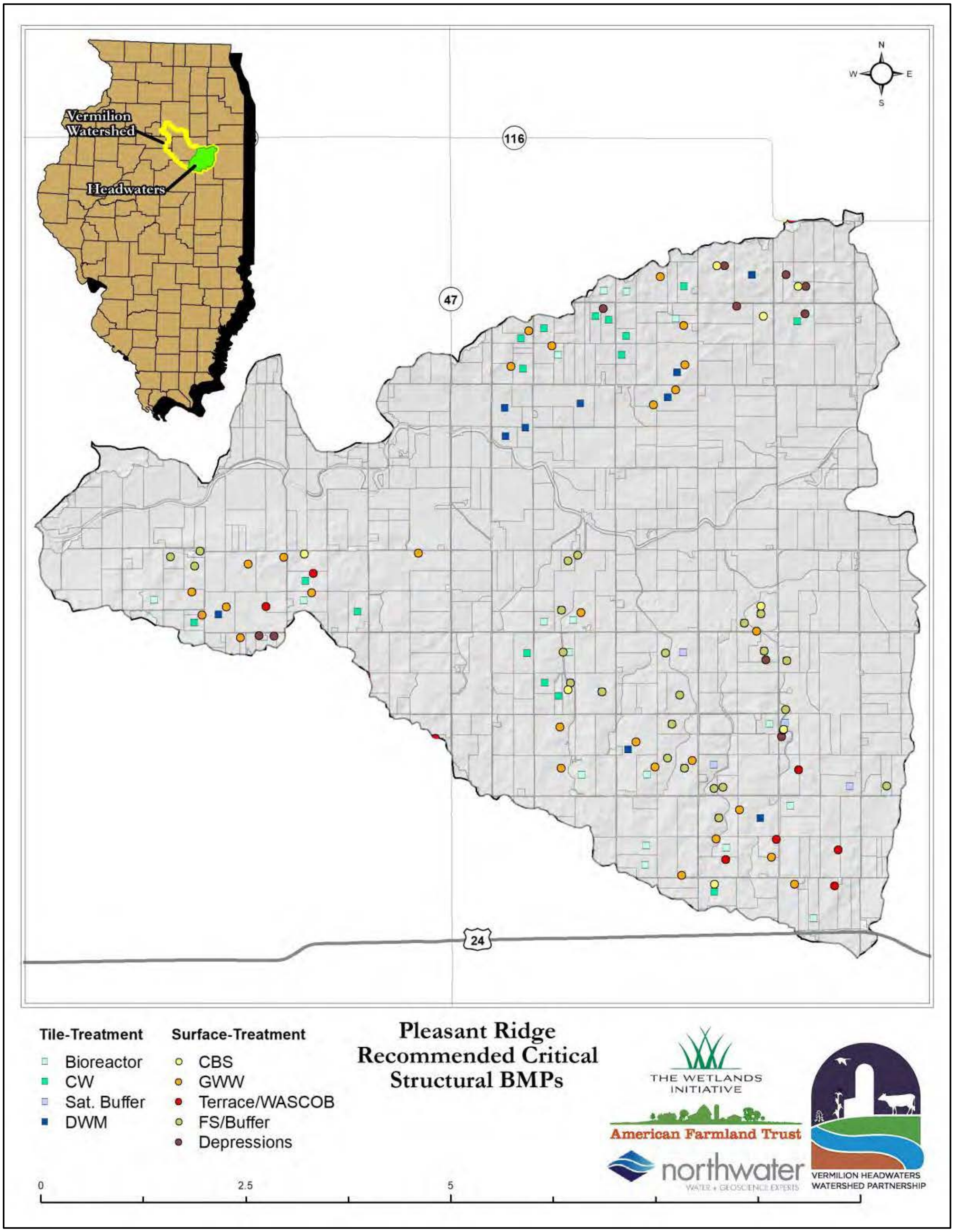


Figure 52 - Recommended Critical Structural BMPs for Pleasant Ridge – North Fork Vermilion River Subwatershed

10.0 Technical and Financial Assistance

Entities listed below are available for plan implementation and funding. For those that can provide funding specific to the VHW watershed, descriptions of the programs or financial assistance mechanisms are provided, with a separate list of entities providing in-kind contributions to watershed efforts. Entities that may not have a direct avenue to a funding apparatus are listed under Section 10.1 Technical Assistance.

Any agency or entity providing a role in implementation will need to work with willing landowners, and all implementation is completely voluntary.

Farmers/Landowners - In the VHW watershed, there are varying business arrangements regarding who farms the land and makes the important conservation decisions. If the farmer is the landowner, then the farmer–landowner is considered the primary responsible party. If the person/entity who owns the land is an absentee owner, then it could be either the farmer-tenant or the absentee landowner who is responsible for conservation decisions. In some cases, the conservation practice decisions are made together in a collaborative fashion by the tenant and landowner. Frequently, the lease terms will determine who makes conservation decisions on the agricultural parcel.

> **Financial Assistance:** Private funds can come from foundations, individual farmers, and landowners and can be used as cash match for grant funds or as private contributions to VHW conservation activity.

Natural Resources Conservation Service (NRCS) The USDA has local offices in most Illinois counties, which include the NRCS. The Livingston County office provides service to the VHW watershed. NRCS provides both conservation technical assistance and financial assistance to farmers and landowners. One of the programs frequently used for financial assistance is the Environmental Quality Incentive Program (EQIP). Most applicable to the VHW watershed, the EQIP program provides cost sharing for implementation of approved conservation program practices. The farmer/landowner submits an application to NRCS for a specific conservation program, and they are assisted by staff to complete the application process, certify the practices, and make payments. Four additional programs administered by NRCS are also discussed below: The Regional Conservation Partnership Program (RCPP), the Mississippi River Basin Healthy Watersheds Initiative (MRBI), the Conservation Stewardship Program (CSP), and the Agricultural Conservation Easement Program (ACEP).

> **Financial Assistance:**
>
> **NRCS EQIP** is a cost-share program for farmers and landowners to share the expenses of implementation and maintenance of approved soil and water conservation practices on farmland for qualified entities and is a dedicated source of funding available in the watershed through the Livingston County NRCS office.
>
> http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

NRCS/USDA RCPP promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS aids producers through partnership agreements and through program contracts or easement agreements. It combines the authorities of four former conservation programs – the Agricultural Water Enhancement Program, the Chesapeake Bay Watershed Program, the Cooperative Conservation Partnership Initiative, and the Great Lakes Basin Program. Assistance is delivered in accordance with the rules of other NRCS programs. RCPP encourages partners to join in efforts with producers to increase restoration and sustainable use of soil, water, wildlife, and related natural resources on regional or watershed scales. Through RCPP, NRCS and its partners help producers install and maintain conservation activities in selected project areas.

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/

NRCS MRBI Launched in 2009, the 13-state MRBI uses several Farm Bill programs, including EQIP and ACEP, to help landowners sustain America's natural resources through voluntary conservation. The overall goals of MRBI are to improve water quality, restore wetlands, and enhance wildlife habitat while ensuring economic viability of agricultural lands.

States within the Mississippi River Basin have developed nutrient reduction strategies to minimize the contributions of nitrogen and phosphorus to surface waters within the basin, and ultimately to the Gulf of Mexico. The MRBI uses a small watershed approach to support the states' reduction strategies. Avoiding, controlling, and trapping practices are implemented to reduce the amount of nutrients flowing from agricultural land into waterways and to improve the resiliency of working lands. VHW has been part of an MRBI project since 2015.

https://www.nrcs.usda.gov/programs-initiatives/mississippi-river-basin-healthy-watersheds-initiative

NRCS CSP NRCS provides conservation program payments through CSP. CSP participants receive an annual land use payment for operation-level environmental benefits they produce. Under CSP, participants are paid for conservation performance: the higher the operational performance, the higher their payment.

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/

NRCS ACEP provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps Native American tribes, state and local governments, and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/

Illinois Environmental Protection Agency (Illinois EPA) In Illinois, the Illinois EPA Bureau of Water's Watershed Management Section provides program direction and financial assistance for water quality protection through the Clean Water Act Section 319 program.

Financial Assistance: Administered by the Illinois EPA, the Section 319 program provides funds for addressing NPS pollution. The purpose of the 319 program is to work cooperatively with units of local government and other organizations toward the mutual goal of protecting the water quality in Illinois through the control of NPS pollution. The program includes providing funding to these groups to implement projects that utilize cost-effective BMPs on a watershed scale.

Projects may include structural BMPs, such as detention basins and filter strips; non-structural BMPs, such as construction erosion control ordinances; and setback zones to protect community water supply wells. Technical assistance and information and education programs are also eligible. Section 319 funds are reimbursable and require a match of either cash or in-kind services, or a combination of both cash and in-kind contributions.

http://www.epa.illinois.gov/topics/water-quality/watershed-management/nonpoint-sources/section-319/indexhttps://epa.illinois.gov/topics/water-quality/watershed-management.html

National Fish and Wildlife Foundation (NFWF) supports conservation in all 50 states and US territories. Their projects are rigorously evaluated and awarded to both large and small organizations. NFWF focuses on bringing all partners to the table, getting results, and building a future for our world. The VHW watershed was able to hire a full-time conservation technician to focus primarily on targeted technical assistance and outreach with a grant from the NFWF Conservation Partners Program, awarded in 2021. https://www.nfwf.org/

Soil and Water Conservation Districts (SWCDs) are a political subdivision of state government authorized under the SWCD Act to provide assistance to the public in conserving and protecting soil, water, and other natural resources. SWCDs work with Farm Bill programs administered by NRCS, provide cost-share opportunities to farmers, and support technical service providers.

Strategic Partners

Watershed Agricultural Retailers

Nutrien Ag Solutions is the retail division of Nutrien, the world's largest provider of crop inputs and services. Under the Nutrien umbrella, the company has expanded its product and service offerings and is part of a global network of retailers spanning three continents. Nutrien Ag Solutions provides nutrient management solutions to growers and provides customers with products and services to improve their operations. Nutrien Ag has facilities in Fairbury and Pontiac offering farmers a variety of services including soil sampling, seed treatments, and field scouting among others.

BCS LLC is a locally owned, full-service, retail operation offering a variety of services to farmers. BCS began as a soil testing facility assisting farmers in soil fertility consulting and crop consulting. Since then, BCS has grown their operation to include: seed treatment, fertilizers, chemicals, and cover crop sales and seeding. Including organic products and organic fertilizers.

Evergreen FS is an Agricultural Cooperative that provides a full range of farming products and services including agronomy, seed, fertilizer, precision farming, technology, fuel, lubricants, and a wide variety of stores, fueling sites, and lawn and tree care. Evergreen FS serves the local counties of DeWitt, Livingston, Macon, McLean, and Woodford.

Illinois Corn Growers Association (ICGA) Established in 1972, ICGA is a grassroots membership organization with over 4,000 members. ICGA conducts governmental affairs activities at all levels, market development projects, and educational and member service programs. ICGA runs the Precision Conservation Management Program described in the Technical Assistance section.

Illinois Soybean Association (ISA) is a statewide organization that strives to enable soybean producers to be the most knowledgeable and profitable soybean producers around the world. They represent more than 43,000 soybean farmers in Illinois through two main roles. The checkoff funds market development, soybean production, and legislative and regulatory advocacy efforts. The membership program advocates for legislation for farmers at local, state, and national levels. ISA supports the watershed by promoting and partnering on watershed events, doing farmer profiles, and providing media coverage of watershed events.

Livingston County Farm Bureau is a not-for-profit membership organization that provides various methods of support to farmers and farmland owners. They facilitate communication between Farm Bureau members at local, state, and national levels. They also provide information to farmers about technology, trends or issues, current marketing techniques, and support agricultural education through their Ag in the Classroom program.

The Mosaic Company is the world's leading producer and marketer of phosphate and crop nutrient products. They currently fund planning, monitoring, and outreach efforts in the VHW watershed and are particularly interested in efficient, sustainable, and environmentally responsible agricultural phosphorus applications.

US Geological Survey (USGS) is the nation's largest water, earth, and biological science and civilian mapping agency. USGS collects, monitors, analyzes, and provides information about natural resource conditions, issues, and problems. In the watershed, there is one monitoring station in Fairbury that provides upstream and downstream water quality data. This data is analyzed on an annual basis by USGS and provided to the VHW Steering Committee.

Walton Family Foundation (WFF) focuses on improving water quality and restoring habitat in the Mississippi River watershed. Their goal is to ensure improved water quality and restored habitat that benefits people and nature in the Mississippi River Basin, and ultimately the Gulf of Mexico by reforming the incentives that drive water quality degradation. WFF currently supports ongoing planning, monitoring, and outreach efforts in the VHW watershed.

McKnight Foundation focuses on restoring water quality and resilience in the Mississippi River watershed. Their goal is to restore the Mississippi River and to ensure a clean, resilient river system for communities across the American heartland. McKnight currently supports ongoing planning, monitoring, and outreach efforts in the VHW watershed.

10.1 Technical Assistance

In addition to the technical assistance provided by the entities listed below, there are conservation technical assistance resources provided through the University of Illinois Cooperative Extension Service (Coop Ext.) and by private professional consultants such as Certified Crop Advisors (CCA) or Technical Service Providers (TSP) that producers rely upon. Technical assistance relevant to the VHW watershed is also provided by non-profit organizations, such as ISA, AFT, Quail and Pheasants Forever, and The Nature Conservancy (TNC), among others.

American Farmland Trust (AFT) currently leads the VHW Watershed Steering Committee and is the lead partner for ongoing MRBI projects in the watershed. The mission of AFT is to protect farmland, promote sound farming practices, and keep farmers on the land. AFT advocates for programs and policies that protect farmland, food, and the environment, conduct education and outreach, and promote conservation.

Illinois Department of Agriculture (IDOA) Bureau of Land and Water Resources distributes funds to Illinois' 98 soil and water conservation districts for programs aimed at reducing soil loss and protecting water quality. It also helps to organize the state's soil survey every two years, which tracks progress toward the goal of reducing soil loss on Illinois cropland.

Illinois Department of Natural Resources (IDNR) provides technical assessments of streams for the IDOA's streambank stabilization program. The request for local assessment assistance comes through local county SWCDs. IDNR also manages other state programs related to wildlife and forestry and oversees the state portion of the Conservation Reserve and Enhancement Program (CREP).

Illinois Stewardship Alliance (ISA) is a membership-based organization whose mission is to promote environmentally sustainable, economically viable, socially just, local food systems through policy development, advocacy, and education. Most relevant to the VHW watershed is ISA's work to promote cover crops and educate producers on their benefits. ISA staff can assist with landowner outreach and education programs related to conservation.

Illinois Sustainable Ag Partnership (ISAP) mission is to create a network to support a systems approach to improve soil health and reduce nutrient loss. They provide a platform for disseminating relevant research, coordinate field days and events, provide expertise through collaboration, resources for soil health networks, and outreach and education.

Livingston & Ford Counties Soil Water Conservation District (SWCD) In many Illinois counties, it is the local county SWCD that takes a lead role in providing information, guidance, and funding arrangements for local conservation practices on farmland in the county. The Livingston and Ford Counties SWCD provides a range of support in achieving VHW water quality goals, including serving on the Steering Committee, identifying farmers and landowners within targeted conservation areas, conducting annual tillage and cover crop transect surveys specific to the VHW watershed, and promoting and assisting in watershed programming and events.

Precision Conservation Management (PCM) is a farmer-led effort developed to address natural resource concerns on a field-by-field basis by identifying conservation practices that effectively address environmental issues in a financially viable way. PCM specialists work with farmers to identify conservation needs and use data from agronomic management practices, economic models, and sustainability metrics to develop customized solutions. Livingston County is one of the counties PCM is active in and they also provide staff support and promotion of watershed events.

11.0 Implementation Milestones, Objectives and Schedule

Implementation milestones and goals are intended to be measured by NRCS EQIP, CSP and CRP/CREP contracts, RCPP and MRBI program funding, 319 and SWCD funded cost-share measures, and VHW Watershed Partnership initiated projects including practices promoted and implemented via agricultural retailer partners. The goals are meant to be both measurable and realistic. Targeted outreach and on-farm visits with landowners are vital to the success of future activities and will be a component of every effort to ensure the adoption of the BMPs listed below. Communication and outreach will also help to ensure practices are maintained over time.

An aggressive 10-year implementation schedule the watershed is presented in Table 72. The milestones or objectives presented are intended to be achievable and realistic over a 10-year period, though actual implementation will depend on landowner interest coupled with financial sense for the producer. Aggressive goal implementation will also depend on the provision of funding (public or private).. The schedule takes into consideration limited NRCS and SWCD staff capacity in the watershed and incorporates the total number of ac and practices necessary to achieve water quality targets. A selection of in-field and structural BMPs as well as two high nitrogen loading subwatersheds are considered critical as described in Section 9.0 and are prioritized for implementation within 10 years. Critical subwatersheds include Fivemile Creek and Pleasant Ridge – North Fork Vermilion River. Milestones noted after 10 years are considered long-term. In-field practice long-term goals are simply a continuation of short- and medium-term objectives. Structural practices targeted for long-term implementation are those treating sediment and phosphorus rather than the primary constituent of concern in this plan, nitrogen. A few long-term projects will begin after the sixth year to allow more time to execute given funding and staff limitations. Long-term milestones will help to ensure water quality targets are met and maintained.

Table 73 summarizes BMP milestones or objectives, the responsible entities, and the primary technical/financial assistance available. The implementation milestones or objectives will meet water quality targets and are divided between those that are realistic within a 10-year period and those that should be pursued as long-term management measures. Given the high cost and limited resources available, it is anticipated that more than 10 years will be required to fully meet water quality targets and maintain it over time.

Table 72 - Implementation Milestones and Timeframe

Timeframe	Milestone
Years 1–2	1. Continue targeted outreach and one-one-one communication with producers. 2. Plant 7,148 ac of cover crops. 3. Convert conventional tillage to strip-till or no-till on 12,087 ac. 4. Complete nitrogen management activities on 11,622 new ac. 5. Install 5 bioreactors. 6. Install 6 constructed wetlands. 7. Install 313 ac of drainage water management (DWM). 8. Install 15,853 ft of saturated buffers. 9. Develop a water quality sampling strategy and initiate baseline monitoring.
Years 3–5	1. Continue targeted outreach and one-one-one communication with producers. 2. Plant 7,148 ac of cover crops. 3. Convert conventional tillage to strip-till or no-till on 12,087ac. 4. Complete nitrogen management activities on 11,622 new ac. 5. Install 5 bioreactors. 6. Install 6 constructed wetlands. 7. Install 626 ac of drainage water management (DWM). 8. Install 31,706 ft of saturated buffers. 9. Install 29 contour buffer strips. 10. Install 80 filter strips. 11. Install 17 terraces/WASCOBs. 12. Restore 9 depressions. 13. Install 36 grassed waterways.
Years 6–10	1. Continue targeted outreach and one-one-one communication with producers. 2. Plant 7,148 ac of cover crops. 3. Convert conventional tillage to strip-till or no-till on 12,087 ac. 4. Complete nitrogen management activities on 11,622 new ac. 5. Install 14 bioreactors. 6. Install 10 constructed wetlands. 7. Install 939 ac of drainage water management (DWM). 8. Install 47,559 ft of saturated buffers.

Timeframe	Milestone
	9. Install 29 contour buffer strips. 10. Install 80 filter strips. 11. Install 17 terraces/WASCOBs. 12. Restore 9 depressions. 13. Install 36 grassed waterways.
10 + Years	1. Continue targeted outreach and one-one-one communication with producers. 2. Plant 7,148 ac of cover crops. 3. Convert conventional tillage to strip-till or no-till on 12,087 ac. 4. Complete nitrogen management activities on 11,622 new ac. 5. Install 34 bioreactors. 6. Install 20 constructed wetlands. 7. Install 626 ac of drainage water management (DWM). 8. Install 31,706 ft of saturated buffers. 9. Install 30 contour buffer strips. 10. Install 80 filter strips. 11. Install 17 terraces/WASCOBs. 12. Restore 9 depressions. 13. Install 36 grassed waterways.

Table 73 - Implementation Objectives, Responsible Parties, and Technical Assistance

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
Watershed BMPs/Education and Outreach (1–10 years)		
BMP: Cover Crops **Objective:** Install 28,592 ac	Landowner/SWCD/NRCS/ Ag Retailers	**Technical Assistance**: SWCD/NRCS/AFT/ISAP/SHP/PCM/Ag Retailers **Funding Mechanism**: 319 Grant/Private Funds/NRCS and State Programs
BMP: No-Till/Strip-Till **Objective**: Convert 36,261 ac	Landowner/SWCD/NRCS/ Ag Retailers	**Technical Assistance**: SWCD/NRCS/AFT/ISAP/SHP/PCM/Ag Retailers **Funding Mechanism**: 319 Grant/Private Funds/NRCS and State Programs
BMP: Nitrogen Management **Objective:** Install 34,866 ac	Landowners/SWCD/NRCS	**Technical Assistance:** NRCS/SWCD/PCM/Consultants **Funding Mechanism:** 319 Grant/Private Funds/NRCS
BMP: Bioreactors **Objective:** Install 45 bioreactors	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultants/ **Funding Mechanism**: 319/Private Funds/NRCS and USDA Programs/State Cost Share
BMP: Constructed Wetlands **Objective:** Install 33 constructed wetlands	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS/TWI/Consultants **Funding Mechanism**: 319 Grant/ NRCS and USDA Programs/State Cost Share
BMP: Drainage Water Management **Objective:** Install drainage water management on 1,878 ac	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/ Consultants **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/State Cost Share

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
BMP: Saturated Buffers **Objective:** Install 95,118 ft	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA /Consultants **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/Private Funds/State Cost Share
BMP: Contour Buffer Strips **Objective:** Install 58 contour buffer strips	Landowners SWCD/NRCS/IDOA	**Technical Assistance:** SWCD/NRCS/Consultants **Funding Mechanism:** 319 Grant/USDA Programs/Private Funds/NRCS /State Cost Share
BMP: Filter Strips **Objective:** Install 160 filter strips	Landowners /NRCS/SWCD	**Technical Assistance:** NRCS/SWCD/Consultants **Funding Mechanism:** 319 Grant/NRCS and USDA Programs/Private Funds/State Cost Share
BMP: Terrace/WASCOB **Objective:** Install 34 Terraces/WASCOBs	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism:** NRCS Programs/Private Funds/State Cost Share
BMP: Depressions **Objective:** Restore 18 wetland depressions	Landowners/NRCS	**Technical Assistance:** NRCS/USFWS/ Consultants **Funding Mechanism:** NRCS EQIP/319 Grant/State Cost Share/USFWS PFW and USDA Programs
BMP: Grassed Waterway **Objective:** Install 72 waterways	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/AFT/PCM/Ag Retailers **Funding Mechanism**: 319 Grant/Private Funds/ NRCS and USDA Programs/State Cost Share
BMP: Education and Outreach **Objective:** Stakeholder engagement	AFT/ISA/SWCD/NRCS/Coop Ext.	**Technical Assistance:** SWCD/NRCS/ISA/AFT/C - BMP/Coop Ext. **Funding Mechanism:** 319 Grant/City Funds/Private Funds
Long-Term Management Measures (10+ years)		
BMP: Cover Crops **Objective***:* Install 7,148 ac	AFT/ISA/SWCD/NRCS/Coop Ext.	**Technical Assistance:** SWCD/NRCS/ISA/AFT/Coop Ext. **Funding Mechanism:** 319 Grant/City Funds
BMP: No-Till/Strip-Till **Objective**: Convert 12,087 ac	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/AFT/PCM **Funding Mechanism**: 319 Grant/Private Funds/ NRCS and USDA Programs
BMP: Nitrogen Management **Objective:** Install 11,622 ac	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/PCM/AFT **Funding Mechanism**: 319 Grant/Private Funds/ NRCS and USDA Programs
BMP: Bioreactors **Objective:** Install 14 bioreactors	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultants/ **Funding Mechanism**: 319/Private Funds/NRCS and USDA Programs/State Cost Share
BMP: Constructed Wetlands **Objective:** Install 10 constructed wetlands	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS/TWI/Consultants **Funding Mechanism**: 319 Grant/ NRCS and USDA Programs/ State Cost Share
BMP: Drainage Water Management **Objective:** Install drainage water management on 626 ac	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/ Consultants **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/State Cost Share
BMP: Saturated Buffers **Objective:** Install 31,706 ft	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA /Consultants

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
		Funding Mechanism: 319 Grant/NRCS and USDA Programs/Private Funds/State Cost Share
BMP: Contour Buffer Strips **Objective:** Install 30 contour buffer strips	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA / Consultants **Funding Mechanism**: 319 Grant/USDA Programs/Private Funds/NRCS /State Cost Share
BMP: Filter Strips **Objective:** Install 80 filter strips	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA/ Consultants **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/State Cost Share
BMP: Terrace/WASCOB **Objective:** Install 17 Terraces/WASCOBs	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA /Consultants **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/Private Funds/State Cost Share
BMP: Depressions **Objective:** Restore 9 restored wetland depressions	Landowner/SWCD/NRCS	**Technical Assistance:** NRCS/USFWS/ Consultants **Funding Mechanism:** NRCS EQIP/319 Grant/State Cost Share/USFWS PFW and USDA Programs
BMP: Grassed Waterway **Objective:** Install 36 waterways	Landowner/NRCS	**Technical Assistance:** NRCS/Consultants **Funding Mechanism:** 319 Grant/Private Funds/ NRCS and USDA Programs/State Cost Share

12.0 Information and Education

AFT, in partnership with staff from the NRCS, SWCD, and the VHW Partnership Steering Committee (Table 74), actively conducts education and outreach throughout the watershed. Steering Committee meetings are on-going and held quarterly to improve outreach efforts and share opportunities. An overview of outreach goals and objectives are listed in this section. Outreach events that have occurred to date are listed in Table 75. Various outreach strategies will be implemented to target new and existing stakeholders. Targeted education and outreach recommendations are offered in Table 76.

Table 74 - VHW Steering Committee Members

Name	Organization
Adam Thorndyke	Farmer
Adam Wyant	NRCS Pontiac Office
Aidan Walton	Precision Conservation Management
Becky Taylor	Livingston County SWCD
Brent Byarley	Compeer Financial
Brent Crane	First Financial/Associate Director SWCD
Zach Stephenson (tentative)	Pheasants Forever
Chris Bunting	Livingston County Farm Bureau

Chuck Hanley	Livingston County SWCD
Brittney Miller (tentative)	Livingston County Planning
Craig Swartz	Farmer
Danny Harms	Farmer
Dewey Haag	Livingston County SWCD/Farmer
Jean McGuire	The Wetlands Initiative
Jesse Tinges	NRCS Pontiac Office
Jill Kostel	The Wetlands Initiative
Jim Fulton	Farmer
Jim Ifft	Farmer
Jim Isermann	Illinois Sustainable Ag Partnership/Farmer
Jim Martin	Illinois Soybean Association
John Dassow	Farmer
Larry Thorndyke	Farmer
Lee Bunting	Livingston County SWCD/Farmer
Marcus Maier	Livingston County SWCD/Farmer
Sarah Earles	Ford County SWCD
Sarah Hostetter	Landowner
Terry Bachtold	Livingston County SWCD/Farmer
Tristan Rieger	Farmer

VHW Outreach & Education Goals:

1. Elevate the visibility of the producer-led VHW Partnership and local water quality goals.
2. Highlight watershed successes and accomplishments.
3. Attract new watershed advocates and inspire sustained participation in achieving water quality goals.
4. Increase awareness of NLRS goals, including the promotion of in-field and edge-of-field nutrient loss reduction practices.
5. Improve messaging to target audiences using recommendations from the VHW Steering Committee.
6. Increase education on cover crop practices and profitability in the watershed.

VHW Outreach & Education Objectives:

1. Gain new attendees at farmer workshops and encourage retention of current attendees.
2. Increase presence in local media such as radio and news publications.
3. Increase project visibility on the landscape using watershed signage to indicate support for INLRS goals. As BMP practices are implemented, drawing attention to these fields through signage to encourage visibility.

4. Increase the volume of voluntary adoption of NRCS/SWCD programs and incentives through outreach activities described below.
5. Increase farmer implementation of best management practices.
6. Establish frequent use of the interactive watershed model by showcasing this model at field days and other outreach events.
7. Increase consistent use and visibility of key messages through the development of toolkits, style guidelines in collaboration with the VHW Steering Committee.
8. Work with AFT Communications and VHW Steering Committee to highlight profitability of conservation methods.

Outreach and education events AFT have hosted or attended in the VHW watershed are listed below.

Table 75 - Outreach Events 2018-2023

Event	No. of Attendees	Date	Location
Cover Crops and More	67	3/27/2018	Saunemin Community Center
Growing Inputs: A Way to Aid Weed & Fertilizer Management	n/a	4/4/2018	Thorndyke Farms
Vermilion Headwaters Field Day	48	07/26/2018	Wilken Farms
Cover Crop Field Day & Market Outlook	40	11/13/2018	Jim Ifft's Farm
Wildlife & Water Quality	18	4/4/2019	Chatsworth American Legion Hall
Nitrogen Management Workshop	21	7/23/2019	Forrest Community Center
Soil Health Lunch & Learn	30	2/18/2020	Mulligan's Saunemin Tap
Women, Wildflowers and Wildlife: Restoring nature's bounty on your farm or homestead	n/a	3/11/2020	Saunemin Community Center
Issued press release announcing award	n/a	2020	Virtual
Farming for the future: Implementing a vertical system	122	12/10/2020	Virtual
Watersheds and Soil Erosion – Women Landowner Meeting	13	3/11/2021	Virtual
Vermillion Watershed Field Tour	54	8/11/2021	Swartz Farms
March Field Day	43	3/10/2022	Jim Ifft's Farm
Cover Crop Field Day	21	7/28/2022	Zach Grady's Farm
Farm Family Social #1	23	2/21/2023	Jim Ifft's Farm

Event	No. of Attendees	Date	Location
Farm Family Social #2	25	3/16/2023	Swartz Farm
Farm Family Social #3	30	06/22/2023	Danny Harm's Farm
Farm Family Social #4	35	08/16/2023	Ben Kafer's Farm

The VHW Steering Committee acknowledges that community outreach is a critical component of the watershed planning process to build momentum and bring awareness to the community on issues related to watershed health. Some of the VHW communications strategies are listed below. Specific activities, along with their recurrence, target audience, and purpose are listed in Table 76.

VHW Outreach & Education Strategies:

1. Draft press releases using easily relatable language that speaks to the values and priorities of the target audience. Establish guidelines for communication based on feedback and collaboration with the VHW Steering Committee to best tailor content. Utilize consistent messaging in all flyers, fact sheets and promotional materials.
    a. Efforts will be made to coordinate outreach and education campaigns with all partner organizations to ensure language, graphics and photos reinforce and support the established watershed goals.
2. Organize and plan workshops, field days, social events, and watershed tours to appeal to a diverse target audience, including farm operators (tenants and owners), landowners (operating and non-operating), conservation staff, agricultural professionals, the general public, and others.
3. Promote and share information through passive and active efforts such as media releases, fact sheets, informational meetings, newsletter articles, field days, social media, and website content.
4. Use watershed signage to call attention to fields and farms that have implemented priority in-field and edge-of-field management practices.
5. Post frequent updates on watershed events, successes and activities on social media sites and keep all weblinks current on dedicated webpages.
6. Create unique fact sheets that use AFT and partner mission values.

Future outreach activities will target new and existing stakeholders, including farmers and landowners; local businesses, particularly businesses providing services to farmers; FFA,4-H groups, and farm groups; municipal water facilities; representatives from the USDA-NRCS and the SWCD; and residents and government leaders from Livingston and Ford Counties, along with local municipalities.

Table 76 - VHW Outreach & Education Activity Recommendations

Activity	Recurrence	Target Audience (2)	Partners Responsible	Purpose
Announcement of plan completion	Upon completion of plan	All	AFT	Communications
Review / update watershed fact sheet for farmer audience	Yearly	1,2,3	AFT, Steering Committee	Communications
Review / update watershed fact sheet for new stakeholders & public	Yearly	All	AFT, Steering Committee	Communications
Review / update watershed website	Twice a year	All	AFT	Communications
Host informational displays at community events (e.g. County Fair)	Quarterly	All	AFT, VHW Partners	Outreach and Education
Hold field days & workshops	Yearly	1,2,3	AFT, Farmer Partners	Outreach and Education
Produce and distribute newsletter articles	Twice a year	All	AFT	Communication
Hold on-farm meetings with individual or small groups of farmers	Monthly	1	AFT, Farmer Partners, Steering Committee	Outreach
Mail letters / postcards to landowners in target areas	Quarterly	1	AFT	Communications & Outreach
Hold Steering Committee meetings	Quarterly	All	AFT, Steering Committee	Outreach

Audiences: 1 – Farmers & landowners; 2 – Ag businesses; 3 – FFA, 4-H, Farm Groups; 4 – Municipal water facilities; 5 – NRCS / SWCD; 6 – Residents; 7 – Government leaders

13.0 Water Quality Monitoring Strategy

Monitoring water quality is crucial to ensuring that water bodies meet the necessary standards and is an effective way to measure progress toward meeting water quality targets. Utilizing water quality indicators (I.E. water chemistry and flow) are excellent for assessing overall changes in watershed conditions and can provide insights into water quality. A major data gap in the watershed is sediment and streamflow, especially from smaller tributaries.

The purpose of this monitoring strategy is to utilize and expand upon existing monitoring data and sampling routines to evaluate the condition and health of the watershed in a consistent and on-going manner. Water quality monitoring also serves to assess the effectiveness of plan implementation and its watershed-scale contribution towards achieving the reduction targets listed in this plan. While programmatic monitoring tracks progress through achievement of actions, this section outlines a strategy to directly monitor the effectiveness of actions on water quality.

13.1 Approach

The primary focus of monitoring in the VHW is to determine changes in sediment, nitrogen, and phosphorus concentrations and loadings over time that may result from management practices and educational outreach. The ongoing, comprehensive effort to assess the effectiveness of nutrient-reduction practices includes monitoring at various locations within the watershed. Table 77describes active monitoring stations in the VHW and their approximate locations. One USGS station is located along the Vermilion River at Pontiac, and one is in Indian Creek South of Fairbury. Additionally, Illinois EPA has sampled 30 relevant monitoring locations. Illinois EPA's Intensive Basin Survey Program assesses the VHW on a 5-year rotating schedule. The agency divides the watershed into two separate basins, the Little Vermilion and Vermilion (Wabash) basin and the upper Vermillion (Illinois Basin). On this rotating schedule, the Little Vermilion and Vermilion (Wabash) basin were sampled in 2021 and will be sampled again in 2026. The upper Vermilion (Illinois basin) was sampled in 2019 and will be again in 2024.

Paired watershed monitoring is another approach that has been used in VHW. A targeted monitoring program was established to comprehensively monitor water quality and gain insights from collected data (Perkins et al., 2016). The program aimed to target data that can assist in establishing water quality trends in this area. In addition, the program aimed to incorporate an analytical approach to assess the impact of BMPs on water quality. This analysis provided an opportunity to leverage the data and insights gained to other parts of the larger Vermilion watershed. Out of this paired watershed approach, future locations for stations were identified as listed in Table 78 and selected based on access to the stream and river bottoms and ease of stream gage installation to collect water velocity readings and determine flow. A combination of water chemistry and flow is needed for accurate estimates of loading.

These multifaceted approaches allow for a comprehensive understanding of the various factors impacting water quality. Following a regular sampling schedule and tracking changes in nutrient and sediment loading can further support implementation of actions to restore water quality in the VHW.

Table 77 – Active Water Quality Monitoring Stations in the VHW

Station Code	Supporting Agency	Waterbody Name	Location
05554300	USGS	Indian Creek near Fairbury	Rt. 24, 1 mi south of Fairbury, 4 mi west of Rt. 47
05554500	USGS	Vermilion River at Pontiac	S. Ladd St., 1 mile south of E 1750 North Rd.
0555400*	USGS	Vermilion River	North Fork Vermilion near Charlotte
05554200*	USGS	Vermilion River	South Fork Vermilion near Forrest

American Farmland Trust THE WETLANDS INITIATIVE northwater

Station Code	Supporting Agency	Waterbody Name	Location
05554480*	USGS	Vermilion River	Vermilion at Hwy 6 near McDowell

**Locations where discreet sampling was collected by USGS.*

Table 78 - Proposed Future Water Quality Monitoring Stations in the VHW

Site	Stream Name	Road	Relative Location
A	Five Mile Creek	N 2600 E	0.42 miles south of E1500 N
B	Pre-Pleasant Ridge	N 3100 E	0.2 miles south of E 1400 N
C	Kelly Creek	N 1300 E	0.15 miles south E 3000 N

13.2 Continuous and Discrete Sample Collection

Continuous water quality data is collected daily at the USGS sampling site at Indian Creek near Fairbury, IL. Important parameters that are measured by this gage include discharge, nitrate and nitrite, and turbidity. USGS also collects discrete samples quarterly at the locations indicated in Table 77. Recently, cameras have been added to the gage near Charlotte with the aim to estimate streamflow from images captured.

Discrete sampling serves to document ambient water quality which captures climatic, land-use, and seasonal differences and effects on quality. Discrete water quality sampling has been performed at Illinois EPA sites from 2014-2020. Most frequently, Illinois EPA collected samples that evaluated inorganic nitrogen, fecal coliform, and iron (dissolved) in the Vermilion River, Indian Creek, and a tributary to Indian Creek. While Illinois EPA monitoring occurs on a rotational schedule, there is opportunity to collect regular samples and engage local stakeholders.

Recommendations for continued discrete sampling include using citizen science and volunteer efforts to address data gaps, especially sediment and streamflow. Using a crowd-sourced approach and the water quality objectives identified in this plan, parameters will be established for citizen scientists to assist in the monitoring process. As of the writing of this plan, there are major data gaps for sediment and flow, especially from smaller tributary streams. Additionally, data is needed over a larger range of flow events. There is an opportunity for the creation of a new program where volunteers can be recruited and trained to support monitoring at the future locations identified in Table. Continual engagement with volunteers and citizen scientists, in addition to improvement efforts, could sustain the program's impact overtime.

13.2.1 Data Analyses Components

Data analysis informs decision-making, identifies trends in water quality data, and tracks progress towards achieving water quality goals in the VHW watershed. Data analysis for water quality monitoring will be provided as indicated below.

1. Calculations of annual sediment, phosphorus, and nitrate loads at the USGS monitoring station will be computed, as practical, from the discrete sample and continuous streamflow data provided by the USGS.
2. Basic statistical summaries of measured and sampled concentrations including physical and chemical characteristics of the water and loadings will be conducted and provided by the USGS. Characteristics could include pH, specific conductance, temperature, and dissolved oxygen. At sites where available, summaries are transmitted automatically and available on the current USGS data system. (USGS, 2023)
3. Quality assurance and control are conducted as part of the sampling routine and through laboratory analysis. Field-based quality control consists of quarterly to semi-annual replicated sampling methods. Sample blanks are used to assess contamination potential from deionized water and sample processing equipment. All samples are taken in accordance with and adhere to Illinois EPA laboratory requirements; laboratory quality control measures include procedures such as measuring precision and accuracy.

13.2.2 Reporting

Water quality data reporting in the VHW ensures transparency, accountability, and effective communication between stakeholders and the public. Reporting can facilitate engagement and collaboration among stakeholders and promote public awareness. Recommendations for reporting strategies are listed below.

1. Continuous streamflow and discrete water quality data are and will continue to be quality-assured and available on a continuous basis via the USGS National Water Information System: Web Interface (NWISweb).
2. Informal annual summaries of monitoring activities, data statistics, and sediment, phosphorus, and nitrate loads have been and will continue to be provided by USGS.
3. Should the proposed citizen science and volunteer data collection be used as a monitoring approach, data collection could occur through online platforms or physical submissions to an identified responsible party.
4. As part of the plan’s outreach and education efforts, the creation of one-page documents, regular newsletters, webinars, or other methods can be used to disseminate report findings to various audiences in the watershed.

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Appendix A: SWAT+ Model Methodology

The VHW project utilized the *SWAT+* application, which is a completely revised and modified version of *SWAT (Soil and Water Assessment Tool). SWAT+* is a public domain model developed by the *USDA Agricultural Research Service (USDA-ARS) and Texas A&M AgriLife Research (Texas A&M University). SWAT+* was used to assess land use management and operations practices on water and land resources in the VHW over the period 1985-2014.

- Hydrologic Response Units (HRUs) are a fundamental variable within the SWAT+ model. HRUs were created with the application *QSWAT+*, which grouped together geographic zones that share the same land use/management, slope interval (user-defined), and soil type. Because of the large watershed area, this process resulted in many different combinations of those variables. While *QSWAT+* provides options to aggregate similar HRUs and simplify the model, we chose to keep all the originally generated HRUs (n = 67,690). This was done to achieve a better spatial quantification of the BMP-baseline scenario in place in the VHW.
- These were the input data sources for *QSWAT+* HRU creation:
    - Elevation/slope: 10-meter Digital Elevation Model (DEM).
        - Four slope intervals (%) were created based on the relatively flat topography of the watershed: 0-1, 1-3, 3-5, >5
    - Land use: 30-meter Cropland Data Layer 2012 (to coincide with the end of model run time period 1980-2014)
    - Soil data: NRCS 10-meter gSSURGO grided soils.
- While our configuration of *SWAT+* captured crop rotation schedules (corn-soy, corn-soy-rye, continuous corn, etc.), it did not analyze land use changes over the model run. For example, the model did not know if land changed from 'forest' to 'corn' or from 'corn' to 'developed'. Because nearly 90% of the total watershed-HRU area is cropland and only 5% is 'urban-developed', we felt that such changes in land use were likely to be minor in areal extent.
- Weather data was downloaded from the *National Centers for Environmental Prediction* (NCEP), which was used directly *SWAT+* without additional processing. These data already contained the necessary climate variables (temperature, precipitation, solar radiation, relative humidity, and wind speed). Because the climate variables were available for the period 1979 - July 2014, we chose our model simulation period: 1980 - July 2014 with a 5-year warm-up period.
- There is only one USGS stream gage within the study area during the model simulation period: "*USGS 05554300 INDIAN CREEK NEAR FAIRBURY, IL*". Additionally, the temporal overlap with the model run is limited: 7/7/2011-7/31/2014. Since there was no data collected in August 2012, only 35 months of observed flow data could be used to calibrate the model. Moreover, nutrient sampling during the simulation was even more limited with 12 months of data. We were able to supplement observed nutrient data with various field sample data from the *EPA TMDL Report* at different locations in the watershed. However, because of the overall limited spatial and temporal coverage in the watershed, there was not enough observed data to split into formal calibration and validation data sets. Instead, we used the available observed data to parameterize key variables, and then compared model outputs to the observed data for calibration purposes.
- We input four wastewater treatment plants as point sources (WWTP) in the model. Annual data for flow and NO3 variables were included and assumed to remain constant each year for the entire model run 1980-2014.

- Land uses 'corn' or 'soy' (88% of HRU watershed area) were randomly assigned crop and tillage operations based on transect surveys (field observations) performed throughout the watershed. The number of HRUs assigned to each rotation was broadly based on the percentages of each rotation type found in the field surveys:
    - Corn-soy (CS) rotation = 85% of corn or soy HRUs
    - Corn-soy-cover crop [rye] (CSR) = 5% of corn or soy HRUs
    - Corn-soy-wheat [double-crop] (CSW) = 5% of corn or soy HRUs
    - Continuous corn (CCC) = 10% of corn HRUs, however, the HRU count also represented 5% of the total corn or soy HRUs.
  - Among all the rotations, the CCC rotation was assigned first by randomly selecting 10% of the corn HRUs (17,304 corn HRUs* 0.10 = 1,730 CCC HRUs). 1,730 also represents 5.2% of the HRUs that are either corn or soy (33,149). These corn HRUs were then removed from the corn/soy rotation pool, which left 31,419 (33,149-1,730) HRUs of corn/soy to assign to the remaining rotations.
- Tillage operations were assigned separately for corn and soy. Soy was assigned to two tillage types: conventional and strip. Corn was assigned to either conventional or reduced. All CSW rotations were assigned to conventional tillage, while all CSR rotations were assigned to reduced. Tillage types were also assigned randomly yet based on sub-basin level percentages from the transect survey.
- Fertilizer applications followed the attached schedule (create attachment). A small number of HRUs differed slightly from the attached schedule. Approximately 5% of the CCC rotations (83) were assigned to a specific manure fertilizer schedule. These HRUs were chosen based on proximity (within 200 meters) to livestock ponds. Additionally, 20% of HRUs with a CS rotation and conventional tillage with drainage tile were assigned to a fall fertilizer application (7,324 * 0.20 = 1,465 HRUs).
- We created 2 tile drain types in the model based on hydrologic soil groups. The overwhelming majority of tiled HRUs (n = 37,602) were assigned tile depths of 900mm (3 ft). However, we discovered that where tile occurred on hydrologic group "D" soils, nutrient loading was extraordinarily high. As a result, we reassigned tiled HRUs on class "D" soils (n = 2,745) to a separate tile type where the tile depth was closer to the surface (530mm/1.7 ft).
- Several codes and parameters were changed from system defaults to calibrate the model to the following sets of observed variables: monthly streamflow, annual total nitrogen, annual total phosphorous and annual county-level crop yield (corn and soybeans). Many of the changes affected the entire watershed/basin area (Basin Codes and Parameters)—see table below for a list of all the parameter changes. Some parameter changes were dependent on attributes within either the HRU or a specific land use, so the value changes were relative to the original values.

Table 1 – Model Values

Type	Parameter name	Variable name	Default value	New value	Change type	Change value
Basin Codes	Potential ET method	pet	Penman Monteith	Penman Monteith		
	Water routing method	rte_cha	Variable storage	Muskingum		
	CN method	cn	CN-funct. soil moist.	CN-funct. Plant ET		
	Tile drainage EQ	tiledrain	origitile method	new (wt_shall) method		
Basin Parameters	N uptake distribution	n_uptake	20	100		
	P uptake distribution	p_uptake	20	100		
	N percolation	n_perc	10	0.025		
	P percolation	p_perc	10	17.5		
	P soil partitioning	p_soil	175	190		
	P availability index	p_avail	0.4	0.01		
	Denitrification exponential rate	denit_exp	1.4	3		
	Denitrification threshold water content	denit_frac	1.3	0.1		
	Maximum daily-n fixation	n_fix_max	20	3		
	Concentration coefficient for tile flow	nperco_lchtile	0.5	0.15		
	Surface runoff lag	surlag	4	3		
	Humus mineralization (N&P)	cmn	0.0003	0.00024		
Plants	Harvest index (corn)	harv_idx	0.55	0.95		
	Fraction of N in yield (corn)	frac_n_yld	0.0175	0.0275		
	Fraction of P in yield (corn)	frac_p_yld	0.0025	0.015		
	Harvest index (soy)	harv_idx	0.31	0.5		
	Fraction of P in yield (soy)	frac_p_yld	0.0077	0.01		
Tiles	Depth of drain tube from the soil surface	dp	1000	900		
	Time to drain soil to field capacity	t_fc	24	48		
	Distance between two drain tubes or tiles	dist	30	29500		
	Pump capacity	pump	1	0		
Tiles in (D soils)	Depth of drain tube from the soil surface	dp	1000	530		
	Time to drain soil to field capacity	t_fc	24	48		
	Distance between two drain tubes or tiles	dist	30	29500		
	Pump capacity	pump	1	0		

Type	Parameter name	Variable name	Default value	New value	Change type	Change value
Soil Nutrients	Labile phosphorus in soil surface	*Lab_p*	5	1		
HRU	CN for moisture condition 2	*CN2*	*HRU-dependent*	*HRU-dependent*	absolute	-5
Land Use	Percolation	*perco*	*landuse-dependent*	*landuse-dependent*	percent	-20

Appendix B: Reviewer Feedback

The following people reviewed chapters 6, 9, 11 and 12 of the watershed plan and provided feedback: Marcus Maier (farmer), Becky Taylor (Livingston County SWCD), Joe Stuckel (farmer), Aidan Walton (Precision Conservation Management), Sarah Earles (Ford County SWCD), Danny Harms (farmer), and Terry Bachtold (farmer). Their responses to the project team's prepared questions are listed below, along with our comments on their feedback.

Chapter 6.0 Nonpoint Source Management Measures and Load Reductions

1. Are the expected pollutant load reductions written in a clear manner?
    a. **Marcus Maier:** Yes
    b. **Becky Taylor:** The expected pollutant loads are written in a clear manner. I understand the reason for breaking out tiled and non-tiled fields for some of the practices, but it seems redundant when the numbers are the same (Table 56).
    c. **Joe Stuckel:** Yes
    d. **Aidan Walton:** Yes! I like how each in-field BMP and structural BMP is laid out with the expected load reductions listed for each practice by nutrient/sediment. Those sections explain each practice very thoroughly and seem easy to understand for someone who may not be familiar with one of the practices.
    e. **Sarah Earles:** Yes
    f. **Danny Harms:** Nothing to add.
    g. **Terry Bachtold:** Yes, they are.

Project Team Response: Based on reviewer responses, the project team did not make any changes to expected pollutant load reductions.

2. What feedback do you have on the proposed locations for the various best management practices (BMPs) in Figures 39-44?
    a. **Marcus Maier:** Recommended structural BMPs figures 1 & 2 make sense. However, recommended in-field BMPs seem a bit confusing. What exactly are these modeling pictures conveying? Where does it make the most sense to use cover crops, no-till, or split nitrogen application - from a conservation perspective, cost savings, etc.? What exactly? Isn't the goal to use these practices on as many acres as possible? I must be missing something.
    b. **Becky Taylor:** The proposed locations look fine. May want to note or mention that some of the practices, like cover crops, tillage, and nutrient management, could go on more than what is modeled. I understand needing parameters for the modeling but I also don't want producers/landowners to think that these practices wouldn't work or be beneficial on their land because it wasn't identified in the model. Also, prairie strips and filter strips have a minimum width of 20 feet, not 15.
    c. **Joe Stuckel:** I think the proposed locations look good. However, the critical part of implementing these practices is the connection of willing landowners with adequate funding for the desired practices. Since the limiting factor will likely be landowner's knowledge and interest in navigating the obstacles needed to have their practices funded. My thought is that the focus should be to connect willing landowners with available funding as conveniently as possible regardless of location within the watershed so that as many BMPS can be implemented as possible within the watershed in the near future.

d. **Aidan Walton:** Those figures/maps are good visuals. First, it is helpful to see exactly where the boundaries of the VHW are. I would say that the volume of acres/sites for structural BMPs seems aggressive, although I am not as familiar with adoption rates of those practices as that is not the focus of my role with PCM. I know those practices will be crucial to meeting the goals of the NLRS. As for the in-field BMP recommendations, I think they seem attainable. I work with a number of growers in this watershed who are already implementing cover crops, no-till, etc., and would be willing to expand those practices across their operation.

e. **Sarah Earles:** If operators in the proposed locations are on board with management practices, then this would be very achievable.

f. **Danny Harms:** Nothing to add.

g. **Terry Bachtold:** That DWM (drainage water management) will be hard to implement. Cover crops, strip-till and split-app—locations are fine and will be easier to promote and get results.

Project Team Response: Based on reviewer feedback, the project team added language on page 113 that states more BMPs can be applied to the watershed than the locations identified in the model. Due to the model limitations and lack of field specific data, additional comments could not be addressed.

Chapter 9.0 Critical Areas

a. What feedback do you have on the proposed locations for the critical areas best management practices (BMPs) in Figures 46-51?

a. **Marcus Maier:** No feedback. Fine to look at - good information, but making it cost effective for operators to implement is another story.

b. **Becky Taylor:** Like in chapter 6, I think something needs to be mentioned for infield practices not being limited to the modeling parameters.

c. **Joe Stuckel:** See answer to question 2 from chapter 6. Same basic principles apply.

d. **Aidan Walton:** The first figure, recommended critical in-field BMPs for the entire watershed, visually looks daunting. One of my first observations was that there appears to be far more blue and green, representing no-till and cover crops, than there is pink representing split fertilizer applications. After referring back to the tables above, I was reminded that there are more critical acres of nutrient management than cover crops, and almost just as many critical acres of nutrient management as there is conservation tillage. The figure of recommended critical structural BMPs for the entire watershed looks much less daunting than the similar figure in chapter 6. This figure really helps to visualize exactly where the maximum load reductions could be achieved from structural BMPs. The figures for the two subwatershed give the proposed locations more meaning, especially to farmers and landowners in those areas.

e. **Sarah Earles**: If operators are on board, then it could work.

f. **Danny Harms:** Nothing to add.

g. **Terry Bachtold:** Locations are fine but DWM (drainage water management) is not achievable as proposed.

Project Team Response: Based on reviewer feedback, the project team added language on page 113 that states more BMPs can be applied to the watershed than the locations identified in the model. The project team also created two maps from Figure 46 to provide more clarity on the proposed in-field critical areas BMP locations on page 143 and 144.

b. Do you think the number and amount of BMPs proposed is achievable? Why or why not?

a. In what time frame do you think they are achievable?

b. **Marcus Maier:** No. 752 proposed structural BMPs in less than 10 years - a goal, ok. Realistically, I don't see that happening. Cost, time to implement, maintenance thereafter, return on investment for the operator are all things that will hinder structures getting built. As overall farming margins get tighter, surplus monies to do these BMPs will wane. Unless IL EPA/Legislature mandate nutrient loss reduction standards, voluntary implementation will be tough.

c. **Becky Taylor:** I think that the number and amount of BMP's proposed will be extremely hard, if not impossible, to achieve, especially when you look at structural practices. We may be able to come close for infield practices, but it will require a lot more buy in from producers, especially ones who are new to the practices.

d. **Joe Stuckel:** Implementation of in-field practices could proceed at a very rapid rate if and when farmers are convinced that they are a worthwhile investment in time & money on their own merits. Cost-share funding can encourage farmers to prove the value of BMPs in their operations. The structural practices will be more of a challenge to implement in my opinion. The amount of time it takes to apply for cost share of engineered practices is a hurdle. NRCS staff state they do not have the capacity to handle the engineering for current applications timely. To accommodate the number of structures proposed would require greatly increased engineering capacity and/or streamlining of application process. Also, availability of drainage contractors to install the structures could be a limiting factor.

i. 10-20 years with an appropriate increase in engineering capacity.

e. **Aidan Walton:** I think the number and amount of BMPs proposed is achievable, with time. Again, in-field BMPs is not my area of expertise, but I feel that with enough cost share and funding, farmers and landowners will be intrigued. The potential threat of regulation should influence adoption as well, especially if/when the goals of the NLRS are not met.

i. At least 5+ years. Possibly 10+ years for all proposed BMPs. I say this because I have been with PCM for 2.5 years now, and there are some growers who I have been trying to get to adopt cover crops or no-till for that entire amount of time, and still aren't ready to do so. Many are interested in trying something new on a field or two, but entire operation adoption takes time and logistical planning.

f. **Sarah Earles:** I feel the acres involved is a lot and will take 15+ years to achieve due to engineering for projects & contractors' availability to get projects done in timely fashion.

i. 15+ Years

g. **Danny Harms:** Some numbers seem kind of high. Would like to see a clearer definition of strip till.

h. **Terry Bachtold:** Not all are achievable. Farmers are not willing to spend money on drainage water management. The other BMPs could be achieved with promotions and government programs…in five to ten years.

Project Team Response: Based on reviewer feedback, the project team added language on page 145 to explain that in order to meet the plan goals of 15% nitrate-nitrogen reduction, there are a substantial amount of BMPs that need to be implemented. Potential challenges with implementing the proposed BMPs include lack of funding, limited NRCS state capacity to handle the engineering component of structural BMPs in a timely fashion, and the voluntary nature of implementing these BMPs.

Chapter 10.0 Technical and Financial Assistance

a. Becky Taylor: I know this was not one of the sections to be reviewed, but I just wanted to mention that SWCDs have cost-share available that could be used in the VHW. They weren't mentioned in the section for funding and were barely mentioned under the TSP section.

Project Team Response: The Livingston and Ford County SWCD's are mentioned under 10.1 Technical Assistance. The project team added reference to SWCDs regarding cost share and TSP sections of chapter 10 on page 161.

Chapter 11.0 Implementation Milestones, Objectives and Schedule

1. Do you think the implementation milestones and timeframe in Table 72 is achievable? Why or why not?
    a. Which milestones and timing would you change and why?
    b. **Marcus Maier:** Again, is it cost beneficial for an operator to do (unless dictated by landowner who may be willing to pay for such). Cover crops/nitrogen management/switching to no-till - strip till perhaps in the timeframes outlined. Cost to do. Yes, NRCS and State/Federal programs can help with funding, but where does that money come from - us the taxpayer. How much national debt can the public stomach? In the end the practice needs to stand on its own.
    c. **Becky Taylor:** I do not think that the implementation milestones and timelines are realistic in Table 72. You are expecting to go from small numbers to huge numbers in a short period of time. Work has been ongoing in the watershed for years, and it is still hard to move the numbers very much. I think you need to bring your numbers down for all practices, because otherwise you will never meet any of the goals.
    d. **Joe Stuckel:** It will be difficult. For the in-field practices those goals could be far exceeded **IF** farmers/landowners see their merit of implementing them apart from receiving funding. If farmers/landowners don't see agronomic/economic returns it will be hard to convince them with cost-share funding alone. The structural practices will be more difficult. See answer to question 2 in chapter 9.
    e. **Aidan Walton:** I think the milestones and timeframes are reasonable. These more or less align with my thoughts from question 2b above. No changes necessarily, but some thoughts – If anything, I think years 1-2 and even 3-5 will be the toughest to achieve. It will take a few new adopters to have success and then spread the word to neighbors and friends for the practices to really take off and become widespread. I could be biased with my focus of work, but I think 15 bioreactors and 11 constructed wetlands could be a tough achievement. I am not sure how many wetlands there currently are in the area, but I know there are very few bioreactors in Livingston County currently, so 15 new ones just in the VHW seems like a stretch. I hope I'm wrong! With the growing rate of carbon markets and incentive programs, I think the in-field
    f. **Sarah Earles:** On some yes, others such as constructed wetlands might be harder to find enough owner willing to convert ground to constructed wetlands. It might be hard to find enough engineers & contractors to get projects done in the correct time frame.
    g. **Danny Harms:** Timing looks ambitious.

h. **Terry Bachtold:** Cover crops and strip-till are achievable. Bioreactors, wetlands and DWM (drainage water management) are too aggressive. Numbers need to be reduced by 75%

i. Water ways and terraces will take 10 years.

Project Team Response: Based on reviewer feedback, the project team adjusted the implementation milestones to move some of the BMPs into later years, especially the structural practices. In particular, the project team moved 20 bioreactor installations into 10+ Years, 10 constructed wetlands to 10+ Years, 313 acres of drainage water management to 6-10 years, and 15,853 ft of saturated buffers to 6-10 years. Additionally, the project team added language on page 164 that emphasized the need for BMPs to make financial sense for the producer or the provision of funding (public or private) in order to meet these aggressive goals in the watershed.

2. Are any responsible parties missing in Table 73?
   a. **Marcus Maier:** No
   b. **Becky Taylor:**
      i. Bioreactors can be cost-shared through state programs.
      ii. Constructed wetlands can be cost-shared through state programs.
      iii. Contour buffer strips are also offered through CRP.
      iv. SWCD also offer technical assistance for filter strips.
      v. At this time, funding mechanisms should be the same for both sections of the table.
   c. **Joe Stuckel:** Engagement with local drainage contractors will be critical for BMPs that involve drainage water management/treatment.
   d. **Aidan Walton:** I think PCM could be added as technical assistance for BMP: Nitrogen Management in the 1-10 years category (unless "Consultants" covers PCM). PCM's three main areas of emphasis are cover crops, no-till/strip-till, and nitrogen management. We discuss the MRTN, NUE rates, and more with all our growers. Thank you for already having PCM listed for the other two!
   e. **Sarah Earles:** Not that I know of.
   f. **Danny Harms:** Nothing to add. Table 73 didn't line up.
   g. **Terry Bachtold:** No parties are missing (that I can see).

Project Team Response: Based on reviewer feedback, the project team added information provided by Becky Taylor and Aidan Walton to Table 73. Additionally, the project team added drainage contractors as responsible parties and technical assistance for BMPs related to drainage water management/treatment.

Chapter 12.0 Information and Education

1. Are the goals and objectives aligned with local needs and opportunities? How can they better align?
   a. **Marcus Maier:** I think they do - just need to sell them.
   b. **Becky Taylor:** The goals and objectives seem to align with what the VHW Steering Committee has been focused on.
   c. **Joe Stuckel:** Looks Good.
   d. **Aidan Walton:** I think the goals and objectives are great. I can't think of any changes.
   e. **Sarah Earles:** Yes, they seem to align perfectly.
   f. **Danny Harms:** Goals look good.

g. **Terry Bachtold:** Goals and objectives will be aligned if there is 100% cooperation from all parties.

Project Team Response: Based on reviewer feedback, no changes were made to the goals and objectives section of Chapter 12.

2. Are there any outreach and education activities missing in Table 76? If so, please describe.

a. **Marcus Maier:** Not that I'm aware of.

b. **Becky Taylor:** I didn't see anything major missing from the outreach and education activities in Table 76. In Table 74, there are some changes that need to be made because of personnel changes. Brodie Eddington is no longer the PF Biologist for Livingston County, it should be Zach Stephenson. Jesse King is no longer the Zoning Administrator for Livingston County, it should be Brittney Miller. It might be good to say that Chris Bunting is with Livingston County Farm Bureau, just so there isn't any confusion.

c. **Joe Stuckel:** Looks Good.

d. **Aidan Walton:** I cannot think of any activities missing. This seems thorough. As you know, PCM will continue to assist with your efforts whenever/wherever needed!

e. **Sarah Earles:** No.

f. **Danny Harms:** Nothing to add.

g. **Terry Bachtold:** I think it is complete.

Project Team Response: The project team updated various Steering Committee names in Table 74 based on Becky Taylor's feedback.