The Slough Watershed Plan

Lawrence, Richland & Crawford Counties, Illinois

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With assistance from: Coles County Soil & Water Conservation District, University of Illinois Extension & the Illinois Farm Bureau

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Acronyms

1. AFT – American Farmland Trust
2. ACEP – Agricultural Conservation Easement Program
3. BMP – Best Management Practice
4. CREP – Conservation Reserve and Enhancement Program
5. CCA – Certified Crop Advisor
6. CRP – Conservation Reserve Program
7. CSP – Conservation Stewardship Program
8. CWS – Community Water Supply
9. CFB – County Farm Bureau
10. DU – Ducks Unlimited
11. DWM - Drainage Water Management
12. EMC – Event Mean Concentration
13. EPA – Environmental Protection Agency
14. FSA – Farm Service Agency
15. EQIP – Environmental Quality Incentive Program
16. fasl – feet above sea level
17. GIS – Geographic Information System
18. HEL – Highly Erodible Soil
19. PHEL – Potentially Highly Erodible Soil
20. gpm – gallons per minute
21. GRP – Grassland Reserve Program
22. GIGO – Green Infrastructure Grant Opportunities Program
23. HUC – Hydrologic Unit Code
24. ICG – Illinois Corn Growers
25. IDNR – Illinois Department of Natural Resources
26. INAI – Illinois Natural Areas Inventory
27. IDOA – Illinois Department of Agriculture
28. Illinois EPA – Illinois Environmental Protection Agency
29. IEMA – Illinois Emergency Management Agency
30. IFB – Illinois Farm Bureau
31. INLRS – Illinois Nutrient Loss Reduction Strategy
32. INSAC – Illinois Nutrient Science Advisory Committee
33. ISGS – Illinois State Geologic Survey
34. ISA – Illinois Stewardship Alliance
35. ISAP – Illinois Sustainable Ag Partnership
36. LRR – Lateral Recession Rate
37. MGD – Million Gallons per Day
38. MRBI – Mississippi River Basin Healthy Watershed Initiative
39. NGRREC - National Great Rivers Research & Education Center
40. NCWS – Non-Community Water Supply
41. NFWF – National Fish and Wildlife Foundation
42. NO3 – Nitrate
43. NPDES – National Pollutant Discharge Elimination System
44. NPS– Nonpoint Source Pollution
45. NRCS – National Resource Conservation Service
46. NTCHS – National Technical Committee for Hydric Soils
47. NWI – National Wetlands Inventory
48. PCM – Precision Conservation Management
49. RCPP – Regional Conservation Partnership Program
50. RD – Rural Development
51. STEPL – Spreadsheet Tool for Estimating Pollutant Loads
52. STP – Stone Toe Protection
53. SSRP – Streambank Stabilization and Restoration Program
54. SWCD – Soil and Water Conservation District
55. TN – Total Nitrogen
56. TP – Total Phosphorus
57. TSP – Technical Service Providers
58. TSS – Total Suspended Solids
59. UofI – University of Illinois Extension
60. USDA – U.S. Department of Agriculture
61. USEPA – U.S. Environmental Protection Agency
62. USFWS – U.S. Fish and Wildlife Service
63. USGS – United States Geological Survey
64. USLE – Universal Soil Loss Equation
65. VRT - Variable Rate Technology
66. NVSS – Nonvolatile Suspended Solids
67. USACE – U.S. Army Corps of Engineers
68. VSS – Volatile Suspended Solids
69. WFF – Walton Family Foundation
70. WASCB – Water and Sediment Control Basin
71. WRP – Wetlands Reserve Program

Executive Summary

The Slough Watershed

The Slough Watershed Plan encompasses 18,201 acres in one Hydrologic Unit Code (HUC)-12 watershed and falls within the greater Embarras River basin. The plan provides a road map to achieve water quality targets and stakeholder goals. Nutrient and sediment water quality targets are in alignment with the Illinois Nutrient Loss Reduction Strategy (INLRS).

The Slough is one of two priority subwatersheds selected for more detailed planning alongside the 2022 update of the larger Embarras River Watershed Management Plan. It was selected using a scoring system based on data such as pollutant yield (weighted towards phosphorus) and percent area in row crops, combined with more subjective criteria such as level of stakeholder interest. The Slough ranked 1 out of 79 other HUC-12 subwatersheds. The other priority subwatershed is Polecat Creek located in portions of Coles and Edgar counties. The intent is to continue HUC-12 level planning based on subwatershed rankings as additional resources become available.

This plan is intended to be monitored, adapted and updated as cost-effective implementation activities achieve the highest load reductions. Priority or critical areas identified should serve as a starting point to guide implementation and outreach efforts by watershed managers and partners.

Stakeholders in the larger Embarras River watershed have been working diligently to improve water quality. Efforts over the years have been supported by local stakeholders, including farmers, communities, government agencies, and non-profit groups. Activities and partnerships will continue and are further strengthened through new subwatershed plans like this one. This plan will guide outreach, Conservation cost-share from the Natural Resources Conservation Service (NRCS) and SWCD, and future funding through the Illinois EPA. Past work in the Embarras has laid the critical groundwork needed to accelerate implementation activities detailed in this subwatershed plan.

The primary goal of this effort is to reduce sediment and nutrient delivery to the Embarras River, specifically, phosphorus. The plan includes a detailed inventory and assessment of current conditions that inform strategic recommendations and projects. Table 1 summarizes and ranks watershed characteristics that are contributing to water quality impairments followed by a summary of key recommendations.

Table 1 – Stream & Watershed Characteristics & Problem Ranking

Inventory/ Assessment Item	Summary	Ranking
Nutrient & Sediment Loading	Nutrient loading from crop ground exceeds other sources and is responsible for 90% of the phosphorus and 77% of the nitrogen. Sediment loading is also high and responsible for 88%. Very little of the cropland nitrogen load is believed to be originating from subsurface flow or drain tiles. Agricultural Best Management Practices (BMPs) will be very effective in reducing nutrient and sediment loads, considering cost and feasibility. Further conversion to agriculture is not expected to occur in the future. Prioritized in-field practices, especially those that treat surface runoff such as cover crops, will significantly reduce nitrogen loading and edge-of-field and structural practices (e.g., filter strips, wetlands, and grassed waterways) will address higher-risk areas and further reduce loading, especially for phosphorus and sediment.	**High**
Water Quality & Monitoring	Chemical water quality data is nonexistent in this watershed. Water chemistry and flow monitoring is needed to establish a baseline. Water quality, especially phosphorus, sediment and nitrogen, is of high concern and a priority for monitoring.	**High**
Tillage & Highly Erodible Soils	No-till systems are common on 63% of all field acres followed by mulch-till (19%). These acres are responsible for approximately 93% of the cropland sediment, 88% of the phosphorus and 90% of the nitrogen load. The 19% of mulch-till delivers 25% of the phosphorus, 24% of the nitrogen and 29% of the sediment load from cropland. Highly erodible and potentially highly erodible soils exist on 31% of all field acres and deliver 37% of the entire cropland sediment load, mostly in no-till. The 4.1% of mulch-till planted on these acres deliver 10% of the entire cropland sediment load. Increasing the percentage of no-till to mulch-till fields in the watershed and promoting cover crops will measurably reduce sediment and nutrient loading.	**High**
Gully Erosion	Gully erosion, primarily from crop ground, is responsible for a relatively moderate portion of the watershed sediment load, or 11% and a low percentage of the overall phosphorus load, or 3.4%. These areas can be addressed through structural practices, primarily grass waterways and water and sediment control basins wetlands to trap or filter sediment before entering a receiving stream.	**Medium**
Streambank Erosion	Streambank erosion is responsible for a moderate portion of the watershed sediment (10%) and low phosphorus (2.9%) load. Although it is a natural process, bank erosion is severe at certain locations. Access constraints and cost limit ability for stabilization. However, one critically unstable segment identified in this plan should be addressed.	**Medium**
Landuse Change & Developed Areas	The watershed contains little developed land. Much of the tillable acres are already converted to cropland and little to no transition from natural areas is likely. These locations should be conserved and improved to promote habitat quality.	**Low**
Septic Systems	There are an estimated 130 homes with septic systems in the watershed. It is possible that up to 15% of all systems may be failing, or 20. Failing systems are estimated to account for a low portion of the overall nutrient load (5% nitrogen and 0.9% phosphorus).	**Low**

Key Recommendations

1. Conduct targeted outreach and one-on-one communication with producers and landowners identified as having critical areas outlined in Section 9.0. Develop grant applications.
2. Utilize this plan to direct NRCS and SWCD conservation cost-share dollars and incorporate into existing ranking systems.
3. Initiate water quality and streamflow monitoring to establish a baseline and track changes over time.
4. Pursue conservation cost-share and incentives through the United States Department of Agriculture Regional Conservation Partnership Program, or RCPP.

The Slough – Flooded

1.0 Introduction

The focus of this plan is the 18,201-acre Slough watershed, located mostly in Lawrence County, Illinois. The area of one United States Geological Survey (USGS) Hydrologic Unit Code (HUC)-12 subwatershed makes up the project area: The Slough (HUC12 – 051201121302). The Slough is within the Paul Creek – Muddy River HUC10 basin (0512011213) and the Embarras River HUC8 (05120112). It is tributary to the Embarras. Figure 1 shows the location of the watershed.

This plan characterizes The Slough and defines an achievable implementation strategy to address water quality concerns, specifically, sediment and nutrients. It also complements the larger Embarras River basin efforts to identify, prioritize, and plan new projects following concerns over phosphorus loading and decades of collaborative conservation activities. The plan will, therefore, provide a road map to achieve water quality targets, as well as stakeholder goals. This plan is intended to be adapted and updated as implementation activities progress to achieve the highest load reductions for the least possible investment.

Unlike the Embarras, The Slough itself does not have a history of water quality impairments. Limited to no water chemistry data exists, however, biological data is available indicating relatively good fish and macroinvertebrate (bug) conditions. The water quality drivers for this watershed plan are elevated nutrients loading in the Embarras, primarily phosphorus. Sediment and nutrient reduction in The Slough is critically important to the long-term resiliency of the Embarras system. Therefore, phosphorus, sediment, and nitrogen reduction is the primary focus of this plan. Water quality targets of a 45% reduction in phosphorus and sediment and a 45% reduction in nitrogen are consistent with the INLRS. Given that most phosphorus is likely a function of eroded sediment, a sediment percentage representing the phosphorus is recommended. If all recommended projects are implemented and constructed, phosphorus and sediment reduction targets will be exceeded. The nitrogen target (Section 8) will not be met without additional conversion of crop ground to permanent grass cover and, therefore, adaptive management strategies will be needed as this watershed plan is implemented. 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 & Load Reductions
- Section 7 – Cost Estimates
- Section 8 – Water Quality Targets
- Section 9 – Critical Areas
- Section 10 – Technical & Financial Assistance
- Section 11 – Implementation Milestones, Objectives & Schedule
- Section 12 – Information & Education
- Section 13 –Monitoring & Tracking Strategy

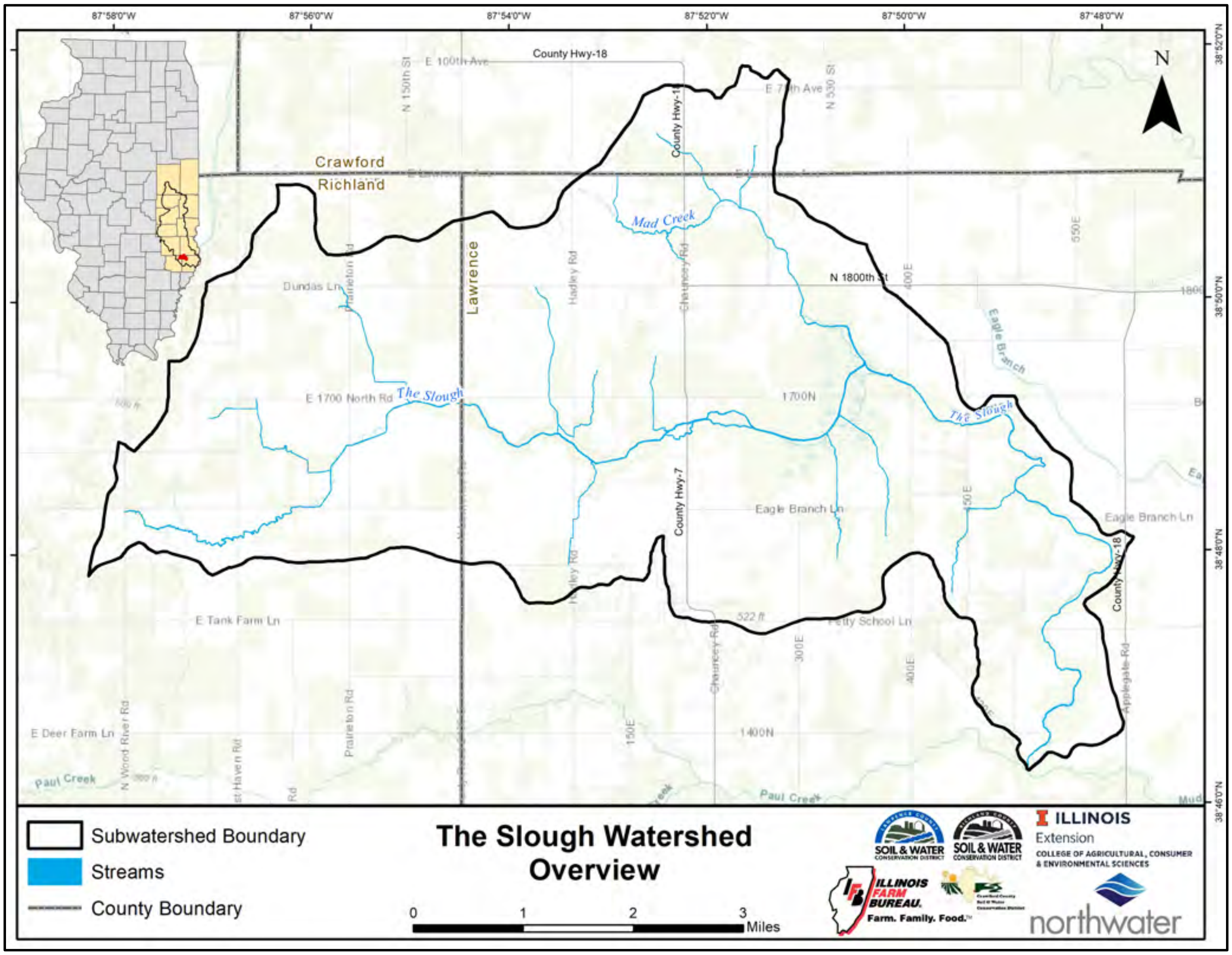


Figure 1 – The Slough Watershed

2.0 Watershed History & Background

Very little is known about the history of The Slough. No specific reports, documentation, notable activities or past events related to the watershed could be found. Information obtained through the Illinois Department of Natural Resources (IDNR) indicate that three endangered species are known to be endemic to the region; tracaulon arifolium, styrax americana, and carex gigantea, also known as Halberd-leaved Tearthumb, Storax, and Large Sedge, respectively. All three are vascular plants. Characteristics of the watershed are detailed in Section 3.0.

2.1 Watershed Planning & Goals

Through opportunities to share feedback, such as subwatershed stakeholder meetings and one-on-one meetings, stakeholders and landowners in The Slough subwatershed identified a series of concerns and goals.

Concerns

- Flooding
- Bank erosion
- In-field, sheet and rill erosion
- Sedimentation in streams, ditches
- Changes in stream flow
- Lack of education of watershed issues and BMPs, including among the general public

Goals

- Install flood control and water storage structures, e.g., ponds
- Initiate streambank stabilization projects
- Update existing tile and terraces
- Develop cover crop education and cost-share opportunities

3.0 Watershed Resource Inventory

The resource inventory summarizes characteristics specific to The Slough. It includes information on hydrology, landuse, soils, habitat and water quality, demographics, and other relevant information.

3.1 Location & Watershed Boundaries

Figure 1 shows the location of The Slough subwatershed and the Embarras River watershed. The Slough flows into Muddy Creek before entering the Embarras River Northwest of Lawrenceville, Illinois. This plan encompasses the watershed area of The Slough from its origins approximately 7 miles Northeast of Onley, Illinois, flowing East and South to Muddy Creek. The only other named stream in the watershed is Mad Creek.

3.2 Water Impairments & Standards

This section provides an overview of applicable and relevant water quality standards, pollutants of concern and impairments. Water quality standards are laws or regulations established to enhance water quality and protect public health and welfare. Standards consist of 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 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. 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 the States to define impaired waters and identify them on the 303(d) list. When no regulatory standards are relevant for a parameter, water quality guidelines are often applied to assess the condition of a waterbody.

3.2.1 Water Quality Impairments

No current or historical record of impairment exists for The Slough (IL_BEAA-01) segment ID or Mad Creek (IL_BEAAA). The closest relevant impaired waterbody is the Embarras River (segment ID - IL_BE_01). In this segment, impairments are related to primary contact recreation and aquatic life and include fecal coliform and dissolved oxygen (Table 2). Fecal coliform persisted until 2014 and became an impairment again in 2016. Dissolved oxygen and iron were impairments in 2014 and 2016 (Table 3)

Table 2 – 2018 303(d) Impaired Waterbodies

Assessment ID	Waterbody	Size (mi)	Designated Use	Cause
IL_BE_01	Embarras River	29.06	Primary Contact Recreation	Fecal Coliform
IL_BE_01	Embarras River	29.06	Aquatic Life	Dissolved Oxygen

Table 3 – Historical 303(d) Impaired Waterbodies

Assessment ID	Waterbody	Designated Use	Cause
2006, 2008, 2010, 2012			
IL_BE_01	Embarras River	Primary Contact Recreation	Fecal Coliform
2014			
IL_BE_01	Embarras River	Aquatic Life	Dissolved Oxygen, Iron
2016			
IL_BE_01	Embarras River	Primary Contact Recreation and Aquatic Life	Fecal Coliform, Dissolved Oxygen, Iron

3.2.2 Standards & Guidelines

No water quality or biological data exists for The Slough. Relevant standards and guidelines are provided for information purposes given this plan's focus on phosphorus, nitrogen, and sediment.

Nitrogen: Nitrate-Nitrogen (NO3-N) is the inorganic form of nitrogen and, when in high concentrations, can be toxic to humans, wildlife and aquatic ecosystems. Excess nitrogen in surface waters also aid algal growth and blooms.

- The public and food processing water supply standard is 10 mg/L.

Nitrogen: Total Nitrogen (TN) includes the sum of nitrate, nitrite, and Total Kjeldahl Nitrogen (organic nitrogen and ammonia). Nitrate + Nitrite is another common measure that refers to the inorganic component of nitrogen.

- There are no TN standards for lakes or rivers/streams in Illinois, however, the Illinois Nutrient Science Advisory Committee (INSAC) recommends 3.8 mg/L as a guideline for wadable streams in the northern ecoregion (INSAC, 2018). It should be noted that the INSAC-recommended standards have not been finalized.

Total Phosphorus (TP) includes dissolved and particulate fractions and is often stored in aquatic biota such as algae. Dissolved factions are more readily available and can stimulate processes that are harmful to water quality and aquatic life. Phosphorus sources in the watershed context include fertilizers and, to a lesser extent, human and animal waste.

- There is no phosphorus standard for rivers and streams in Illinois, however, the standard for lakes states that TP shall not exceed 0.05 mg/L in any stream at the point where it enters any reservoir or lake with a surface area greater than 20 acres. Further, the INSAC recommends a guideline of 0.113 mg/L for rivers in the northern ecoregion (INSAC 2018). The Slough is in this ecoregion and it should be noted that the INSAC recommended standards have not been finalized.

Total Suspended Solids (TSS) is the fraction of total solids suspended in water as retained by a 1.5 µm filter. Concentrations vary temporally in rivers and lakes, typically increasing from erosion during runoff events, lake turnover, biological processes, and human disturbances. Total suspended solids can be differentiated between volatile suspended solids (VSS), organic materials such as algae and decomposing organic matter, and nonvolatile suspended solids (NVSS), which includes non-organic "mineral" substances (Illinois EPA, 1998).

- There are no regulatory TSS standards for rivers and streams in Illinois. In the past, the Illinois EPA has used a statistical guideline of 116 mg/L for streams, which is an indicator of conditions to support aquatic life.

3.3 Watershed Jurisdictions & Demographics

The Slough watershed lies predominantly within Lawrence County – 67%, or 12,267 acres. Approximately 28%, or 5,172 acres, is within Richland County and only 4.2%, or 762 acres, is within Crawford County (Figure 2). Chauncey is the only community in the watershed and is unincorporated.

3.3.1 Watershed Jurisdictions & Jurisdictional Responsibilities

Figure 2 depicts most jurisdictional entities and areas. The Slough spans 3 townships. Petty (12,350 acres) and German (5,056 acres) occupy 96% of the watershed, with Southwest (796 acres) only 4.4%.

No federally owned properties exist in the watershed. One Illinois Department of Natural Resources (IDNR)-managed INAI site is located within the watershed, the Thacker – Pauley Marsh, occupying 48 acres.

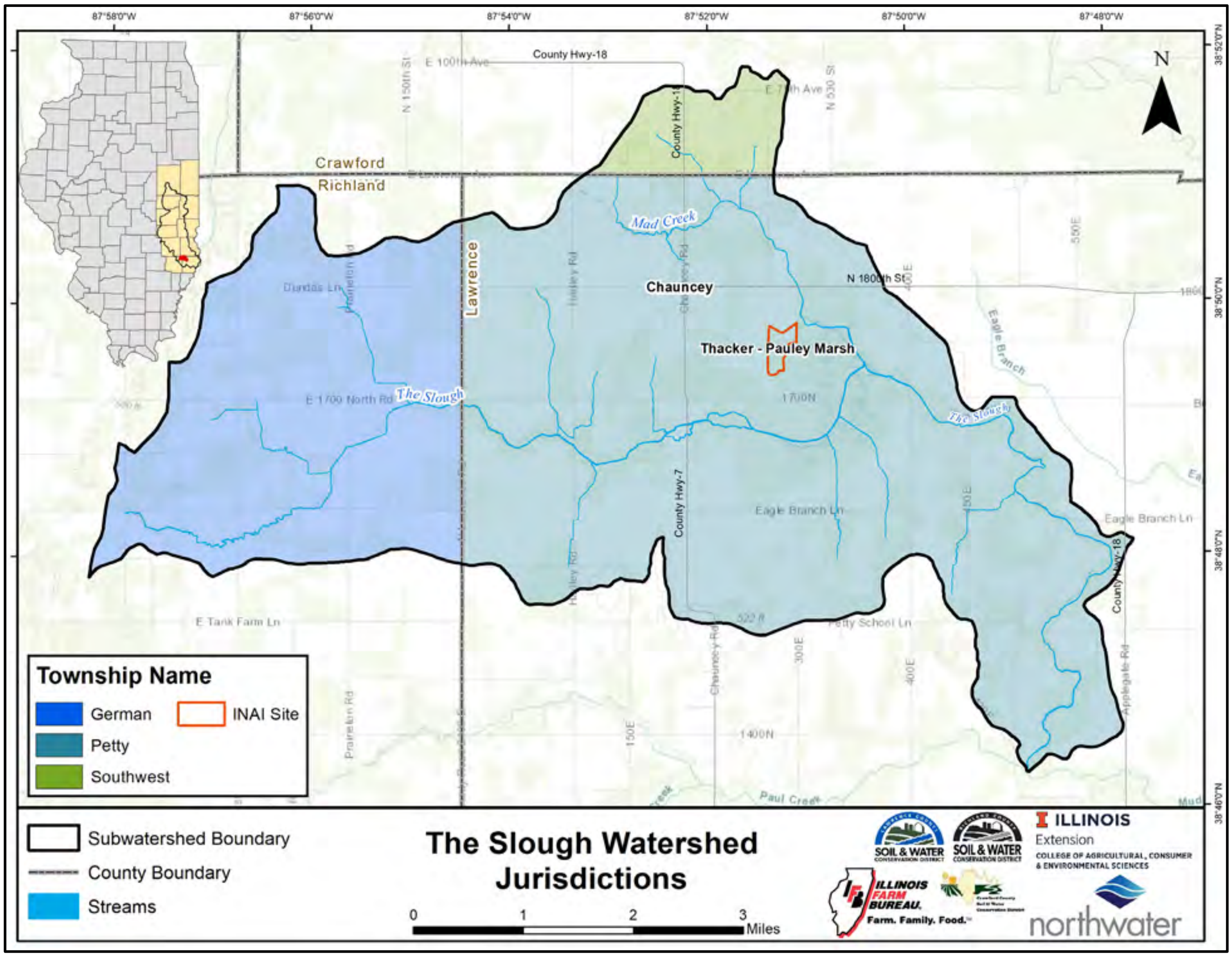


Figure 2 – Jurisdictional Boundaries

3.3.2 Demographics

According to the United States Census Bureau 2019 American Community Survey data, total population of the counties encompassing the watershed is 50,771, with 16,033 in Lawrence County, 15,766 in Richland, and 18,972 in Crawford. In Lawrence, median household income is $31,277 versus $48,894 in Richland and $49,779 in Crawford. There are 7,129 housing units in Lawrence, 7,518 in Richland, and 8,689 in Crawford. All three counties have a median age of 42. In both Lawrence and Crawford, 19% of the population is above the age of 65; in Richland, 20%. Using 2010 data by census tract, the area-weighted population within the watershed is 517 with 244 housing units. The entirety of the watershed is rural. (Figure 3).

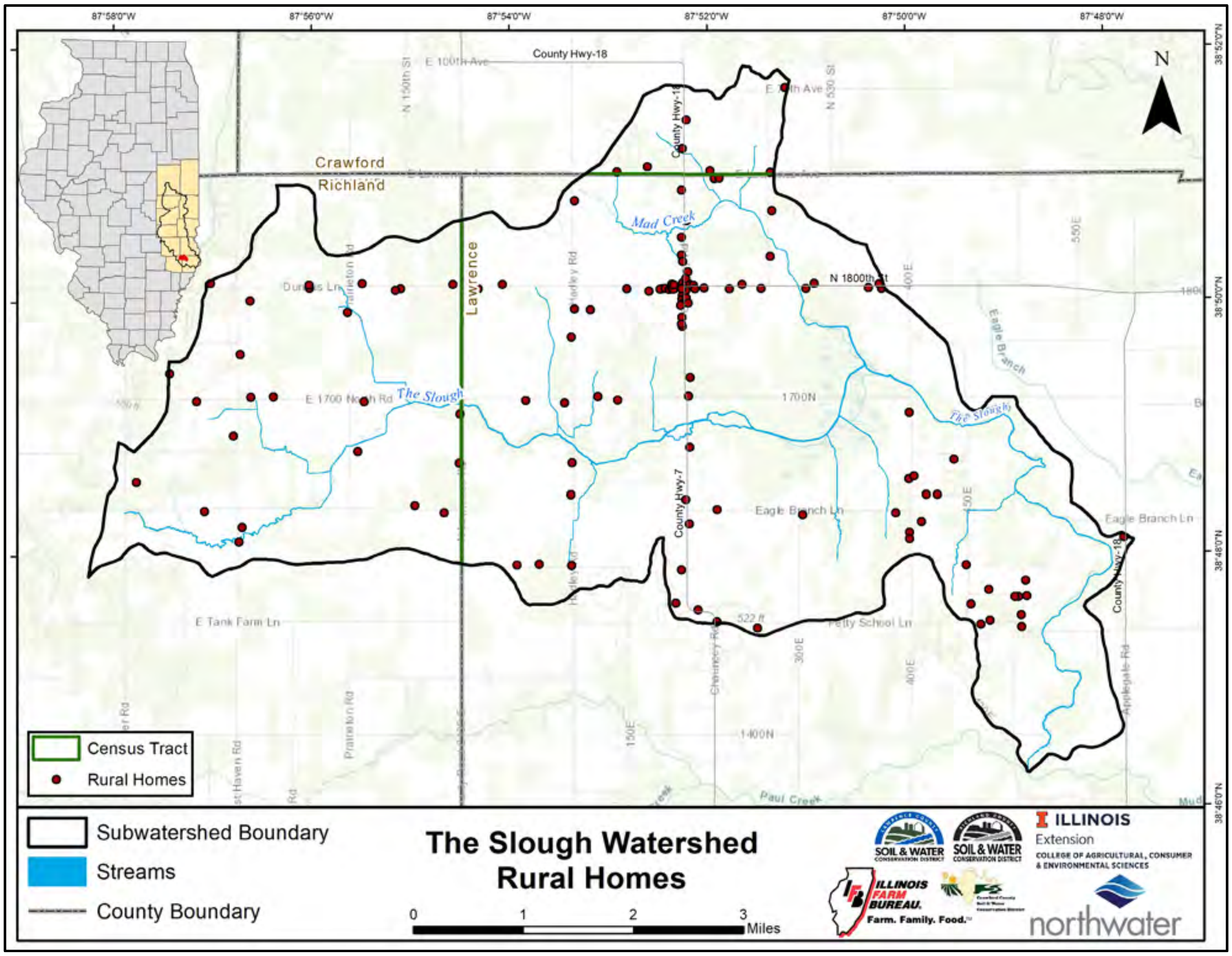


Figure 3 – Rural Homes

3.4 Geology, Hydrogeology, & Topography

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

3.4.1 Geology

The Slough watershed is located at the southeastern end of the Springfield Plain region of Illinois and is bounded to the south by the Mt. Vernon Hill Country Region. Surficial materials and hydrology of the watershed have been fundamentally shaped by glacial processes of deposition and erosion. The watershed is primarily covered with glacial till, which is typically loamy and sandy with variable thickness and composition (Table 4). The spatial extents and statistics of each surficial deposit type are illustrated in Figure 4.

Surficial geology was adapted from Illinois State Geologic Survey (ISGS) 1995 Stack-Unit mapping of the top 50 ft of earth materials. A thin zone of Cahokia Alluvium is present near the confluence of the Slough and Mad Creeks and along the lower reaches of The Slough. Drift thickness varies from less than 25 ft, primarily in the western and central portions, to over 50 ft in the far northern and east-central portions of the watershed, with thicknesses exceeding 100 ft in the far southeastern portion. The thicker lobes of drift material correspond to tributaries of the Embarras buried bedrock valley which trends northwestward along the east side of the watershed. The unconsolidated deposits are primarily underlain by the Upper Pennsylvanian-aged Matoon and Bond formations, with the central portions of the watershed primarily underlain by sandstone, while the eastern and western ends are underlain predominantly by shale.

Table 4 – Surficial Geology of the Slough Watershed

Surficial Geology	Description[1]	Area (acres)	Percent of Watershed
Alluvium	Thin Cahokia alluvium underlain by Pennsylvanian age shale	973	5%
	Thin Cahokia alluvium overlying Carmi Member silt, clay and fine sand, underlain by Pennsylvanian age shale and sandstone	2,322	13%
Clay and Silt	Thin Carmi Member silt, clay and fine sand, underlain by Pennsylvanian age shale	748	4%
Till	Thin to thick sequences of loamy and sandy Glasford till underlain primarily by Pennsylvanian age shale	6,461	36%
	Thin to thick sequences of loamy and sandy Glasford till underlain primarily by Pennsylvanian age sandstone	7,697	42%

[1] Adapted from Illinois State Geological Survey Stack-Unit Mapping of Geologic Materials in Illinois to a Depth of 15 meters

3.4.2 Hydrogeology

There are estimated to be at least 56 private water wells within The Slough watershed based on the ISGS wells and borings database. There are no Community Water Supply (CWS) or Non-Community Water Supply (NCWS) wells recorded in the state database.

Based on the available dataset of private wells, average depth is 155 ft with a minimum of 19 ft and a maximum of 1,127 ft. An inferred average depth to water bearing units of 93 ft was calculated based on the 46 wells which denoted depth to top of productive interval. Well yield or pumping rate data was available for 31 wells, indicating an average yield of 17 gpm, with no wells reported to yield in excess of 50 gpm.

Based on analysis of well record reported lithology, depth and productive interval, wells are primarily completed in the sandstone bedrock aquifer (n=36), with only nine completed in unconsolidated gravels, sands and clays of the till formations and eleven completed in either shale or sandstone bedrock. ISGS mapping indicates that a major sand and gravel aquifer exists along the eastern and northern edges of the watershed, associated with Embarras buried bedrock valley. No high yielding bedrock aquifers are accessible within 500 ft drilling depth in the watershed.

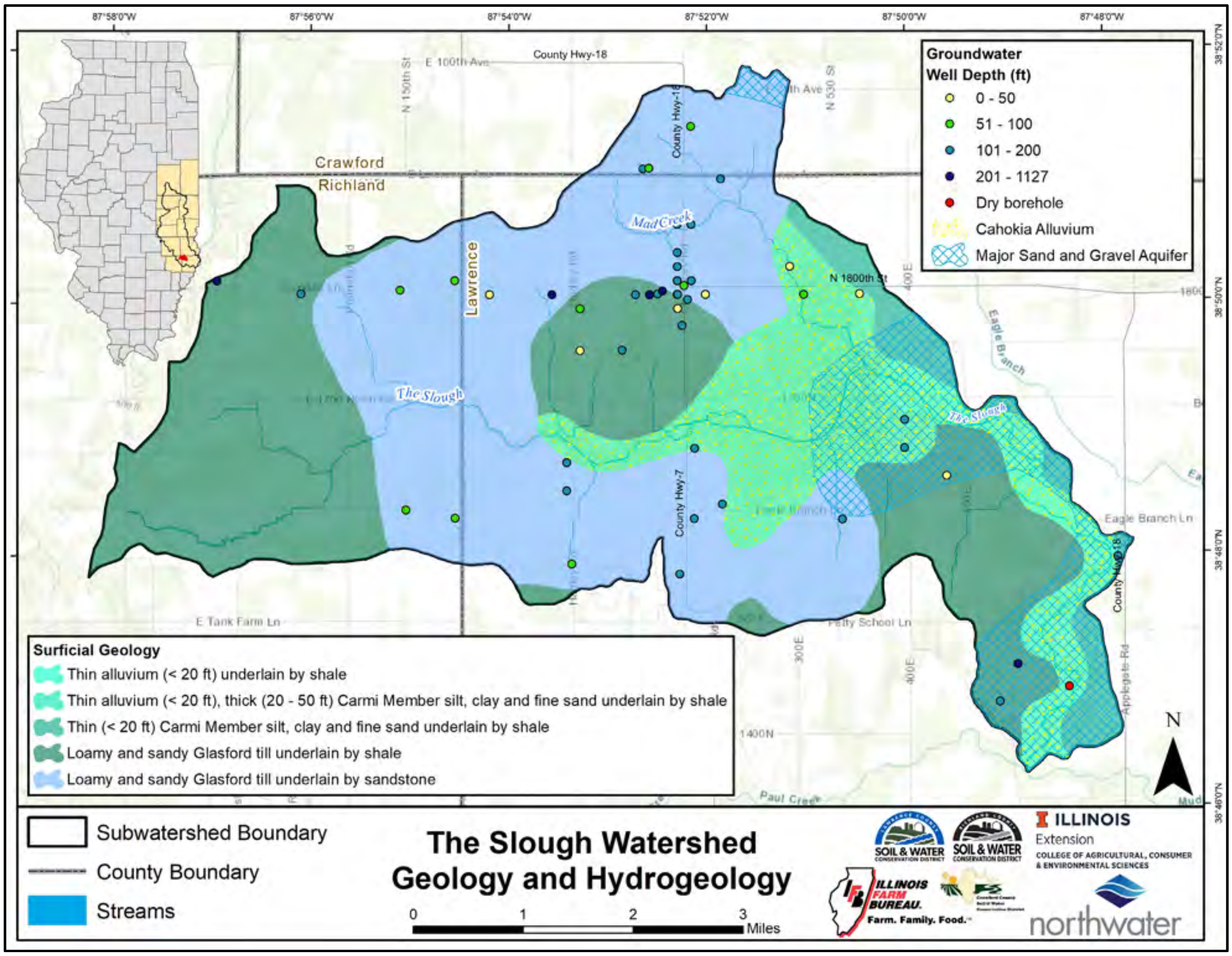


Figure 4 – Geology & Wells

3.4.3 Topography & Relief

Watershed elevation ranges from about 428 to 560 ft above sea level (fasl). Most of the watershed is at 469 fasl or lower, with an average of about 467 fasl. The lowest elevations can be found at the watershed outlet in the southeastern extreme of the watershed (Figure 5).

Watershed slopes are shown in Figure 6. Average slope is 2.1% (1.2°) and the maximum is 133% (53°). Headwaters and upland areas are flatter, transitioning to steeper slopes adjacent to stream corridors and along the western and southern periphery of the watershed.

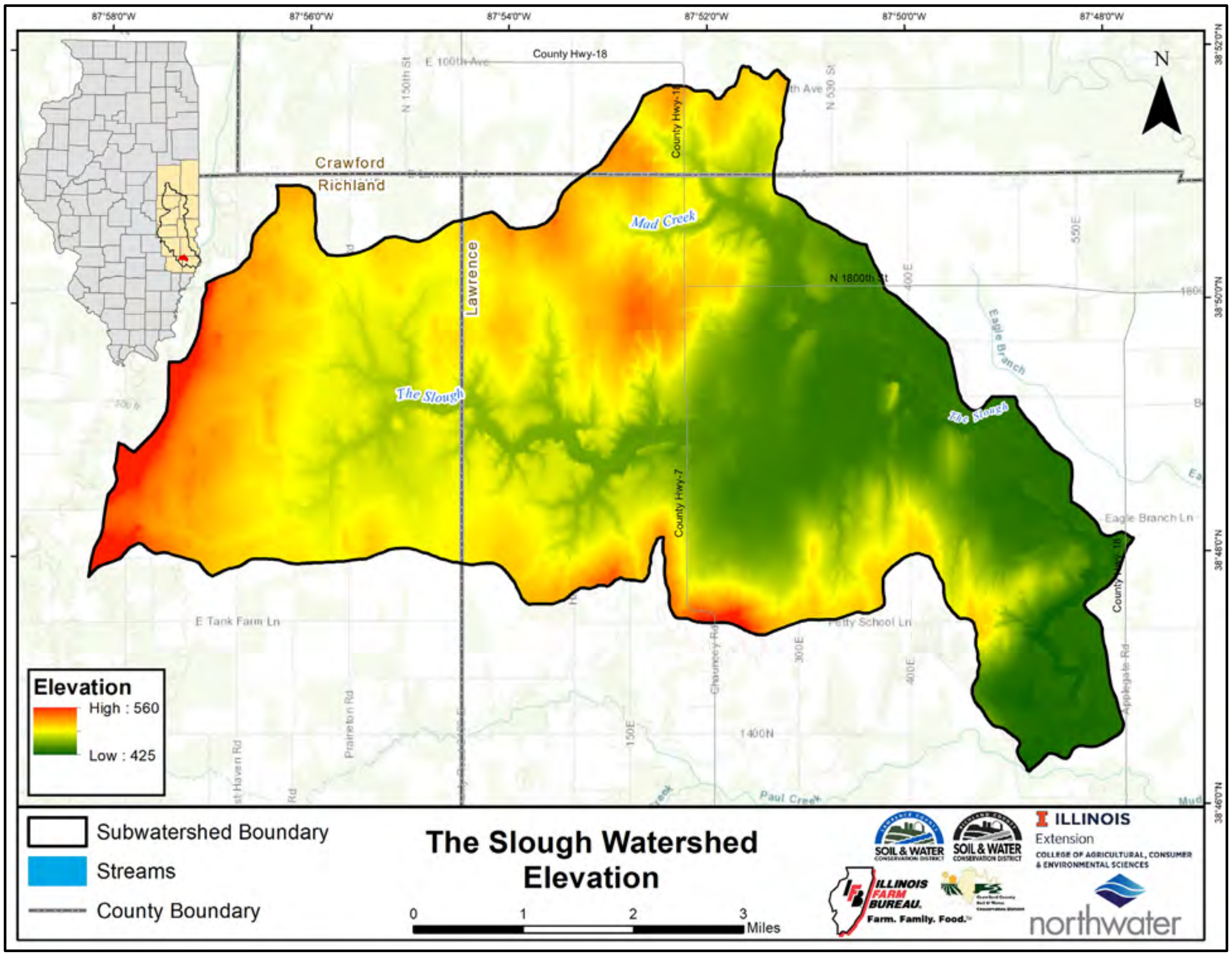


Figure 5 – Surface Elevation in Feet

Sloping Field in the Watershed

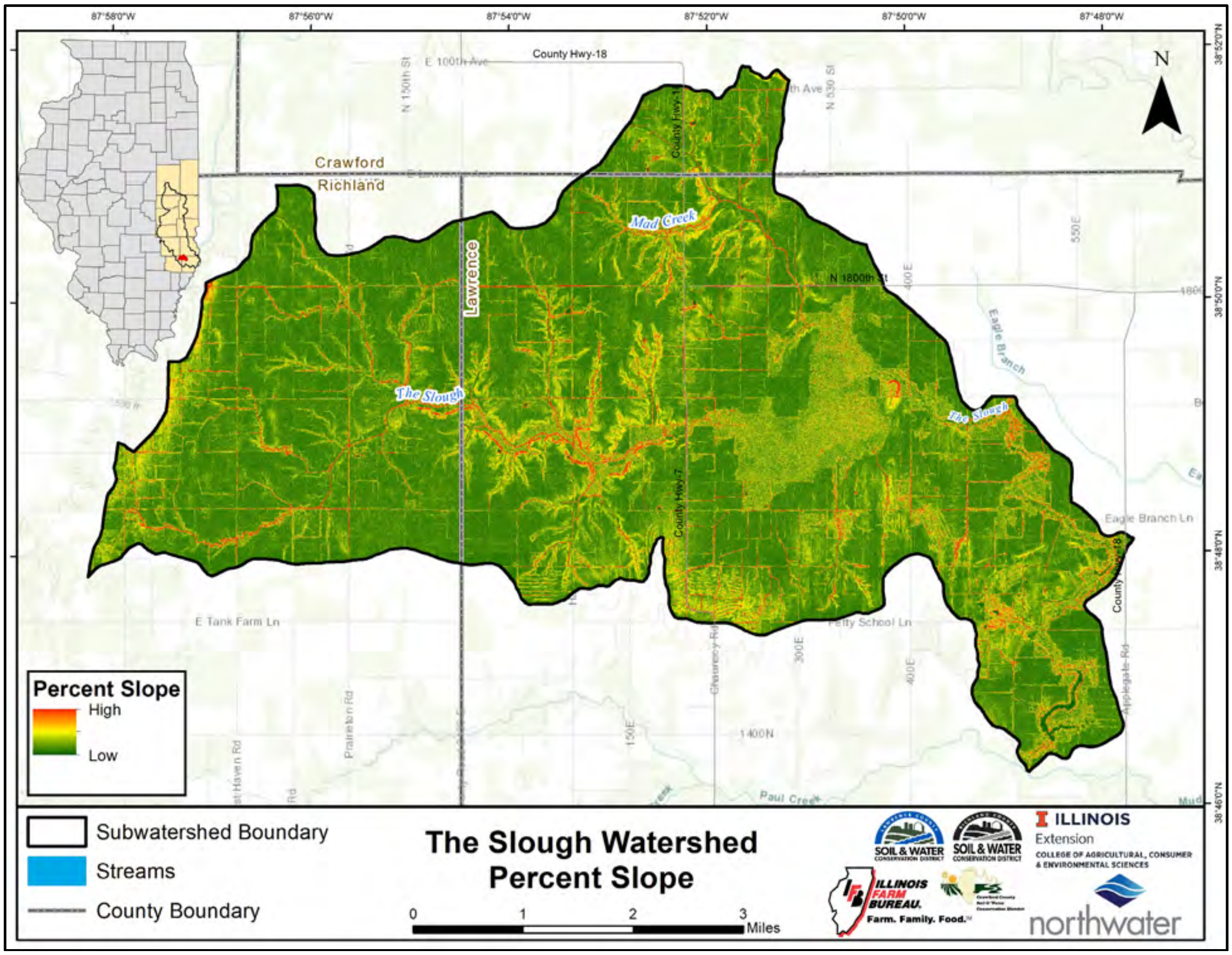


Figure 6 – Surface Slope in Percent

3.5 Climate

The State Climatologist Office for Illinois provides data from weather stations found across Illinois. Thirty-year normals for the watershed were acquired from a weather station in Olney, the nearest weather station to the watershed. The data consists of averages summarized from 1981-2010 and are shown in Table 5. Temperatures are measured in degrees Fahrenheit and the precipitation in inches.

Average annual temperature is 54.2° F. June through August experience monthly averages greater than 70° F; the lowest are in January (29.1° F). The highest average maximum is 87.2° F in July and the average minimum is in January (20.4° F). In general, minimum and maximums follow the same monthly trends as average temperatures.

Average annual precipitation for the 30-year time span is 47.4 in. The month with the highest level is June with a mean of 4.3 in. The lowest average monthly rainfall occurs in February (2.7 in). Average precipitation levels of this time frame follow an identical trend to the averages in recent years past.

Table 5 - Climate Normals (1981-2010)

Month	Maximum Temp (°F)	Minimum Temp (°F)	Mean Temp (°F)	Mean Precipitation (in.)
Jan	37.8	20.4	29.1	3.1
Feb	42.7	23.6	33.2	2.7
Mar	53.7	32.2	42.9	4.3
Apr	65.6	42.7	54.2	4.3
May	75	52.6	63.8	5.8
Jun	84.3	62.5	73.4	4.2
Jul	87.2	65.6	76.4	4.3
Aug	86.5	63.9	75.2	3.2
Sep	80.3	55.4	67.8	3.1
Oct	68.3	44	56.2	4
Nov	54.7	34.4	44.5	4.5
Dec	41.2	24.2	32.7	3.9
Annual	**64.9**	**43.5**	**54.2**	**4.0 (47.4 Yearly)**

Data was also acquired from the PRISM climate group to summarize averages from the last 15 years (March 2006-March 2021). The PRISM climate group is a part of the Northwest Alliance for Computational Science and Engineering based at Oregon State University and supported by the USDA Risk Management Agency. Temperatures are presented in degrees Fahrenheit and the precipitation in inches (Table 6).

The average annual temperature is 55.1° F. June through August experience monthly averages greater than 70° F; the lowest average temperatures are in January (29.7° F). The highest average maximum is 87.2° F in July and the average minimum is in January (21.5° F).

Average levels of recent data are consistent with those from a period of 1981-2010. Average temperature values follow similar monthly trends, however, differences do indicate a slight increase in annual minimum, maximum and average. The average annual precipitation for the most recent 15 years is 49.9 in. The months with the highest level are April and June with an average of 5.4. The lowest average monthly rainfall occurs in January (3.2 in). The wettest months of the year are March through July when the average annual precipitation exceeds 4. As with temperatures, more recent data shows a slight increase in average precipitation.

Table 6 - Monthly Climate, 2006–2021

Month	Maximum Temp (F)	Minimum Temp (F)	Mean Temp (F)	Mean Precipitation (in.)
January	38.0	21.5	29.7	3.2
February	41.1	23.1	32.1	2.9
March	54.9	34.7	44.8	4.3
April	66.1	44.1	55.1	5.4

Month	Maximum Temp (F)	Minimum Temp (F)	Mean Temp (F)	Mean Precipitation (in.)
May	76.1	55.9	66.0	5.1
June	85.4	64.6	75.0	5.4
July	87.2	66.6	76.9	5.3
August	86.1	64.4	75.3	3.1
September	81.4	57.4	69.4	3.3
October	68.7	45.2	57.0	4.1
November	54.4	33.8	44.1	3.9
December	43.3	27.4	35.4	3.9
Average	**65.2**	**44.9**	**55.1**	**4.2 (49.9 Yearly)**

3.6 Landuse

To characterize watershed landuse and nonpoint source (NPS) pollution, a custom Geographic Information System (GIS) layer was developed from 2019 aerial imagery and verified to the extent possible through field surveys. Table 7 lists the results of classification.

As depicted in Figure 7, the predominant landuse in The Slough is row crop agriculture which makes up 79% (14,309 acres) of the total watershed. Crops are primarily a corn-soy bean rotation.

Forest and grasslands are the second and third most prevalent at 12% (2,214 acres) and 4.3% (777 acres), respectively. Residential areas (including all associated landuse categories) cover less than 1%. A combined 75 acres of pasture and small, open livestock feed areas are scattered throughout the watershed.

Only one livestock confinement operation is in the watershed. Animal units from this and pasture operations are unknown.

Table 7 – The Slough Landuse Categories & Area

Landuse Category	Area (ac)	Percent Total Area	Landuse Category	Area (ac)	Percent Total Area
Row Crops	14,280	78%	Open Water Pond Reservoir	15	0.08%
Forest	2,214	12%	Cemetery	5.5	0.03%
Grasslands	777	4.3%	Confinement	3.7	0.02%
Open Space	406	2.2%	Commercial	3.3	0.02%
Roads	135	0.7%	Parking Lot	2.4	0.01%
Wetlands	98	0.5%	Feed Area	1.9	0.01%
Open Water Stream	86	0.5%	Warehouse	1.2	0.01%
Pasture	73	0.4%	Junkyard	0.2	0.001%
Farm Building	45	0.2%	Institutional	0.2	0.001%
Hay	29	0.1%	-	-	-
Residential On Septic	25	0.1%	**Total**	**18,201**	**100%**

Census data for the counties in the watershed show a declining population trend indicating little potential for an increase in urban area.

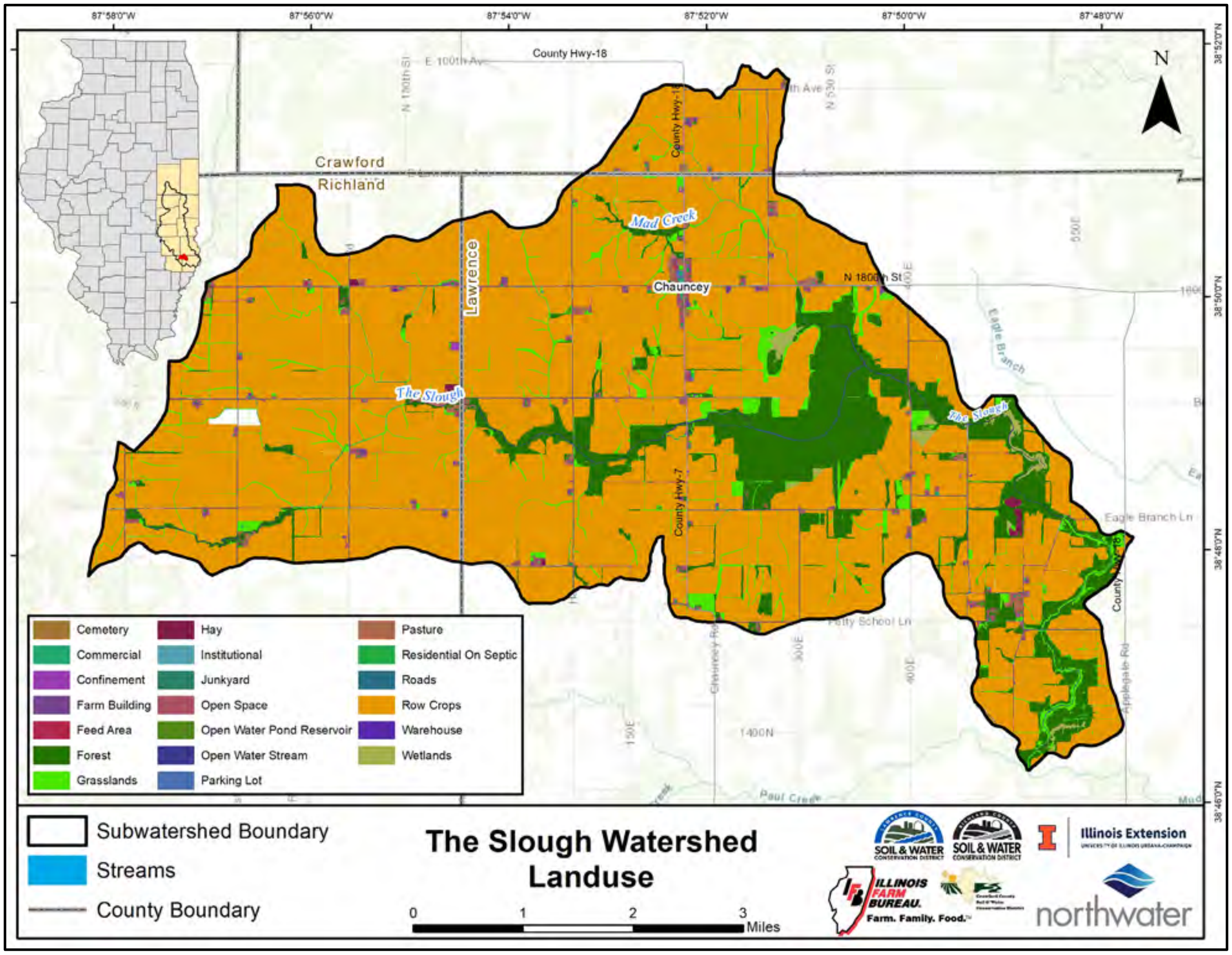


Figure 7 – Landuse

3.7 Soils

Based on soils data from the NRCS National Cooperative Soil Survey, 74 types exist in The Slough watershed (Table 8, Figure 8). Cisne silt loam is the dominant soil, accounting for about 27% of the entire watershed, or 4,849 acres. Hoyleton silt loam is also prevalent and accounts for 8.4% (1,536 acres), and bluford silt loam accounts for 8.2% (1,487 acres). Seventeen other soil types combined account for 47% of the total watershed, while the remaining 54 together account for 9.7%.

The NRCS gives official soil series descriptions (NRCS, 2018b). Cisne silt loams consists of very deep, poorly drained, slowly or very slowly permeable soils on till plains. They are formed in in loess (wind blown) and the underlying gritty loess or pedisediment, with slopes ranging from 0 to 2 percent. The Hoyleton series consists of very deep, somewhat poorly drained soils on uplands. These soils formed in loess and the underlying silty or loamy deposits which overlie a strongly weathered Sangamon age paleosol in the Illinoian age till, with slopes ranging from 0 to 7 percent.

Table 8 - Soil Types & Extent

Soil Type	Acres	Percent of Watershed
Cisne silt loam, 0 to 2 percent slopes	4,849	27%
Hoyleton silt loam, 2 to 5 percent slopes	1,536	8.4%
Bluford silt loam, 2 to 5 percent slopes	1,487	8.2%
Hoyleton silt loam, 0 to 2 percent slopes	1,363	7.5%
Darwin silty clay, occasionally flooded	920	5.1%
Patton silty clay loam	666	3.7%
Belknap silt loam, 0 to 2 percent slopes, occasionally flooded	628	3.5%
Chauncey silt loam	570	3.1%
Bluford silt loam, 0 to 2 percent slopes	508	2.8%
McGary silt loam, 0 to 2 percent slopes	492	2.7%
Ava silt loam, 5 to 10 percent slopes, eroded	486	2.7%
Bluford silt loam, 2 to 5 percent slopes, eroded	441	2.4%
Sexton silt loam, rarely flooded	388	2.1%
Marissa silt loam	386	2.1%
Wynoose silt loam, 0 to 2 percent slopes	324	1.8%
Blair silt loam, 5 to 10 percent slopes, eroded	321	1.8%
Hoyleton silt loam, 2 to 5 percent slopes, eroded	321	1.8%
Ava silt loam, 2 to 5 percent slopes	271	1.5%
Starks silt loam, 0 to 2 percent slopes	269	1.5%
Bonnie silt loam, 0 to 2 percent slopes, occasionally flooded	209	1.1%
54 other soil types, less than 2,000 acres and less than 10% of the watershed	1,766	9.7%
Grand Total	**18,201**	**100%**

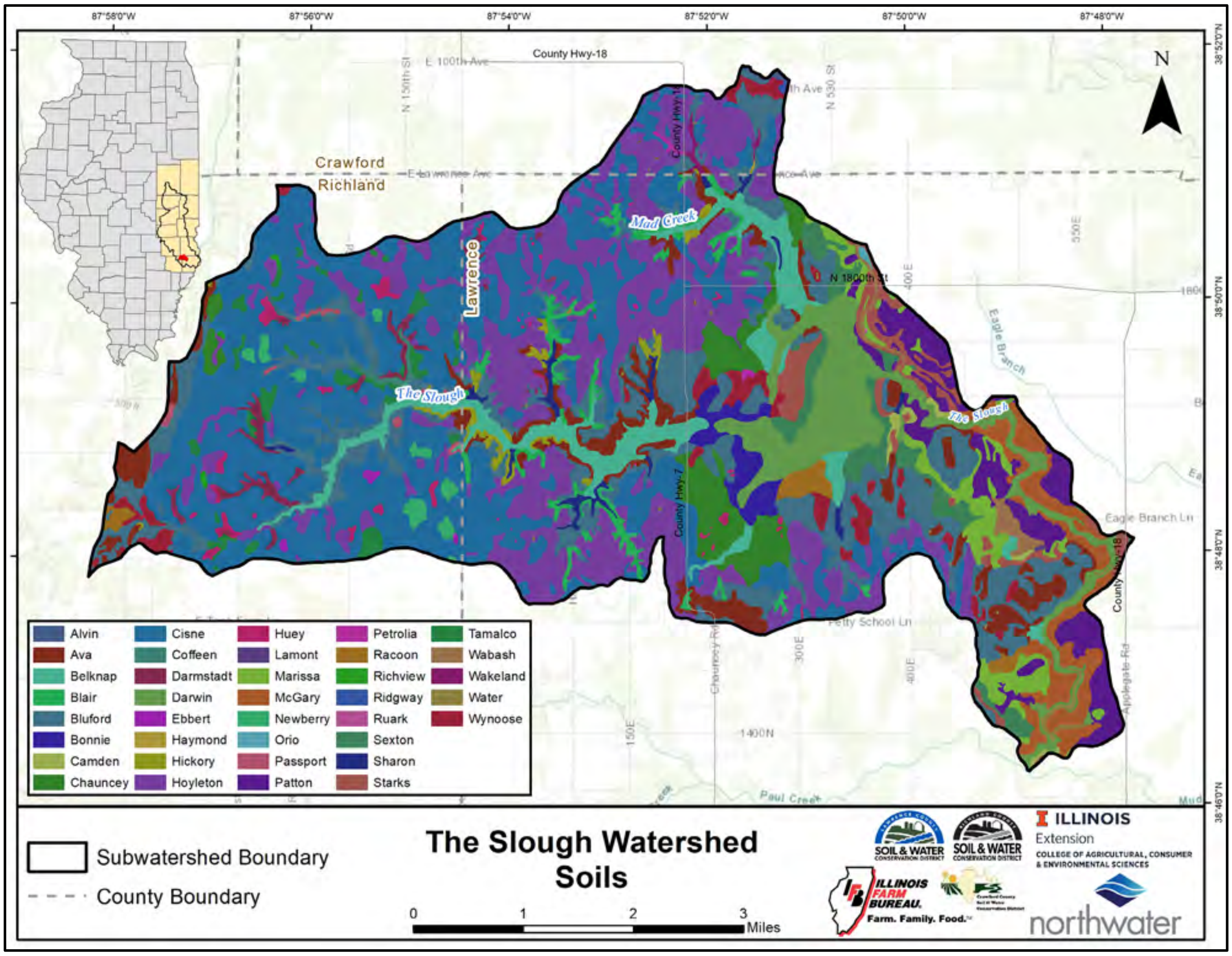


Figure 8 – Soils

3.7.1 Highly Erodible Soils

As defined by the NRCS, a highly erodible soil (HEL)/potentially highly erodible (PHEL), or soil map unit, has a maximum potential for erosion that is greater than eight times the tolerable erosion rate. 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 location and extent of HEL and PHEL soils were identified using the USDA-NRCS SSURGO database and county frozen soils lists. About 4,124 acres of HEL and 1,227 acres of PHEL exist, representing 23% and 6.7% of the total watershed area respectively (Figure 9). These soils are generally located immediately adjacent to streams and in steep forested or grassed areas along the southern and western fringes of the watershed. The majority are non-HEL covering 12,850 acres of the watershed.

3.7.2 Cropped Highly Erodible Soils

If a producer has a field identified as HEL and wishes to participate in a voluntary NRCS cost-share program, that producer is required to maintain a conservation system of practices that maintains erosion rates at a substantial reduction of soil loss. Fields that are determined not to be HEL are not required to maintain a conservation system to reduce erosion.

Of the 14,309 acres of cropland, 24%, or 3,367 acres (18% of the watershed), are considered HEL and 1,104 acres or 7.1% (5.6% of the watershed) are PHEL and could be targeted for erosion control measures (Figure 9). Cropped HEL soils and tillage practices are further discussed in Section 5.0.

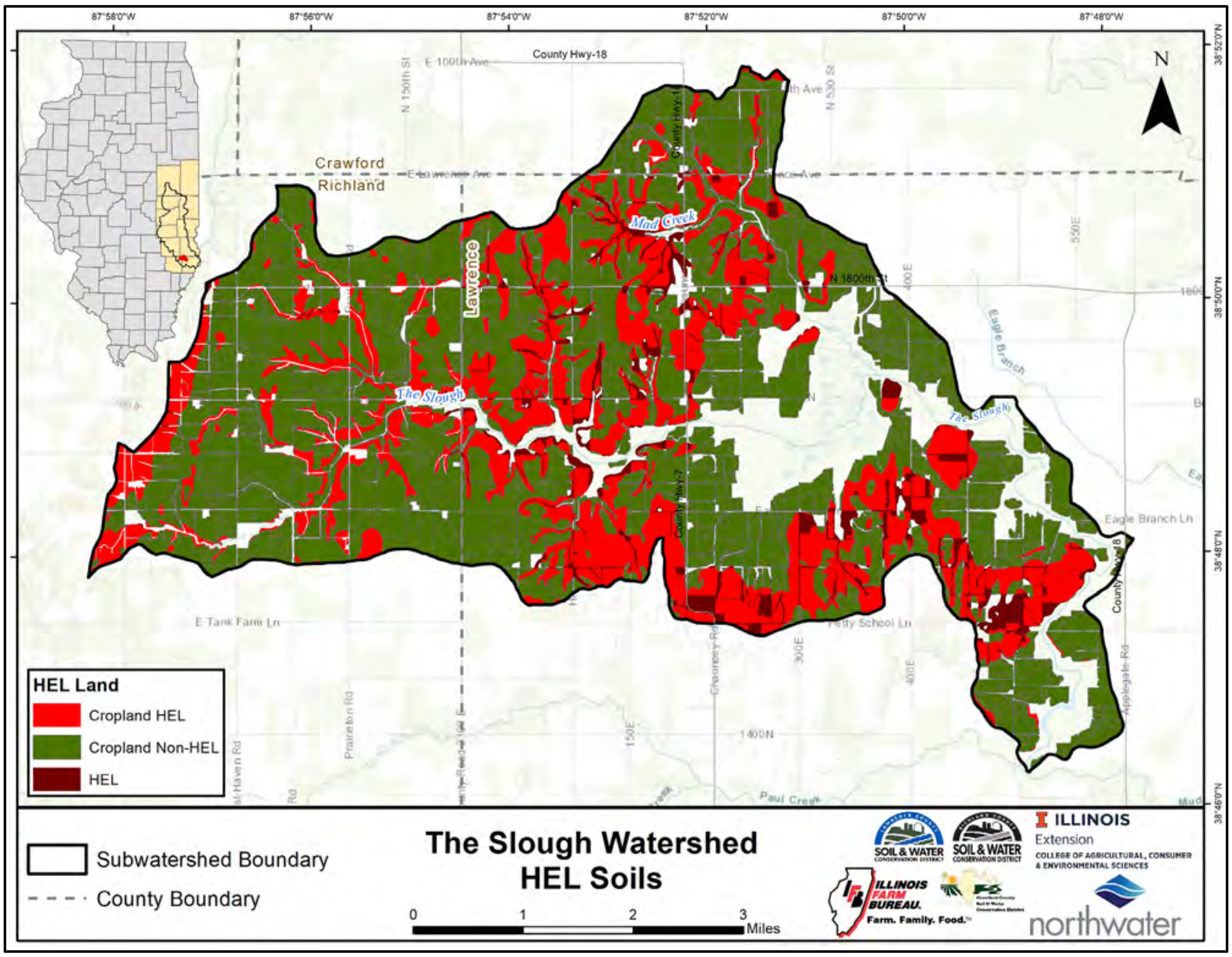


Figure 9 – HEL Soils

3.7.3 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). As an indicator of the potential for wetland development, understanding where hydric soils are located can inform wetland restoration and creation activities.

A total of 8,483 acres of hydric soils are scattered throughout the watershed and are typically wet and will flood if overland or tile drainage is not present. This represents 47% of total watershed area over 18 different soil types (Table 9). Hydric soils are located primarily in flat bottomland areas and along tributaries (Figure 10). Cisne silt loam is the dominant type at 27%.

Table 9 – Hydric Soil Types

Soil Type	Area (ac)	Percent of Watershed
Cisne silt loam, 0 to 2 percent slopes	4,849	27%
Darwin silty clay, occasionally flooded	920	5.1%
Patton silty clay loam	666	3.7%
Chauncey silt loam	570	3.1%
Sexton silt loam, rarely flooded	388	2.1%
Wynoose silt loam, 0 to 2 percent slopes	324	1.8%
Bonnie silt loam, 0 to 2 percent slopes, occasionally flooded	209	1.1%
Huey silt loam, 0 to 2 percent slopes	120	0.7%
Newberry silt loam, 0 to 2 percent slopes	104	0.6%
Racoon silt loam, 0 to 2 percent slopes, occasionally flooded	97	0.5%
Wabash silty clay, occasionally flooded	90	0.5%
Darwin silt loam, overwash, occasionally flooded	82	0.5%
Racoon silt loam, 0 to 2 percent slopes	27	0.1%
Ebbert silt loam, 0 to 2 percent slopes	15	0.1%
Petrolia silty clay loam, 0 to 2 percent slopes, frequently flooded	8.5	0.05%
Orio sandy loam	6.2	0.03%
Petrolia silty clay loam, occasionally flooded	5.6	0.03%
Ruark fine sandy loam	0.6	0.003%
Total	**8,483**	**47%**

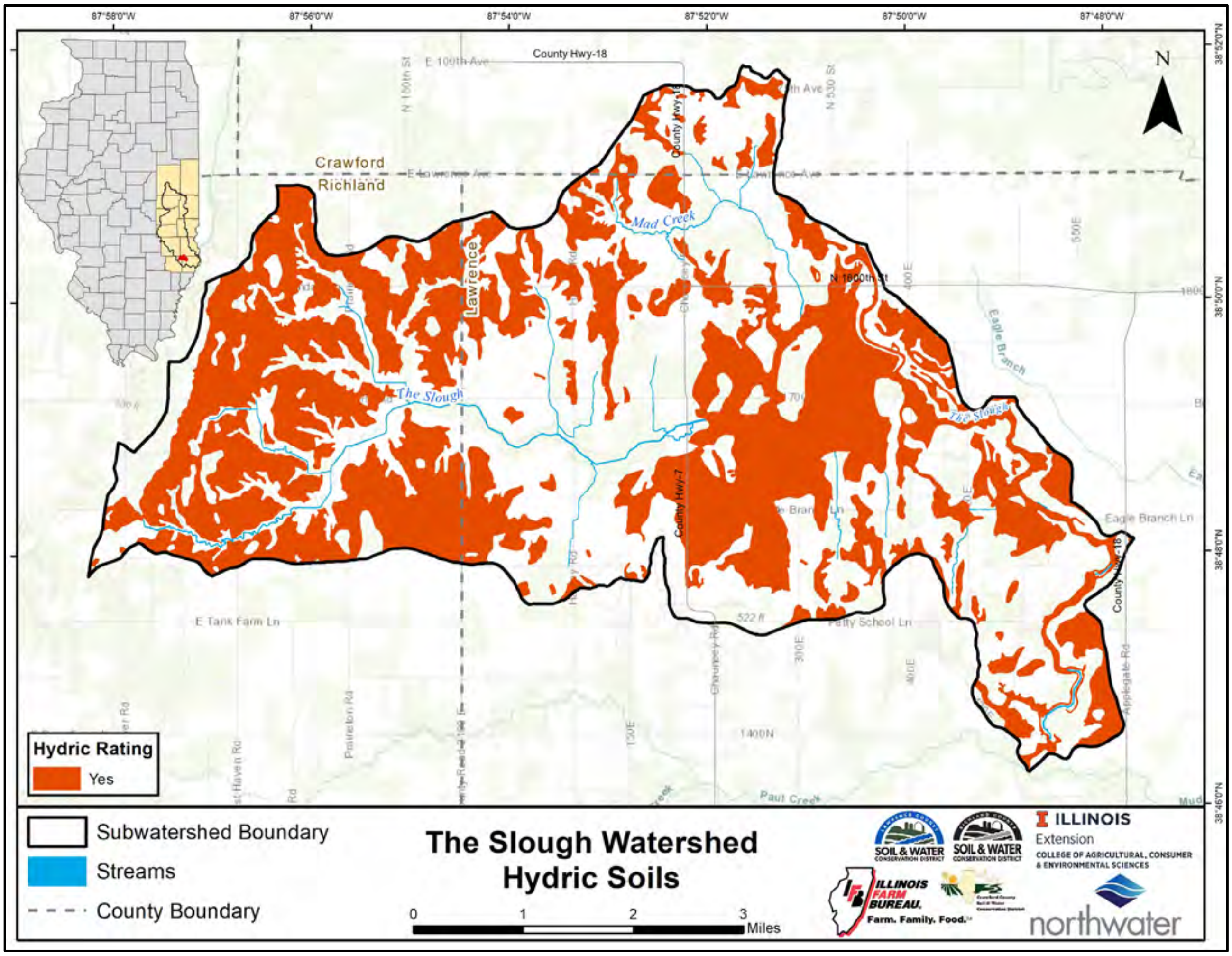


Figure 10 – Hydric Soils

3.7.4 Hydrologic Soil Groups

The NRCS has four hydrologic soil groups based on infiltration capacity and runoff potential. Group A has the greatest infiltration capacity and least runoff potential, while D has the least infiltration capacity and greatest runoff potential. A hydrologic soil group is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to an impermeable layer or to a water table (USDA, 2007). 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 condition (USDA, 2007). This section applies datasets disseminated by the USDA National Cooperative Soil Survey.

Figure 11 and Table 10 illustrate the hydrologic soil groups and statistics for the watershed. The dominant group is C/D, which accounts for 69% of watershed soils and have moderate to high/high rates of runoff. As very few fields in the watershed are tiled, the vast majority will remain in their undrained condition, resulting in higher rates of runoff. Group C and D soils encompass 13% and 12% each and have moderate to high or higher runoff potential.

Table 10 – Hydrologic Soil Groups

Hydrologic Groupings & Total Area							
Group	A	B	B/D	C	C/D	D	Unclassified
Acres	16	183	842	2,302	12,633	2,184	40
Percent of Watershed	0.1%	1.0%	4.6%	13%	69%	12%	0.2%

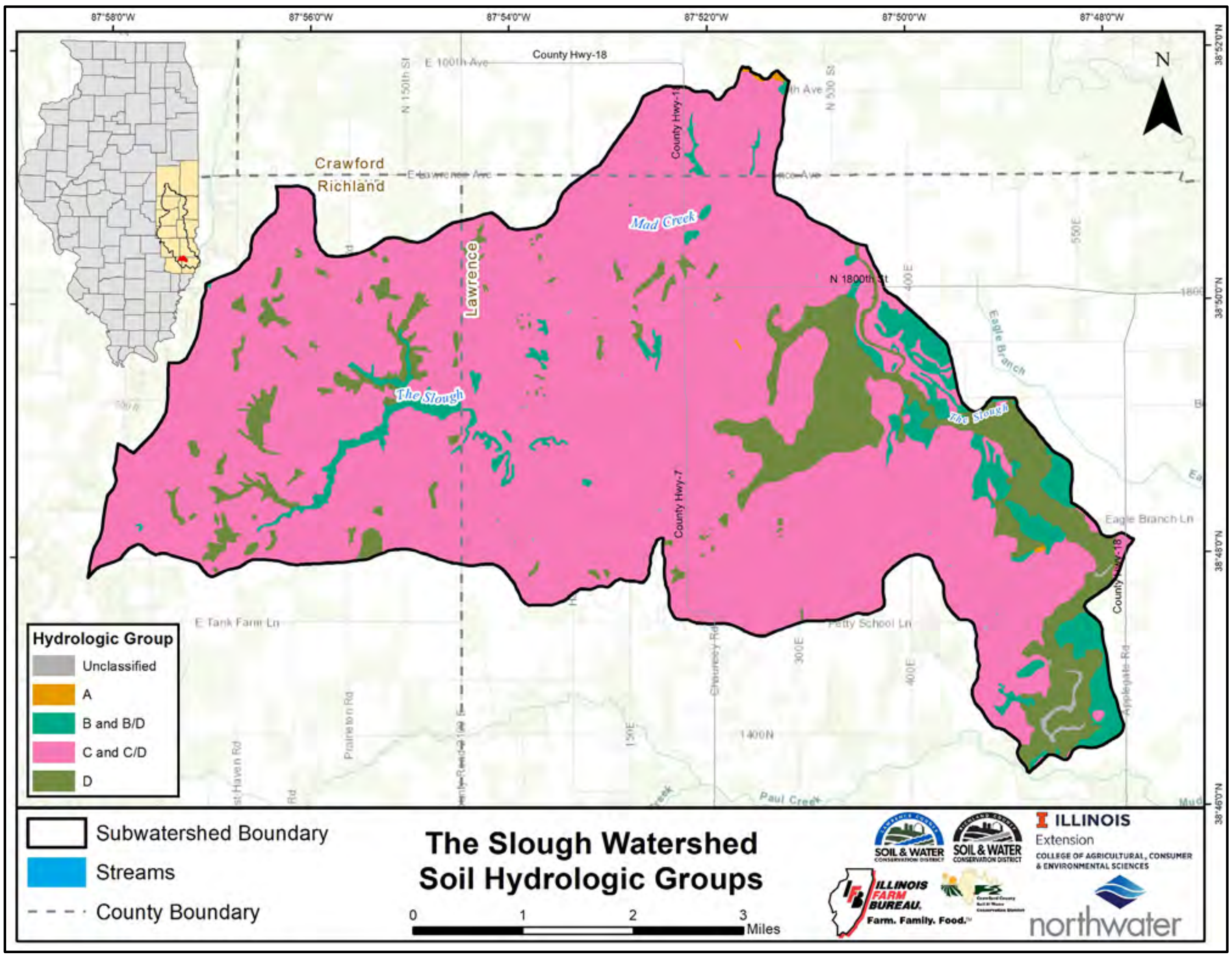


Figure 11 – Soil Hydrologic Groups

3.7.5 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 for the ability to support septic systems.

Results show that 99%, or 17,995 acres (Table 11), of the watershed contain soils classified as "very limited" with respect to septic suitability. This does not indicate that soils are unsuitable for septic systems, but special consideration is required when establishing systems within most of the watershed. A total of 129 homes/buildings believed to have septic systems are located on soils classified as very limited. Figure 12 illustrates the extent of limiting soils for septic fields.

Table 11 – Soil Septic System Suitability, Total Area & Home/Building Count

		"Very Limited"		"Somewhat Limited"		"Not Rated"	
Total Area (ac)	Total Homes on Septic	Area	Septic Systems	Area	Septic Systems	Area	Septic Systems
18,201	131	17,995	129	166	2	40	0

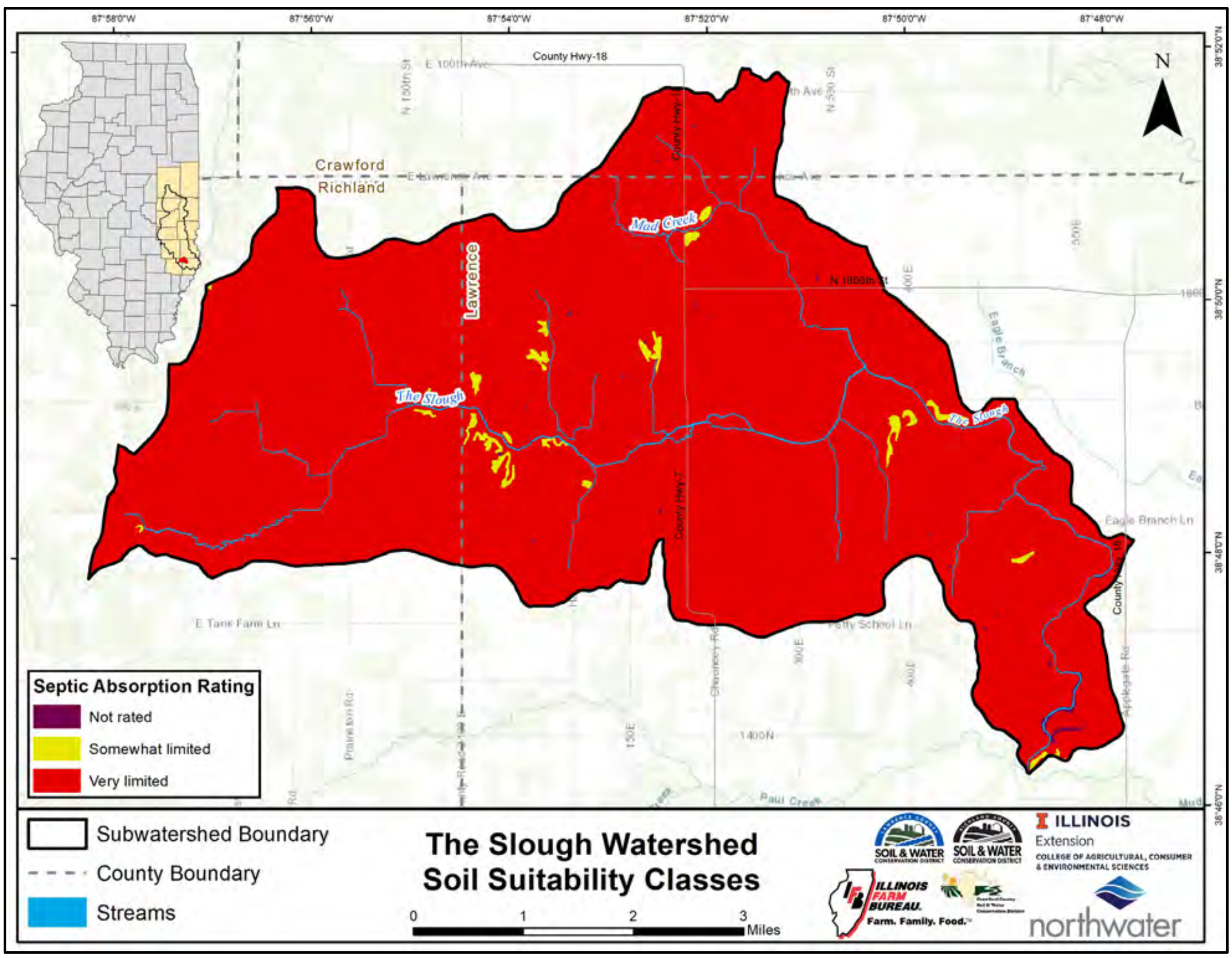


Figure 12 – Soil Septic Suitability

3.8 Tillage

According to a 2018 Illinois Department of Agriculture (IDOA) tillage transect survey completed for Lawrence, Richland and Crawford County, approximately 27% of the corn in Lawrence, 83% in Richland, and 60% in Crawford use conventional tillage. In Lawrence, 13%, Richland 16%, and Crawford 26% of the soybean acreage uses conventional tillage methods which leave little or no residue on the surface. In Lawrence, 57%, Richland 4.3%, and Crawford, 9.5%, of corn acres and 21% (Lawrence), 10% (Richland), and 46% (Crawford) of soybean acres use reduced-till, which can decrease soil loss by 30% compared to conventional tillage. The remaining 16% (Lawrence), 12.5% (Richland) and 30% (Crawford) of corn and 66% (Lawrence), 74% (Richland), and 27.6% (Crawford) of soybean acres are mulch-till or no-till (7.7% no-till corn and 44% no-till beans in Lawrence, 11.6% corn and 44% beans in Richland, and 0% corn and 16% beans in Crawford). Mulch-till leaves 30% residue of the previous year's crop and can reduce soil loss by 75%.

Conventional Tillage

A more detailed field-based assessment of tillage practices was performed in the spring of 2021 to better characterize current conditions, specifically within the watershed. Table 12 and Figure 13 show the acres of tillage types and distribution. Pollution loading by tillage is discussed in more detail in Section 5. Tillage is grouped into three categories plus two cover types: reduced-till, mulch-till, no-till, and cover types consisting of hay and cover crop. Hay is also listed in the landuse section and addressed in the pollution loading and sources section. Cover crops are also addressed in the existing BMP section, as well as in the section on sources of watershed impairment.

Results show that no-till make up the largest portion of The Slough watershed (63%), followed by mulch-till and cover crops (19% and 16%, respectively). Reduced-till accounts for 1.4% and hay is found on 0.2% of all cropland (including hay and cover crops).

Table 12 – Tillage Types, Acres & Percent of Cropland

Tillage Type	Area (ac)	Percent of Cropland
No-Till	9,042	63%
Mulch-Till	2,714	19%
Cover Crops[1]	2,328	16%
Reduced-Till	196	1.4%
Hay[1]	29	0.2%
Total	**14,309**	**100%**

[1] – not a tillage practice

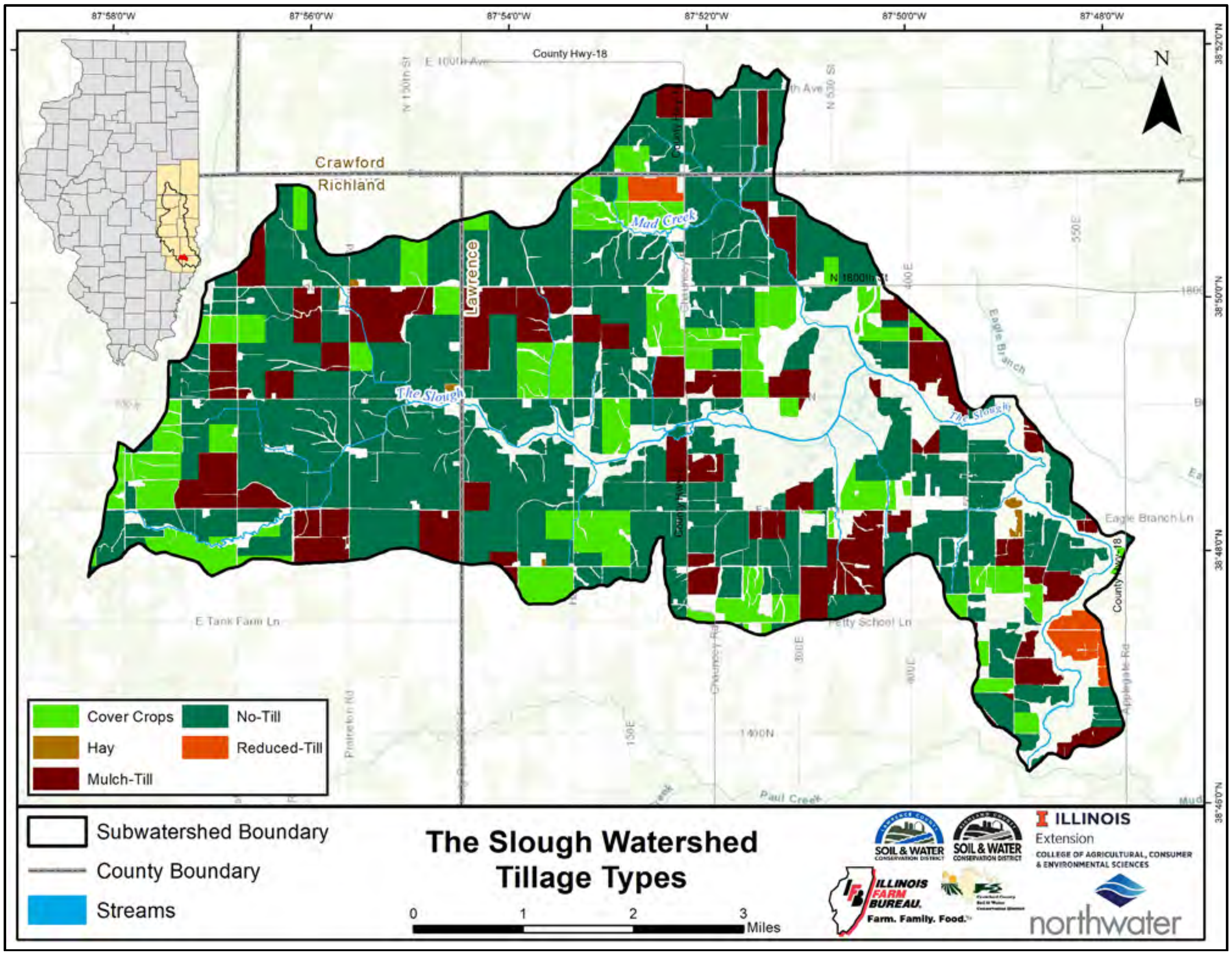


Figure 13 – Tillage Types

3.9 Existing Conservation Practices

Existing management practices within the watershed include grass riparian buffers, cover crops, grass waterways, ponds and basins, terraces, water and sediment control basins (WASCB), wetlands and nutrient management. Table 13 below shows the total number or extent of each management practice identified through field surveys, interpretation of aerial imagery, and discussions with local producers. Figure 14 shows the majority of existing practices. In addition to those listed, other relevant work has included recent education and outreach events related to conservation and water quality.

With relatively large reductions still required to meet water quality goals stated in this plan, substantial opportunities exist to install new practices. This is especially true where nutrient loading is the greatest or where pollutants may bypass existing BMPs, such as tile water bypassing a filter strip. It is important to note that each practice varies in its ability to effectively remove pollutants, however, these practices are providing benefits to water quality and have been accounted for in the watershed pollutant loading estimates.

Table 13 – Existing Conservation Practices

BMP Type	Quantity	Unit
Diversion	2	number
Filter Strip	136	acres
Grasslands	17	acres
Nutrient Management	100	acres
Cover Crops	2,328	acres
Pond	22	number
Sediment Basin	3	number
Terrace	26	number
WASCB	182	number
Waterway	253	acres
Wetlands	98	acres
Calculation of grass riparian buffers are an estimation and include grassed areas within 35 ft of a flowing stream.		

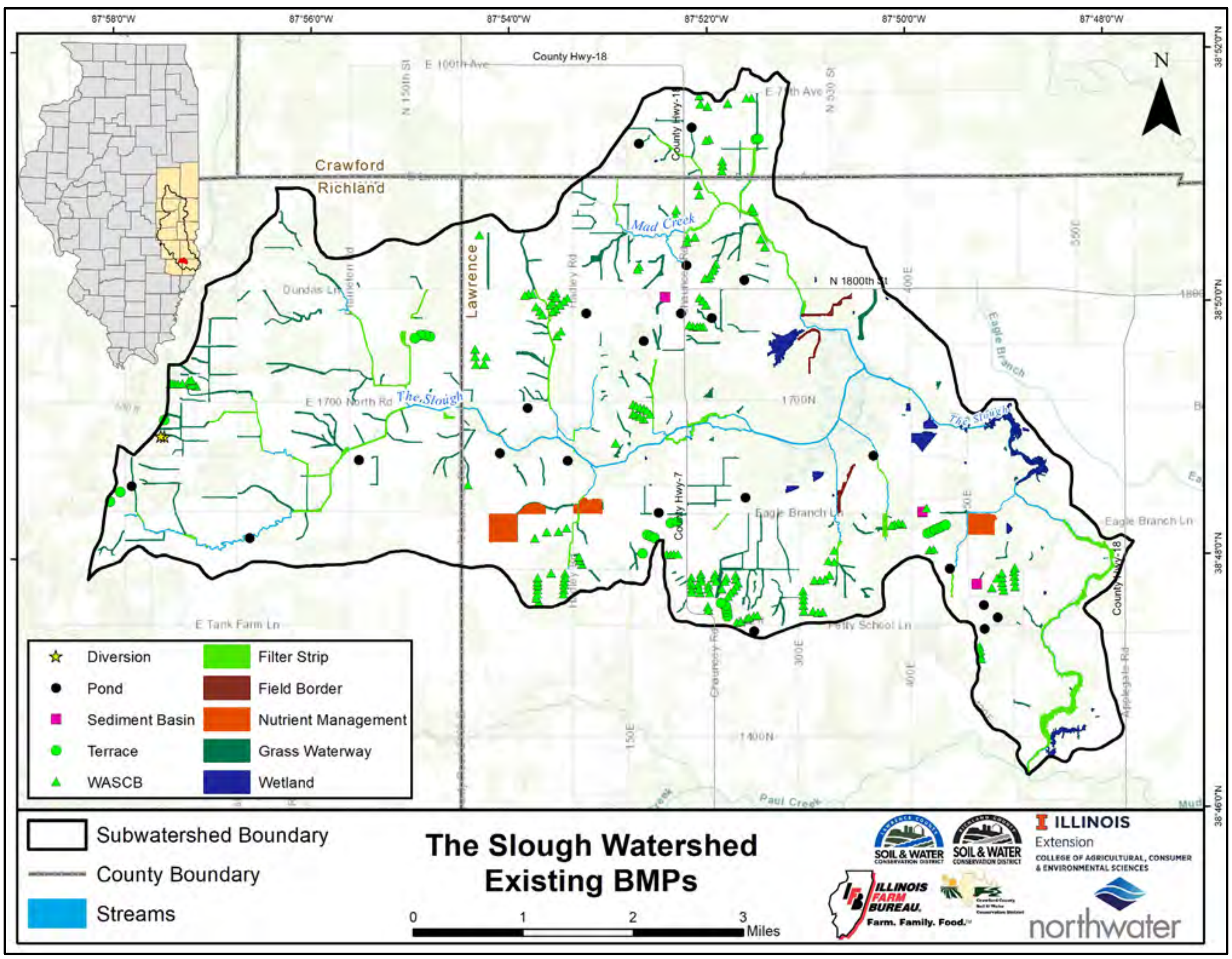


Figure 14 – Existing BMPs

3.10 Hydrology & Drainage System

The Slough is the largest named stream in the watershed. A smaller tributary called Mad Creek enters the Slough from the north. Due to a lack of consistent flow records for these systems, USGS StreamStats was used to retrieve peak flow data (Table 14).

Table 14 – The Slough Primary Tributary Peak Flow Data

Stream	Peak Flow Data (ft^3/s) by Recurrence Level Interval (yrs)					Drainage Area (mi^2)	Stream Slope (ft/mi)
	2	5	10	100	500		
The Slough	982	1,710	2,230	3,940	5,180	27.3	3.1
Mad Creek	487	897	1,210	2,290	3,110	5.1	12.0

3.10.1 Streams

Due to limitations with the accuracy of the National Hydrography Dataset (NHD), the custom landuse layer was used to better represent the actual wetted extent of streams in the watershed. Ponds and reservoirs total only 15 acres, or 0.08%. The largest is just under two acres. The drainage system is depicted in Figure 15.

Table 15 shows perennial open water tributary stream length. Results show a total of 37.5 miles. The only two named tributaries in the watershed are The Slough and Mad Creek. The Slough is 16 miles long and Mad Creek is 4 miles long. The other unnamed tributaries total 17 miles. Although accuracy is limited, the NHD indicates all perennial, intermittent or ephemeral tributaries, forested gullies, and subsurface drainageways total 58.2 miles (Table 16)

Table 15 – Open Water Perennial Streams & Tributaries

Tributary Name	Length (ft)	Length (mi)
The Slough	86,081	16.3
Mad Creek	21,374	4
Unnamed Tributary	90,659	17.2
Total	198,115	37.5

Table 16 – Surface Water Inventory by Subwatershed

Stream Name	Perennial Stream (mi)	NHD Waters* (mi)
The Slough	16.3	15.7
Mad Creek	4	4.2
Unnamed Tributary	14.3	38.4
Total	**34.7**	**58.2**

** = all NHD water sources including perennial streams, intermittent or ephemeral tributaries, forested gullies and subsurface drainageways*

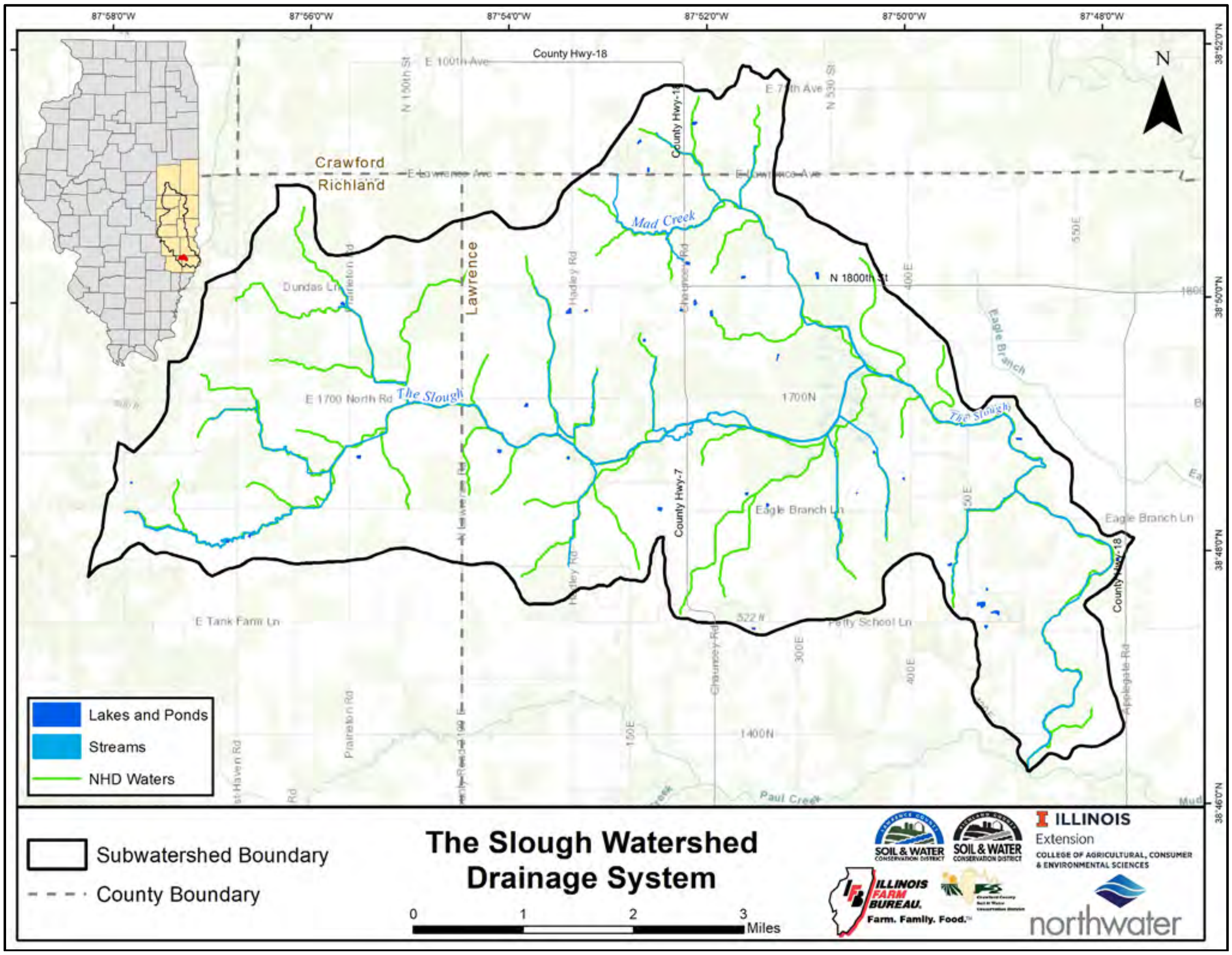


Figure 15 – Drainage System

3.10.2 Tile Drainage

Tile drainage in the watershed is believed to be minor. Methods used to estimate tile drainage included direct observations performed during a watershed windshield survey, knowledge of local agency staff, and analysis of soils, elevation, imagery, and landuse.

It is estimated that 21 fields, or 684 acres in the watershed, are likely tile drained, with 639 fields, or 13,625 acres of farmland, not. This corresponds to 4.8% of all farm ground or 3.8% of the watershed being tile drained.

3.10.3 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).

Channelized Stream

Aerial imagery from 2019 was evaluated to determine the extent of open water stream channelization. Results indicate that channelization is moderate to high. Out of a total of 37.5 stream miles, 45% (17 miles) are channelized. The Slough and Mad Creek are each channelized 17% and 51%, respectively. Approximately 70% of unnamed tributaries are also channelized (Table 17 and Figure 16).

Table 17 – Length of Channelized Streams

Stream Name	Total (ft)	Total (mi)	Channelized (ft)	Channelized (mi)	% Stream Length Channelized
The Slough	86,081	16.3	14,529	2.8	17%
Mad Creek	21,374	4.0	10,995	2.1	51%
Unnamed Tributary	90,659	17.2	63,160	12	70%
Total	198,115	37.5	88,683	17	45%

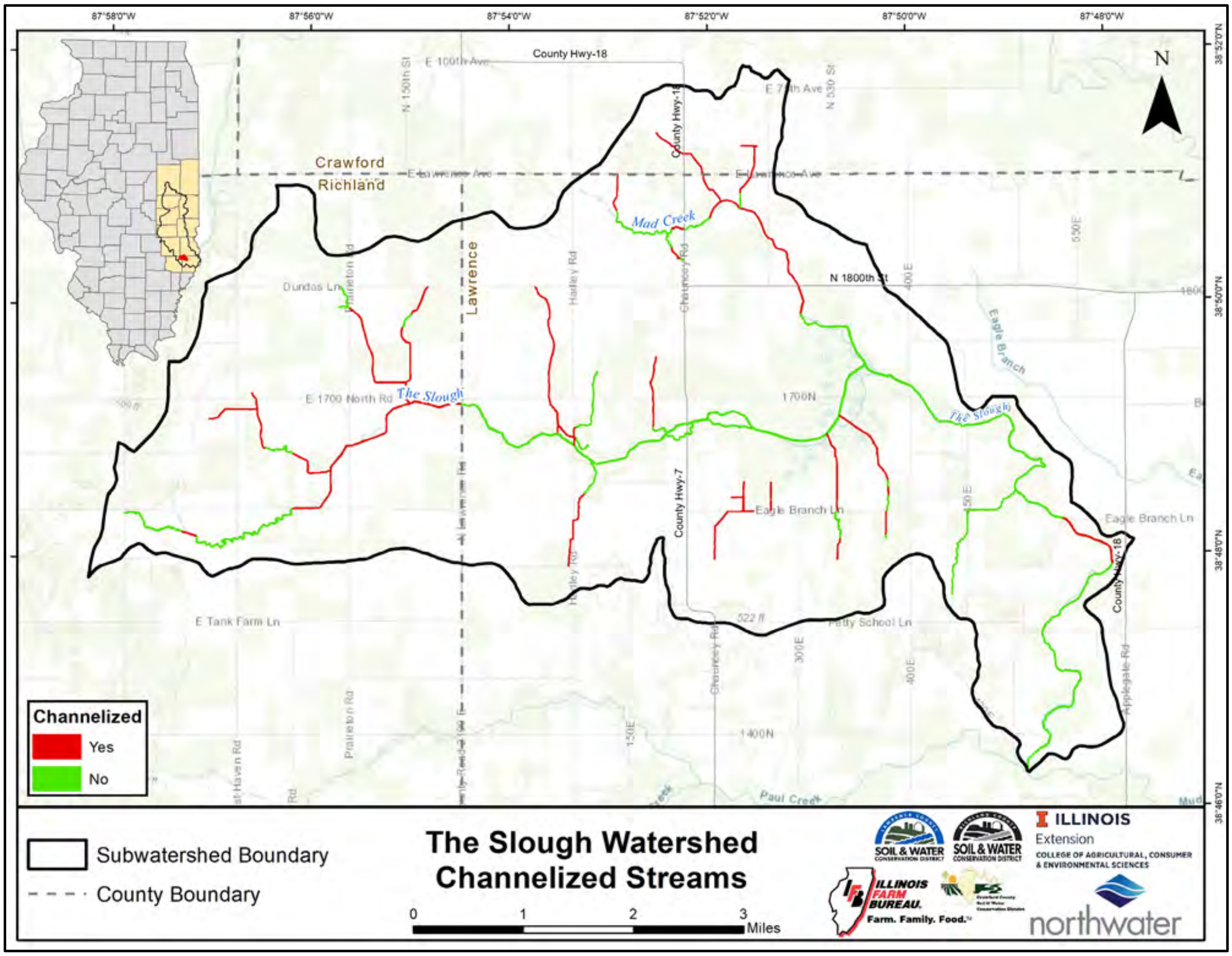


Figure 16 – Channelized Streams

3.10.4 Riparian Areas & Buffers

Riparian and buffer areas exist adjacent to streams and lakes in the watershed. A field assessment, combined with analysis of recent aerial imagery, was used to determine the adequacy and relative extent of natural stream and lake buffers.

Methods – A buffer quality ranking system was developed and applied to individual stream reaches. Stream reaches were organized into a sequential numbering system based on breaks at road crossings. Two categories of buffer quality include:

1. Adequate – greater than or equal to 35 ft of un-impacted riparian or buffer area, either forest grass or wetland.
2. Inadequate – less than 35 ft riparian or buffer area impacted or degraded. Inadequate includes row crops, moderately to highly overgrazed pasture, roads, buildings, and urban open space.

Existing literature was reviewed to determine the minimum adequate buffer with; 35 ft was selected based on the following references:

1. The USDA-NRCS requires a minimum of a 20-foot buffer for suspended solids regardless of slope to be eligible for the Conservation Reserve Program (NRCS, 2010).
2. A study performed in Kansas determined that buffers between 27 and 53 feet significantly removed nitrogen, phosphorus, and suspended solids from entering the stream (Mankin, et al. 2007).

Stream Buffers

Streams are well buffered or approximately 67% of all banks (Table 18). Although most are well buffered, areas exist where improvements can be made. Buffers can be expanded on over 22 miles (33%) of the watershed (Figure 17). Buffer type varies with forest, accounting for 49% of all buffer miles. Row crops with an inadequate buffer makes up 30%, grasslands 16%, and wetlands 2.8%; the seven other categories combined make up roughly another 3.1% (Table 19). Buffer lengths do not match up exactly to length of streambank due to the method used to analyze extent. The buffer setback tends to smooth lines and reduce length, especially along tight meander bends.

Table 18 – Streambank Buffer Adequacy

Total Bank Length (ft)	Total Bank Length (mi)	Inadequate (mi)	Adequate (mi)	Inadequate %	Adequate %
355,757	67	22	45	33%	67%

Table 19 – Streambank Buffer Landuse Categories

Buffer Type	Total Bank Miles	% Streambank Length
Forest	33	49%
Row Crops Inadequate	20	30%
Grasslands	10	16%
Wetlands	1.9	2.8%
Pasture Inadequate	1.1	1.7%
Open Space	0.7	1%
Roads	0.2	0.3%
Open Water Stream	0.04	0.1%
Open Water Pond Reservoir	0.02	0.03%
Farm Building	0.01	0.01%
Row Crop Adequate	0.003	0.004%
Total	**67**	**100%**

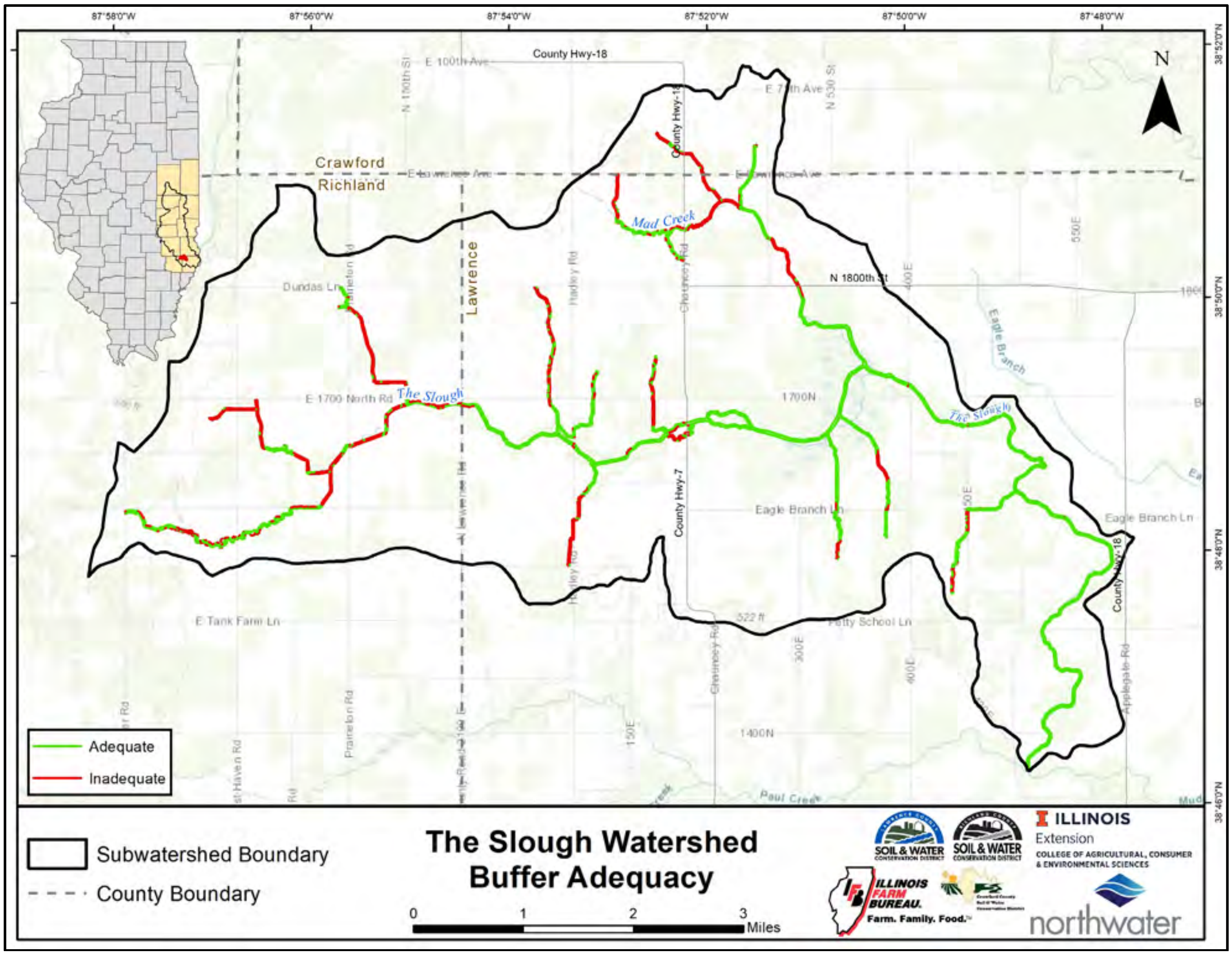


Figure 17 – Stream Buffers

3.10.5 Wetlands

Restored Wetland

Wetlands provide numerous valuable functions that are necessary for the health of a 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. 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 rivers/streams draw on the surrounding groundwater table.

Excluding stream, ponds, and lakes, the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) indicates there is a total of 1,427 acres (7.8%) of wetlands within The Slough. These are categorized as freshwater emergent and forested shrub wetlands. Results are shown in Table 20 and Figure 18.

Considering the outdated nature of the NWI dataset, an analysis of open water and forested wetlands was performed using 2019 aerial imagery to better understand their current extent. Results show 1,219 acres (6.7%) of wetlands in the watershed; 98 of the 1,219 acres can be considered emergent or open water. Comparing to NWI data indicates up to 208 acres of previously delineated wetlands in the watershed may have been drained or modified; therefore, opportunities exist to restore these areas.

Table 20 – Wetlands

Current Wetlands		NWI Wetlands		
Area (acres)	Difference From NWI	Emergent (acres)	Forested/Shrub (acres)	Total (acres)
1,219	15%	79	1,348	1,427

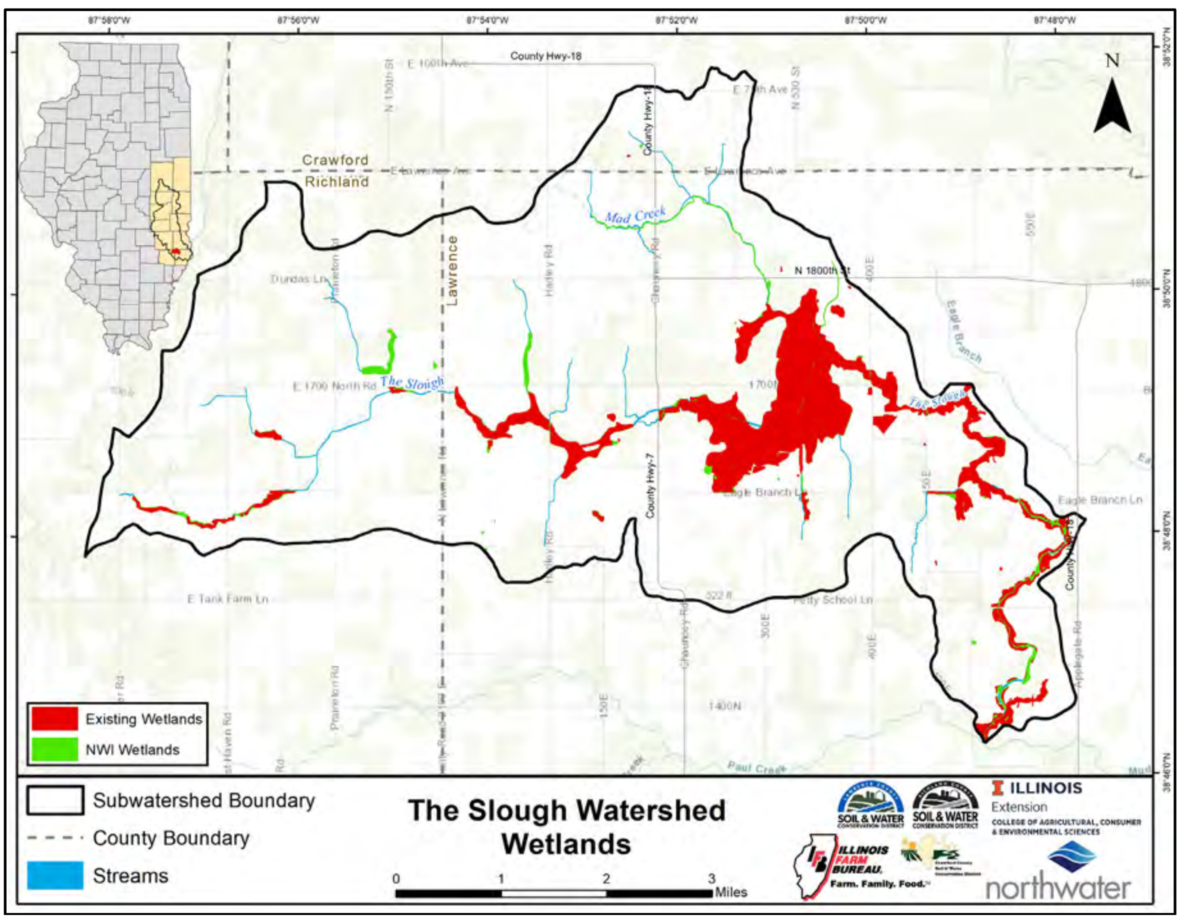


Figure 18 – Wetlands

3.10.6 Floodplain

A review and analysis of the most recent Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRM) indicates there are 2,280 acres of 100-year floodplain within the watershed, or 13% of total area (Figure 19). Flood hazard areas on the Flood Insurance Rate Map are identified as Special Flood Hazard Areas (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year but are broken up into different zones based on severity of flood hazard risk. The 1-percent annual chance flood is also referred to as the base flood, or 100-year flood (FEMA, 2018).

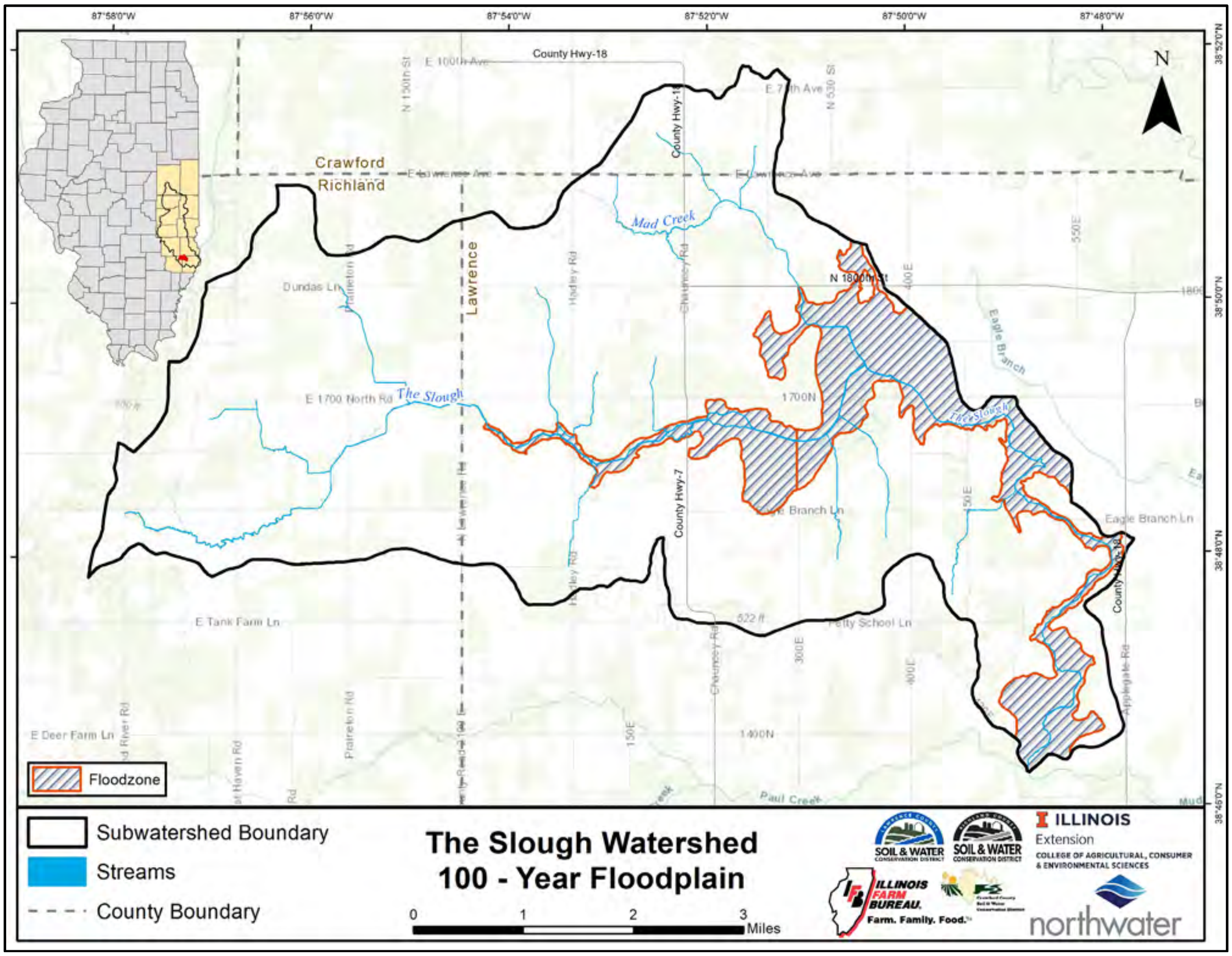


Figure 19 – 100-Year Floodplain

3.11 Streambank & Bed Erosion

Streambank erosion is a source of sediment and nutrients. An evaluation of the extent and severity of these sources was performed to quantify sediment, nitrogen and phosphorus loading. Streambank erosion was estimated through direct observations during a windshield survey in the spring of 2021 followed by a more detailed assessment of high priority stream segments in the fall of 2021. Data was captured with a 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 GIS to create a map layer representing general estimates of annual soil loss. The directly assessed segments included a stream walk with frequent measurements taken along each reach. Streambed erosion was only captured along these segments. Approximately 21 bank miles were measured.

Annual sediment, nitrogen and phosphorus loads were calculated using equations below and adjusted to account for the trapping efficiency of BMPs. Eroding bank height, bank length and lateral recession rates (LRR) estimated in the field were transferred to GIS. Lake bank soil nutrient concentrations were estimated from soil cores obtained from four representative banks. Samples were analyzed at the University of Illinois Crops Sciences Department as part of a statewide study to document phosphorus loading from streambanks. The following equations were used to estimate total annual loads:

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

Sy – sediment yield in tons/yr
L – eroding bank length in feet
LRR – estimated lateral recession rate in feet per year
H – eroding bank height in feet
γd – Soil dry weight density (tons/ft^3)
SDR – Sediment Delivery Rate (1)
STF – Sediment Transport Factor (0.85)

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

TN – Total nitrogen load from streambanks in lbs/yr
Sy – Sediment yield in tons/yr
Nc – Nitrogen concentration in soil (0.000562 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 streambanks in lbs/yr
Sy – Sediment yield in tons/yr
Pc – Phosphorus concentration in soil (0.000249 lbs/lb)
Cf – Correction factor, 1.0

3.11.1 Streambank Erosion

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 variable but overall, low. Results are summarized in Table 21. An overview of streambank erosion is shown in Figure 20 and individual maps of directly assessed segments in Figure 21 through Figure 26. Streambank erosion is responsible for delivering 1,537 tons of sediment, 1,729 lbs of nitrogen, and 765 lbs of phosphorus annually to the Embarras River. Streams in the watershed yield an average of 7.8 lbs of sediment per foot. A selection of banks eroding at high rates are accessible, making localized stabilization feasible. Directly measured streams are responsible for 42% of the total streambank sediment load. Recommended practices are described in Section 6.

Table 21 – Streambank Erosion & Loading

Stream	Sediment Load (tons/year)	Sediment Load (lbs/ft of stream)	Nitrogen Load (lbs/year)	Phosphorus Load (lbs/year)
Directly Assessed				
The Slough	271	15.4	305	135
Mad Creek	236	15.5	265	117
Unnamed Tributary	139	6.1	157	69
Subtotal	**647**	**11.6**[1]	**727**	**322**
Estimated				
The Slough	598	8.5	672	297
Mad Creek	43	7.2	48	21
Unnamed Tributary	250	3.8	282	125
Subtotal	**891**	**6.3**[2]	**1,002**	**443**
Grand Total	**1,537**	**7.8**[3]	**1,729**	**765**

[1] - Value represents lbs/ft for all banks (1,293,118 lbs/111,893 ft), [2] - Value represents lbs/ft for all banks (1,781,288 lbs/283,222 ft), [3] – Value represents lbs/ft for all banks (3,074,406 lbs/395,116 ft)

3.11.2 Streambed Erosion

Bed erosion, degradation or lowering, is a process by which the bed of the stream is eroded to a new lower level at a much faster rate than occurs naturally. This bed lowering is indicated by the presence of "knickpoints" or an abrupt change in a stream's longitudinal profile due to a change in base level, similar to a waterfall. Knickpoints migrate upstream and can be triggered by channel modification or changes in stream discharge. As knickpoints migrate upstream and the channel deepens, corresponding banks become steeper and more susceptible to failure. These features can be mitigated by installing stream riffles to stabilize grade.

A total of 62 knickpoints were observed, generally localized and concentrated along the upstream reaches of assessed segments. Well over half can be found along a channelized section of Mad Creek and correspond with high rates of bank erosion.

Knickpoint in the Watershed

Severe Bank Erosion in the Watershed

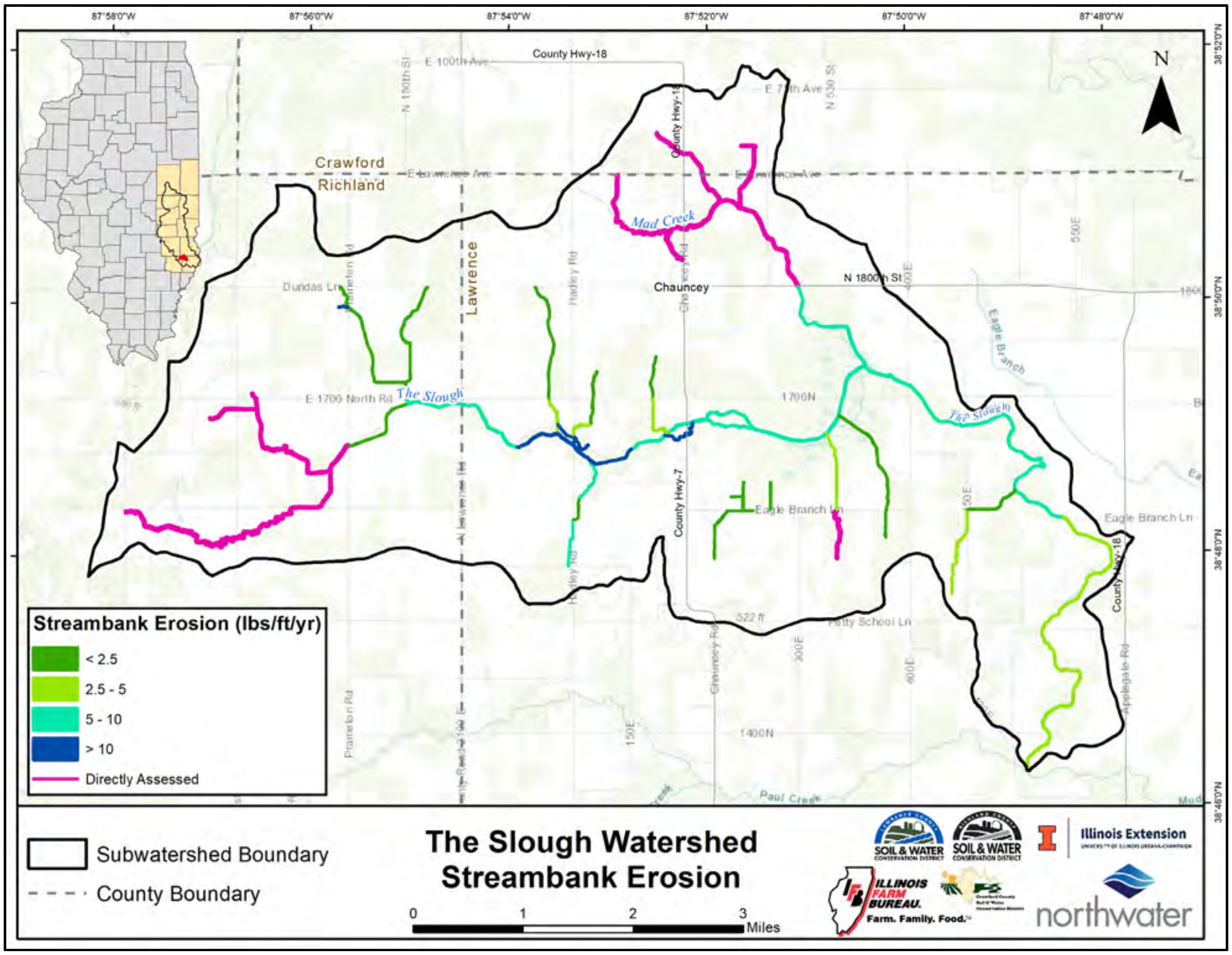


Figure 20 - Streambank Erosion Overview

Low Bank Erosion in the Watershed

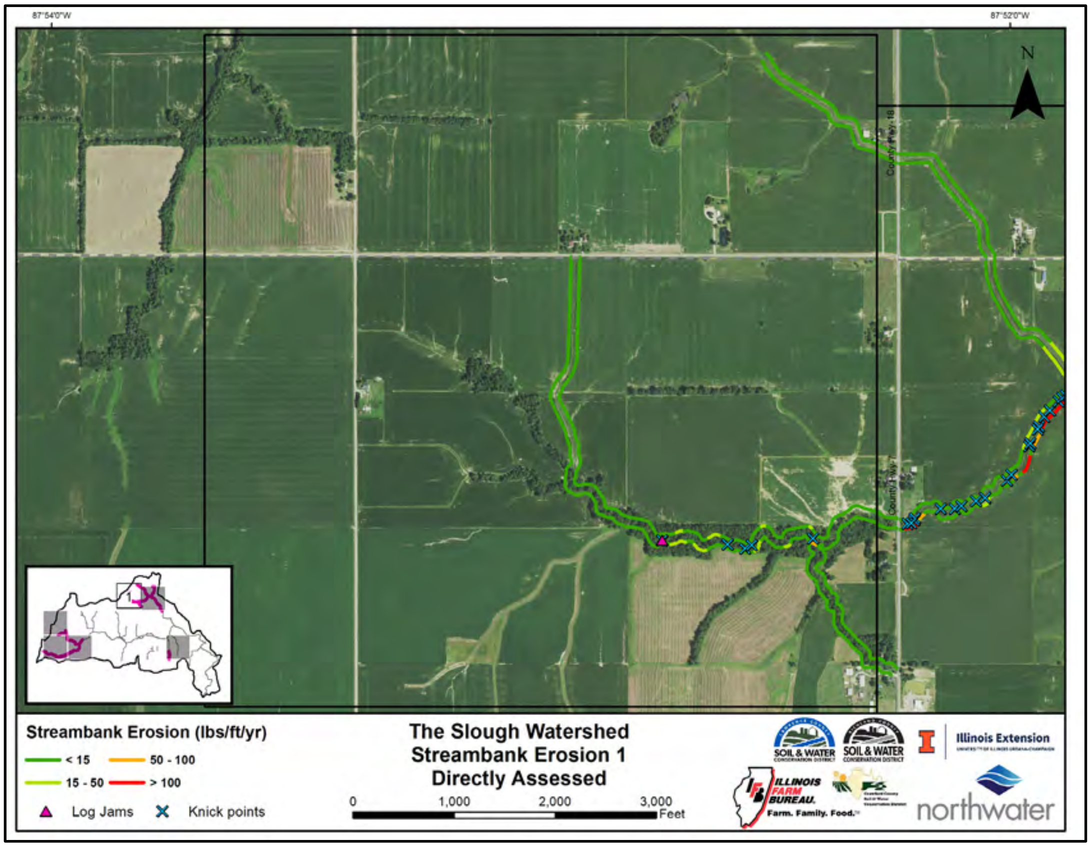


Figure 21 – Directly Measured Stream 1

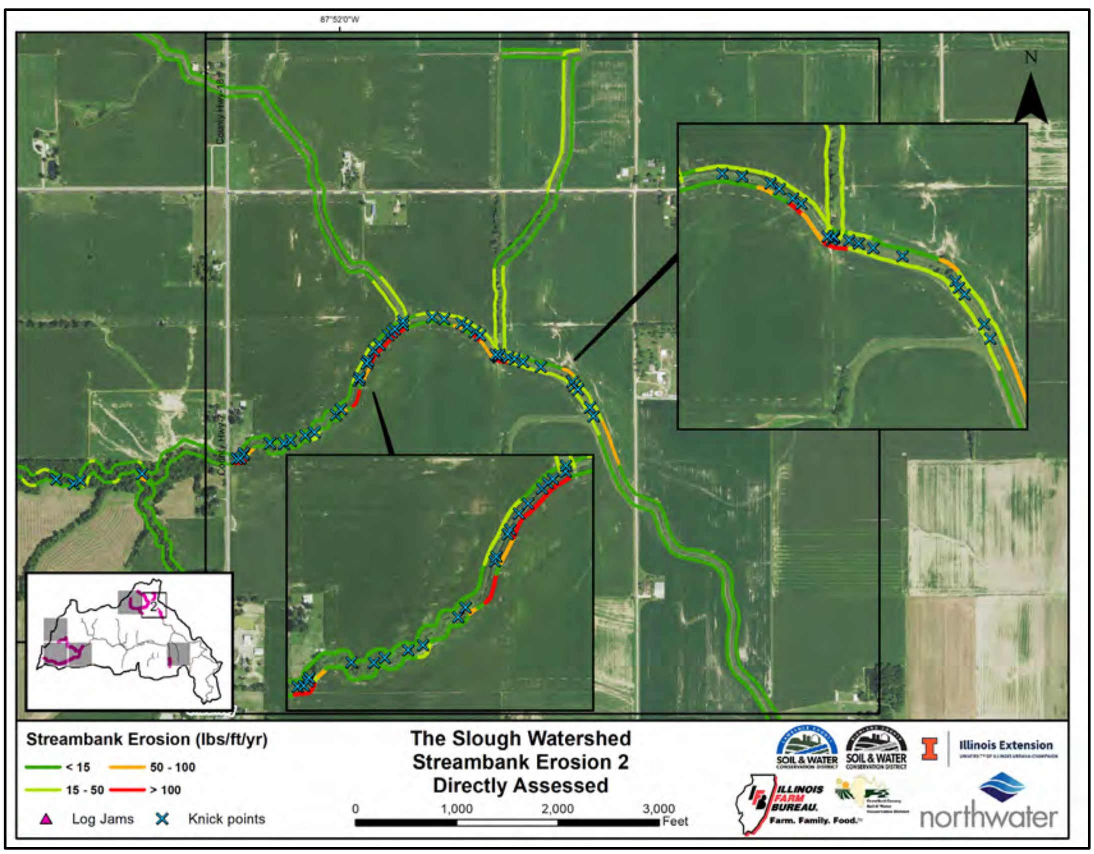


Figure 22 – Directly Measured Stream 2

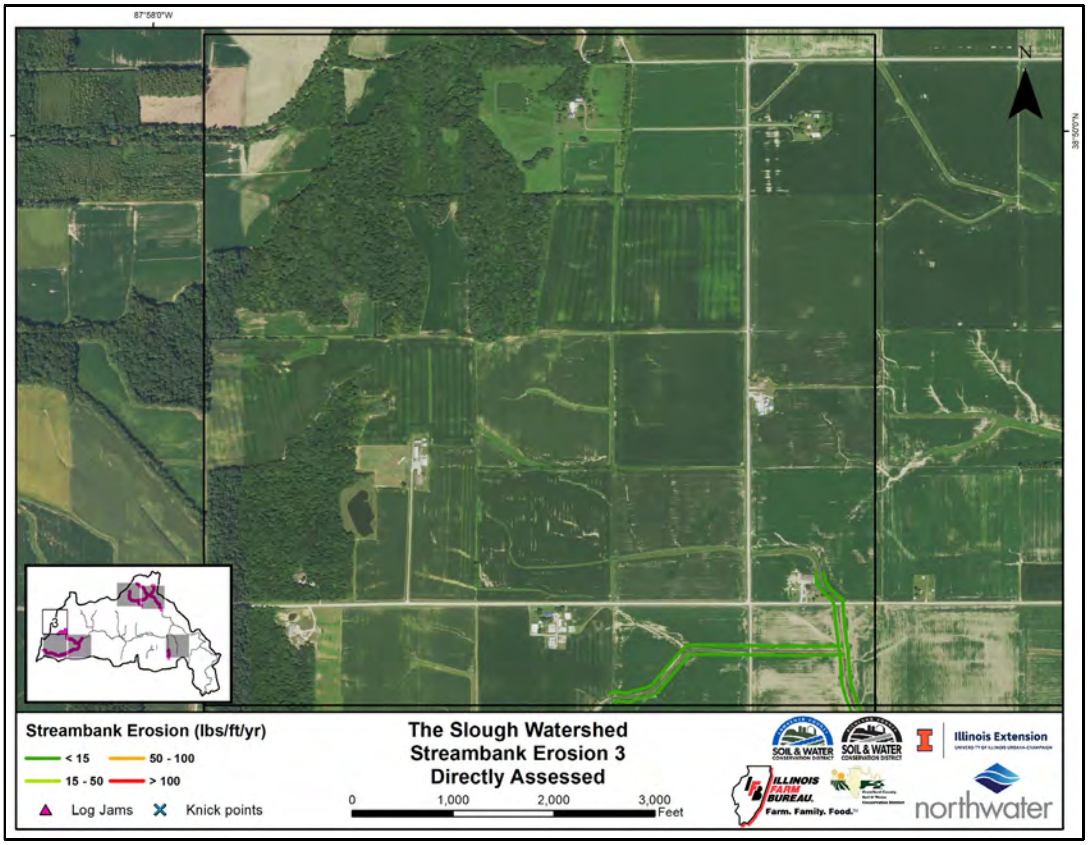


Figure 23 – Directly Measured Stream 3

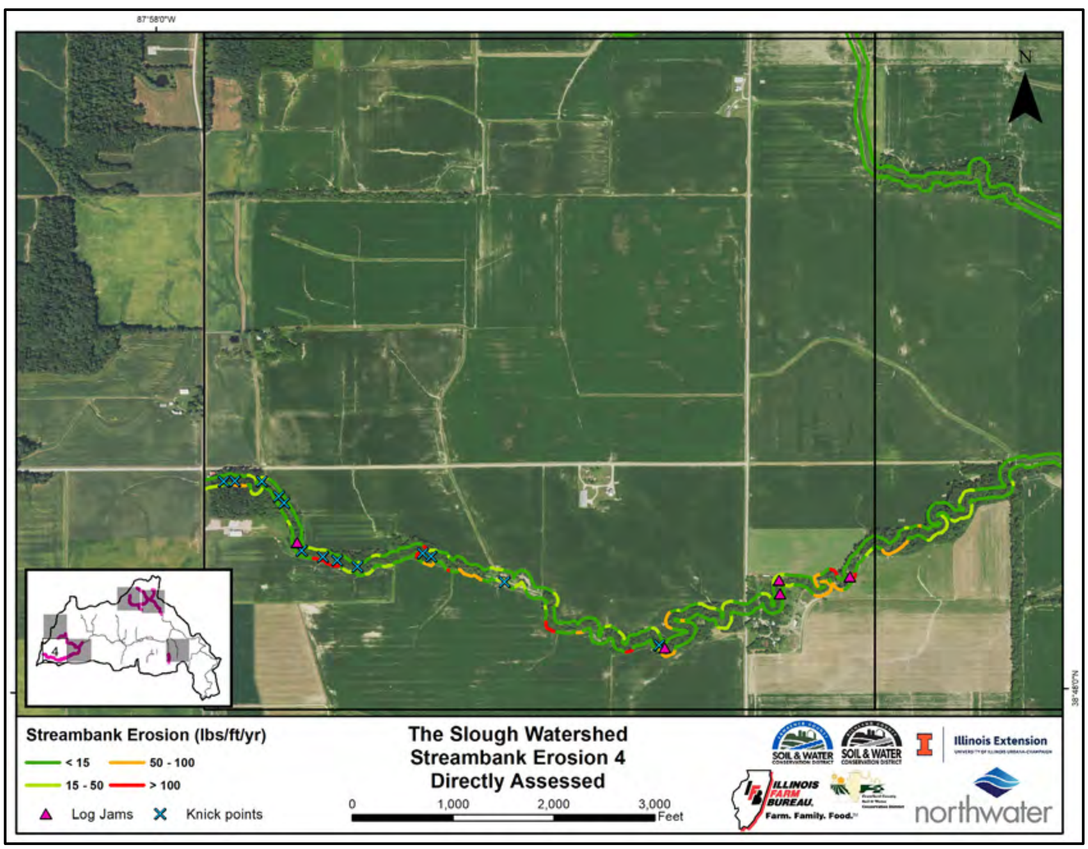


Figure 24 – Directly Measured Stream 4

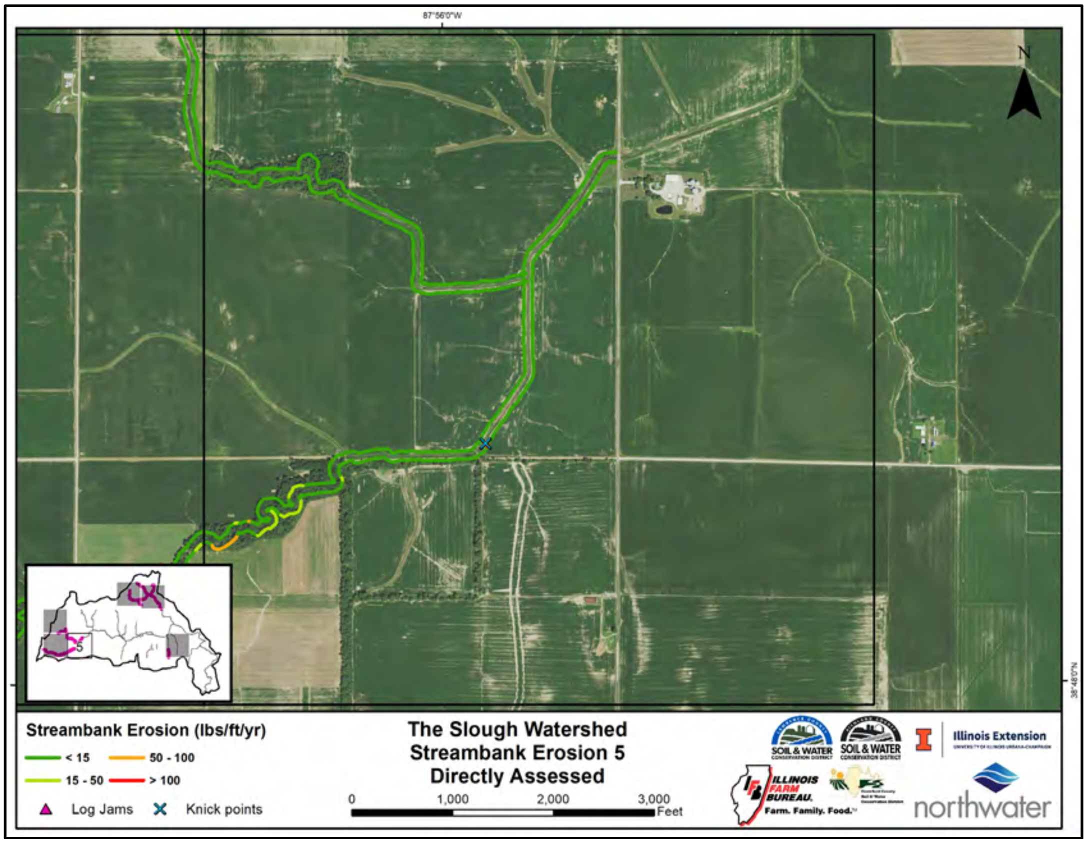


Figure 25 – Directly Measured Stream 5

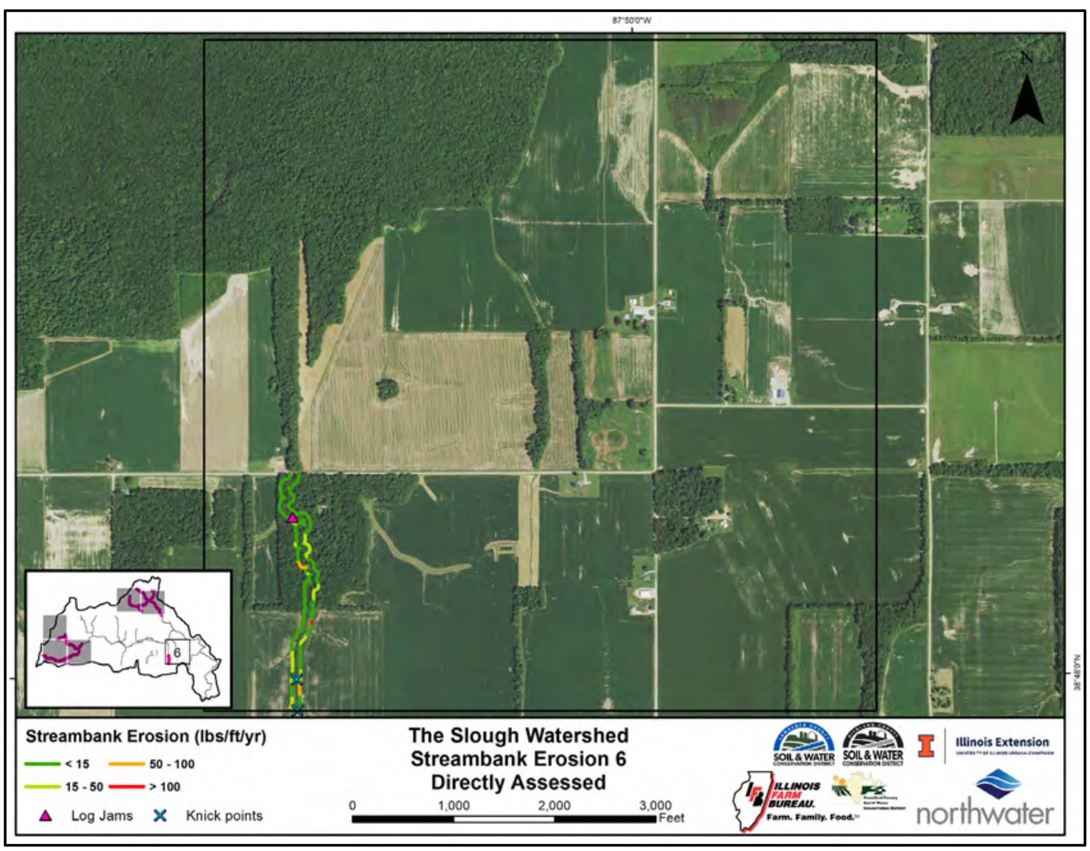


Figure 26 – Directly Measured Stream 6

3.12 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 during a watershed windshield survey and estimated using GIS. 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). For those ephemeral gullies not visible from a road or observed during the windshield survey, GIS was used to estimate their location and extent. Gullies were delineated in GIS using aerial imagery and high-resolution (LiDAR) elevation data, and a conservative average estimated width, depth, and years eroding were applied. For gullies observed in the field, dimensions were directly measured and transferred to GIS for analysis.

Total net erosion in tons/year and estimates of nitrogen and phosphorus loading were calculated using the equations below. A distance-based delivery ratio was applied to account for distance to a receiving waterbody. Sediment trapping efficiency was accounted for if the gully drained to a reservoir or other BMP. Soil nutrient concentrations were obtained from measured data in similar watersheds and STEPL. The following equations were applied to estimate gully erosion and nutrient yields:

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

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

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

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

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

TP – Total phosphorus 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 in the watersheds occurs primarily at ephemeral water courses adjacent to major perennial drainage ways. It is also evident on crop ground, especially on long slopes where subsurface drainage is occurring. Conservation practices observed in the watershed, such as WASCBs or grassed waterways and other grade control structures, have been implemented to address this specific type of erosion.

Results indicate that there are 48 miles of eroding gullies, with an average depth of 0.8 ft and an average width of 1.2 ft (Figure 27). Gullies are responsible for the annual delivery of 1,731 tons of sediment, 2,857 lbs of nitrogen and 907 lbs of phosphorus.

Gully Erosion

An analysis of gully loading by landuse type is presented in Table 22. The highest sediment and nutrient loads from gully erosion are originating from croplands, or 66% of the sediment, 80% of the nitrogen, and 76% of the phosphorus. Forested areas are responsible for 23% of the gully sediment load, 7.1% of the nitrogen, and 16% of the phosphorus. Forested areas contribute substantially more sediment per gully foot due to high rates of delivery and close proximity to a receiving stream.

Table 22 – Gully Erosion & Pollutant Loading

Landuse Category	Gully Length (ft)	Gully Length (miles)	Average Gully Width (ft)	Average Gully Depth (ft)	Sediment (tons/yr)	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)
Row Crops	210,318	40	1	0.6	1,146	2,291	685
Forest	26,709	5.1	2.2	1.7	404	204	149
Grasslands	16,327	3.1	2.3	1.5	167	334	60
Pasture	1,356	0.3	1.9	1.8	9.6	19	7.9
Open Space	1,359	0.3	1.3	1.3	4.4	8.7	4.4
Grand Total	**256,069**	**48**	**1.2**	**0.8**	**1,731**	**2,857**	**907**

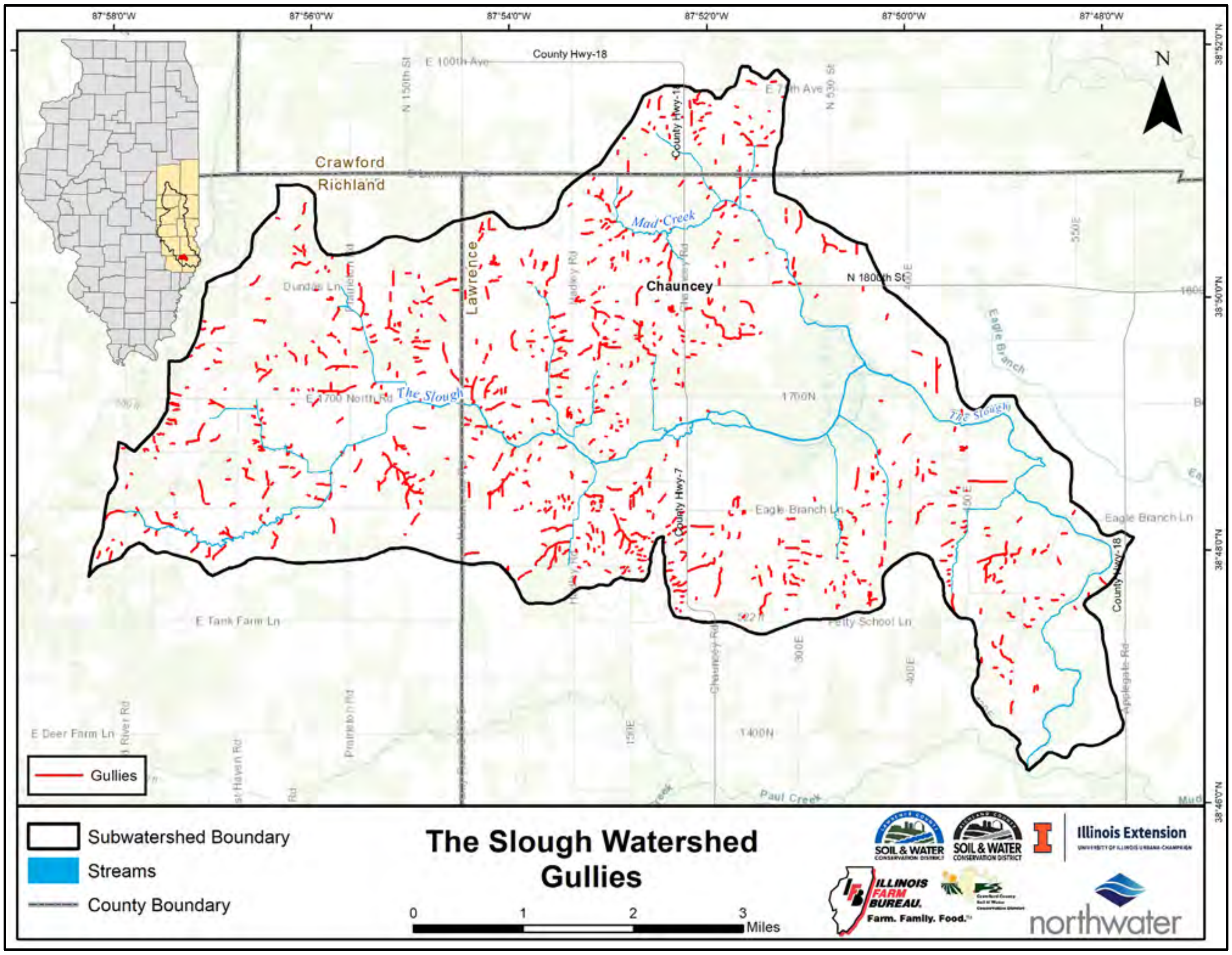


Figure 27 - Gully Erosion

3.13 Sheet & 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. The extent of sheet and rill erosion in the watershed was calculated using the Universal Soil Loss Equation (USLE), which is widely used to estimate rates caused by rainfall and associated overland flow. This method relies on soil properties, precipitation, slope, cover types and conservation practices (if applicable). A map-based USLE model was developed for all cropped soils within the watershed and used to quantify sediment loading from agricultural ground and identify locations with the potential for excessive erosion.

Analysis shows sheet and rill erosion from cropland is responsible for 14,309 tons of sediment and an average 0.82 tons/ac/yr delivered to receiving waterbodies (Table 23). Modeled results indicate that the majority is originating from no-till fields (due to the high overall acreage) and from tilled HEL/PHEL soils (Section 5) and those fields closest to a stream or other waterbody.

Mulch till, that on average delivers greater than 1 ton/ac/yr, represents 19% of all cropland and is responsible for the annual delivery of 29% of the entire cropland sediment load. Although these fields yield the greatest per acre, no-till is responsible for 64% of the total delivered sediment (Table 23), primarily due to higher overall acreage. Not considered a tillage practice but cover crops represent 16% of all cropland and these fields deliver only 5.4% of the sediment load at a yield of 0.27 tons/ac/yr.

Table 23 – Sheet & Rill Erosion Loading by Tillage or Cover Type

Tillage Type	Total Area (ac)	% Cropland area (acres)	Sediment Load (tons/yr)	Sediment Load (tons/ac/yr)	% of Total Sediment Load from Sheet & Rill Erosion
No-Till	9,042	63%	7,493	0.83	64%
Mulch-Till	2,714	19%	3,371	1.24	29%
Cover Crops[1]	2,328	16%	631	0.27	5.4%
Reduced-Till	196	1.4%	186	0.95	1.6%
Hay[1]	29	0.2%	1.6	0.06	0.01%
Total	**14,309**	**100%**	**11,683**	**0.82**	**100%**

[1] – not a tillage practice

3.14 Point Source Pollution

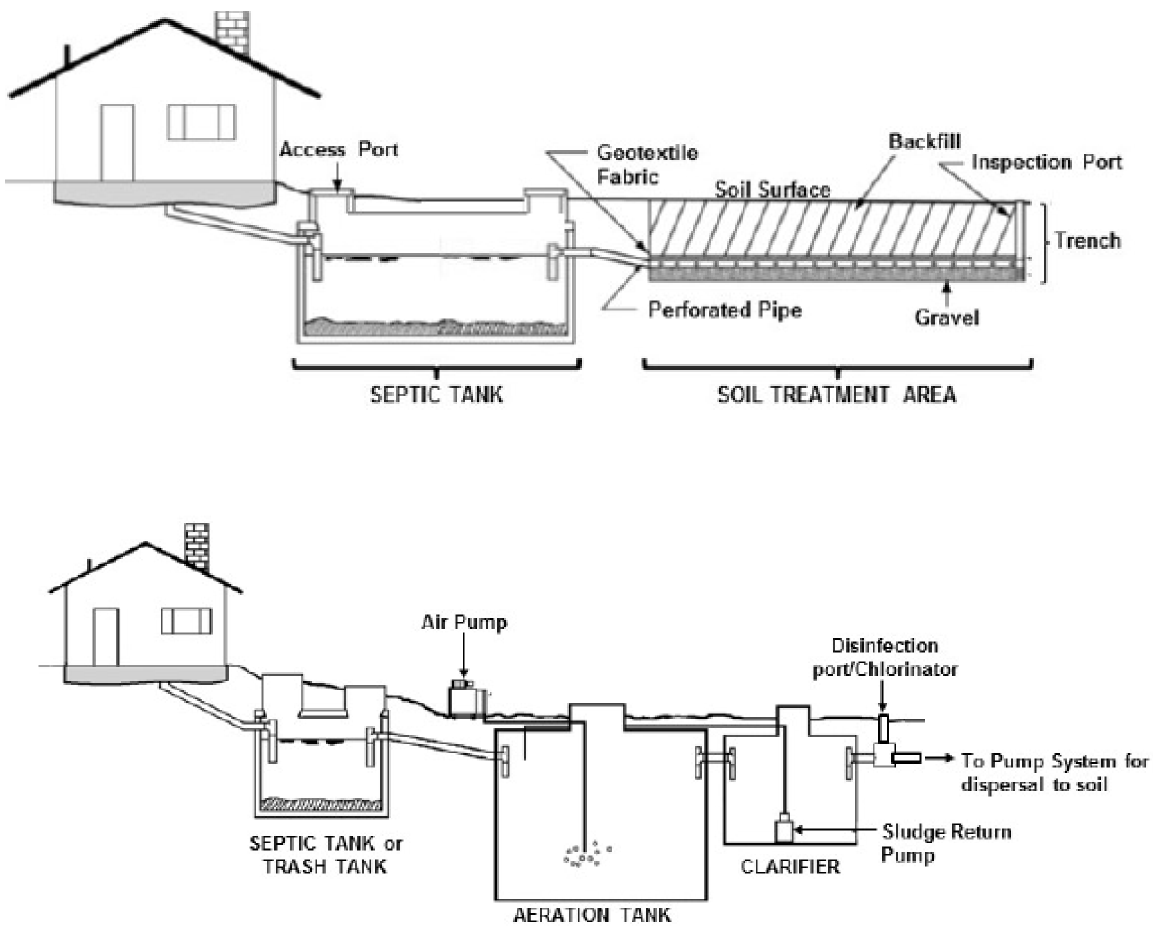
Point source pollution is defined by the United States Environmental Protection Agency (USEPA) as "any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack" (Hill, 1997). The NPDES, a provision of the Clean Water Act, prohibits 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 are for a group of facilities in a geographical area. Permits describe the allowed discharge of pollutant concentrations (mg/L) and loads (lbs/day). Permitted discharges contribute only a small portion of annual point source pollution. This can be expected, as there are many more people dependent on septic systems. The watershed contains no facilities permitted to discharge.

3.15 Septic Systems

Septic systems, although typically considered to be a nonpoint source 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. Septic systems provide treatment of wastewater from individual properties and structures. Failing septic systems can be 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). Based on other watershed plans and discussions with county health departments, a 15% failure rate was used for analysis.

Every home and structure in the watershed not served by a sewer system were located and mapped using GIS to estimate the number of individual structures using septic systems. Corresponding nitrogen and phosphorus loads were estimated using the STEPL.

There are an estimated 130 septic systems in the watershed. Assuming a rate of 15%, it is possible that 20 structures have failing septic systems. (Figure 28). Due to the planning nature of this analysis, the exact number of systems is unknown. Potentially failing systems contribute an estimated 621 lbs/yr of nitrogen and 243 lbs/yr of phosphorous. For the purposes of this report, it is assumed that these loadings make it to waterways, however, loading is a function of location to a waterway, and it is possible that some portion of septic water may be absorbed or filtered prior. Systems range from 78 to 6,534 ft from a receiving water body. Average distance is 1,670 ft and the median is 1,466 ft. Approximately 29% of all systems are at or less than 1,000 ft from a receiving water body.



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

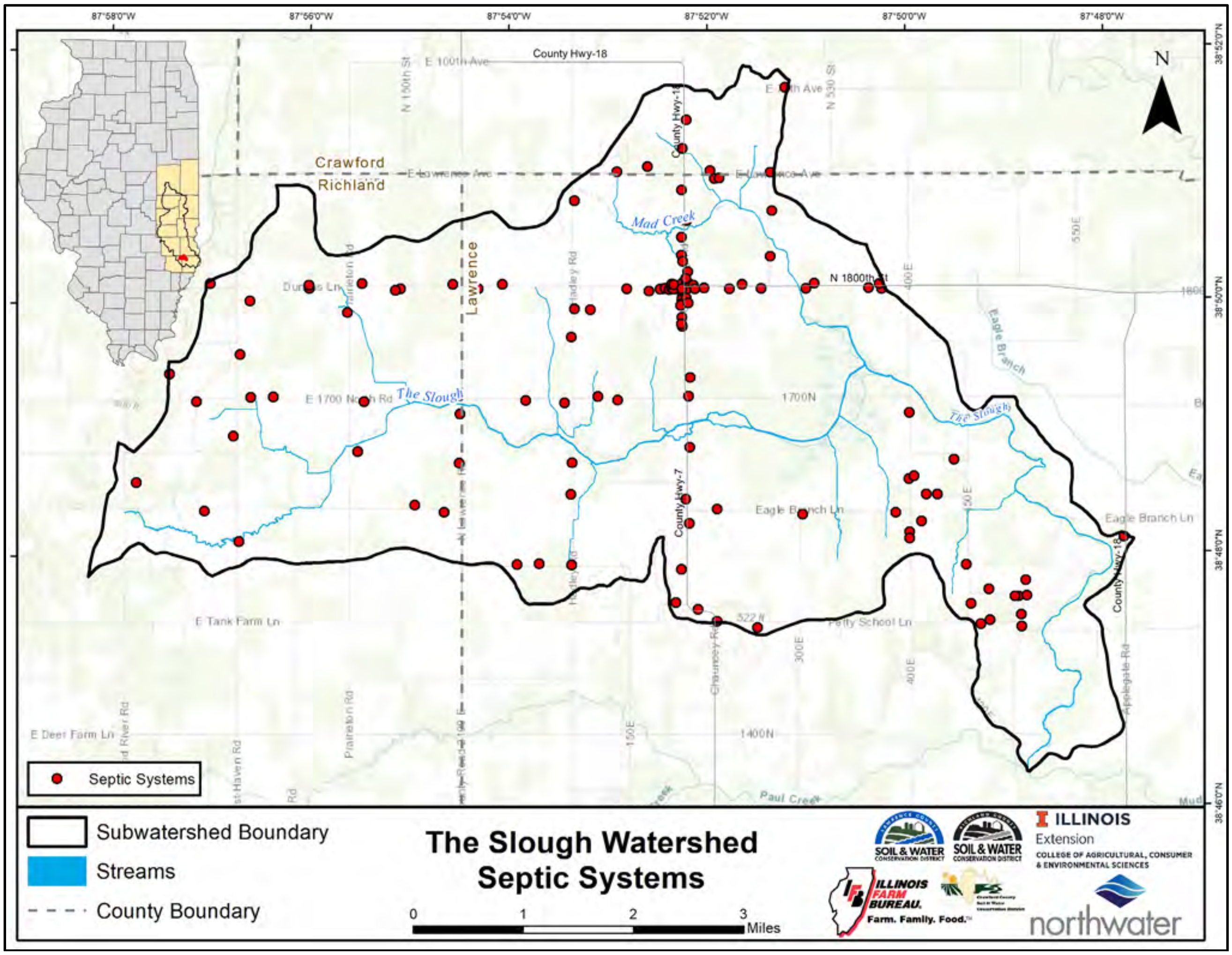


Figure 28 – Septic Systems

4.0 Pollutant Loading

4.1 Introduction

A watershed survey was completed to gain an understanding of conditions and features and to collect field-specific data. This included: tillage practices, cover types, existing project (BMP) locations and site suitability, and sources of sediment and gully erosion. This survey, combined with interpretation of aerial imagery, resulted in the identification of site-specific BMP locations. Drainage areas were then delineated for each.

A spatially explicit GIS-based pollution loading model (SWAMM) was developed to estimate loading from direct runoff and tile or subsurface flow. The model simulates surface runoff and loading using the curve number approach, local precipitation, the USLE, and Event Mean Concentrations (EMCs) specific to landuse and soil types. In addition, field survey data was incorporated, such as tillage practices and existing BMPs. The model accounts for subsurface tile flow by allocating a percentage of annual rainfall. It was not directly calibrated due to a lack of watershed-specific measured water quality and streamflow data. Loads were compared to other similar watersheds and historical data from monitoring stations on the Embarras River to ensure results are in the correct range.

4.2 Pollutant Loading

Pollutant load estimates are presented in this section and are provided for septic systems, surface runoff and tile flow, gully erosion, and streambank erosion. Gully and streambank erosion was observed in the field to the extent it was visible. Streambank erosion was directly assessed. Loading from septic systems was estimated based on those homes not connected to a wastewater treatment system. Results from the GIS-based direct surface runoff and tile flow pollution load model are illustrated in Figure 29, Figure 30, and Figure 31. Loading from direct surface runoff and tile accounts for what is contributed from overland flow and tiles.

As presented in Table 24, total annual loading from all sources is 135,874 lbs of nitrogen, 26,509 lbs of phosphorus, and 15,105 tons of sediment. Direct runoff and tile flow combined are responsible for 96% of the nitrogen load, 93% of the phosphorus, and 78% of the sediment load. Loading from tile flow is likely responsible for only 1.9% of the total nitrogen and 0.9% of the total phosphorus load. All other sources combined - failing septic systems, streambank erosion, and gully erosion account for 4% of the nitrogen, 7% of the phosphorus, and 22% of the sediment load.

Table 24 – Pollution Loading Summary

Pollution Source	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)	Sediment Load (% total)
Surface Runoff & Tile Flow	130,667	24,594	11,837	96%	93%	78%
Streambank Erosion	1,729	765	1,537	1.3%	2.9%	10%

Pollution Source	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)	Sediment Load (% total)
Gully Erosion	2,857	907	1,731	2.1%	3.4%	11%
Septic Systems	621	243	0	0.5%	0.9%	0%
Grand Total	**135,874**	**26,509**	**15,105**	100%	100%	100%

Modeled pollution loading from surface runoff and subsurface tile flow only is reported in Table 25, and depicted in Figure 29, Figure 30, and Figure 31. Per-acre results are calculated by dividing the total annual load of a given landuse category by the total number of acres. Results show that row crops have the highest per-acre sediment load followed by livestock feeding areas. Streams and lakes have the first and third highest per-acre nitrogen load. Very high nutrient yields for streams and, to a lesser extent, ponds and reservoirs are the result of legacy nutrients from the watershed already in the water column and, therefore, high measured concentrations. Livestock feeding areas are responsible for the second greatest per-acre nitrogen load, followed by crop ground. Livestock feeding areas followed by streams and pasture deliver the highest per-acre phosphorus loads.

Cropland delivers 122,341 lbs/yr of nitrogen, or 8.5 lbs/ac/yr; 23,202 lbs/yr of phosphorus, or 1.6 lbs/ac/yr; 11,683 tons, or 0.82 tons/ac/yr of sediment. It is important to note that these results represent delivered loads for all fields in the watershed combined. Individual fields deliver soil and nutrients at different rates based on tillage practices, soil and slope characteristics, proximity to a waterbody, and whether a BMP is in place.

Other landuse categories, such as forest, roads and residential areas, are also relatively high contributors of nutrients and sediment. Although forest and open space have low per-acre values compared to other categories, the watershed contains a higher percentage and, therefore, cumulative loading is higher.

Table 25 – Pollution Loading from Surface & Subsurface Runoff by Landuse

Landuse Category	Area (ac)	Sediment Load		Nitrogen Load		Phosphorus Load	
		tons/yr	tons/ac/yr	lbs/yr	lbs/ac/yr	lbs/yr	lbs/ac/yr
Row Crops	14,309	11,683	0.8	122,341	8.5	23,202	1.6
Forest	2,214	58	0.03	2,248	1	415	0.2
Grasslands	777	11	0.01	564	0.7	112	0.1
Open Space	406	11	0.03	787	1.9	111	0.3
Roads[1]	135	26	0.2	721	5.4	245	1.8
Wetlands	98	0.1	0.001	80	0.8	1.8	0.02
Open Water Stream[2]	86	24	0.3	2,383	28	194	2.3
Pasture	73	12	0.2	763	10	159	2.2
Farm Building	45	7.3	0.2	366	8.2	63	1.4
Residential[3]	25	3.2	0.1	104	4.2	35	1.4
Open Water Pond Reservoir[2]	15	0.4	0.02	215	14	16	1

Landuse Category	Area (ac)	Sediment Load		Nitrogen Load		Phosphorus Load	
		tons/yr	tons/ac/yr	lbs/yr	lbs/ac/yr	lbs/yr	lbs/ac/yr
Cemetery	5.5	0.1	0.03	9.8	1.8	2.9	0.5
Confinement	3.7	0.1	0.02	9.9	2.7	4.2	1.1
Commercial	3.3	0.6	0.2	17	5.2	5.8	1.8
Parking Lot	2.4	0.5	0.2	14	5.7	4.6	1.9
Livestock Feed Area	1.9	0.6	0.3	38	20	21	11
Warehouse	1.2	0.2	0.2	4.8	4	1.9	1.6
Junkyard	0.2	0.01	0.05	0.3	1.2	0.1	0.4
Institutional	0.2	0.03	0.2	0.8	4.9	0.3	1.6
Total	**18,201**	**11,837**	**0.7[4]**	**130,667**	**7.2[4]**	**24,594**	**1.4[4]**

[1] – Roads yield high nutrient loads due to rapid rates of runoff and relatively high Event Mean Concentration values found in existing literature.
[2] – Very high nutrient yields for streams and, to a lesser extent, ponds and reservoirs are the result of legacy nutrients from the watershed already in the water column and, therefore, high measured concentrations. When combined with high runoff rates and rapid delivery of water through the system, yield results exceed other landuse categories. This is a limitation of the model used for estimating surface runoff loading.
[3] - loading from the septic systems themselves is not included in this total. Table 23 quantifies septic system loading separately.
[4] – per acre values in this column represent total loading divided by the total watershed area and is an overall average.

Table 26 compares the loadings originating from direct runoff with the watershed load from all sources. Row crops are the greatest contributor, responsible for 90% of the total nitrogen, 88% of total phosphorus, and 77% of the total sediment load. Forests areas are the second highest contributor of sediment, albeit only 0.4%. Open water streams, forest and open space are the next three highest contributors of surface runoff nitrogen loads, at 1.8%, 1.7% and 0.6%. Forest, roads and open water stream contribute 1.6%, 0.9% and 0.7% of total phosphorus, respectively.

Table 26 – Loading from Surface & Subsurface Runoff by Landuse as Percentage of Watershed Load

Landuse Category	Area (ac)	Sediment Load		Nitrogen Load		Phosphorus Load	
		tons/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load
Row Crops	14,309	11,683	77%	122,341	90%	23,202	88%
Forest	2,214	58	0.4%	2,248	1.7%	415	1.6%
Grasslands	777	11	0.07%	564	0.4%	112	0.4%
Open Space	406	11	0.07%	787	0.6%	111	0.4%
Roads	135	26	0.2%	721	0.5%	245	0.9%
Wetlands	98	0.1	0.0005%	80	0.06%	1.8	0.007%
Open Water Stream	86	24	0.2%	2,383	1.8%	194	0.7%
Pasture	73	12	0.08%	763	0.6%	159	0.6%
Farm Building	45	7.3	0.05%	366	0.3%	63	0.2%
Residential	25	3.2	0.02%	104	0.08%	35	0.1%
Open Water Pond Reservoir	15	0.4	0.002%	215	0.2%	16	0.06%
Cemetery	5.5	0.1	0.001%	9.8	0.007%	2.9	0.01%

Landuse Category	Area (ac)	Sediment Load		Nitrogen Load		Phosphorus Load	
		tons/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load
Confinement	3.7	0.1	0.001%	9.9	0.007%	4.2	0.02%
Commercial	3.3	0.6	0.004%	17	0.01%	5.8	0.02%
Parking Lot	2.4	0.5	0.003%	14	0.01%	4.6	0.02%
Livestock Feed Area	1.9	0.6	0.004%	38	0.03%	21	0.08%
Warehouse	1.2	0.2	0.001%	4.8	0.004%	1.9	0.007%
Junkyard	0.2	0.01	0.0001%	0.3	0.0002%	0.1	0.0004%
Institutional	0.2	0.03	0.0002%	0.8	0.0006%	0.3	0.001%
Total	**18,201**	**11,837**	**78%**	**130,667**	**96%**	**24,594**	**93%**

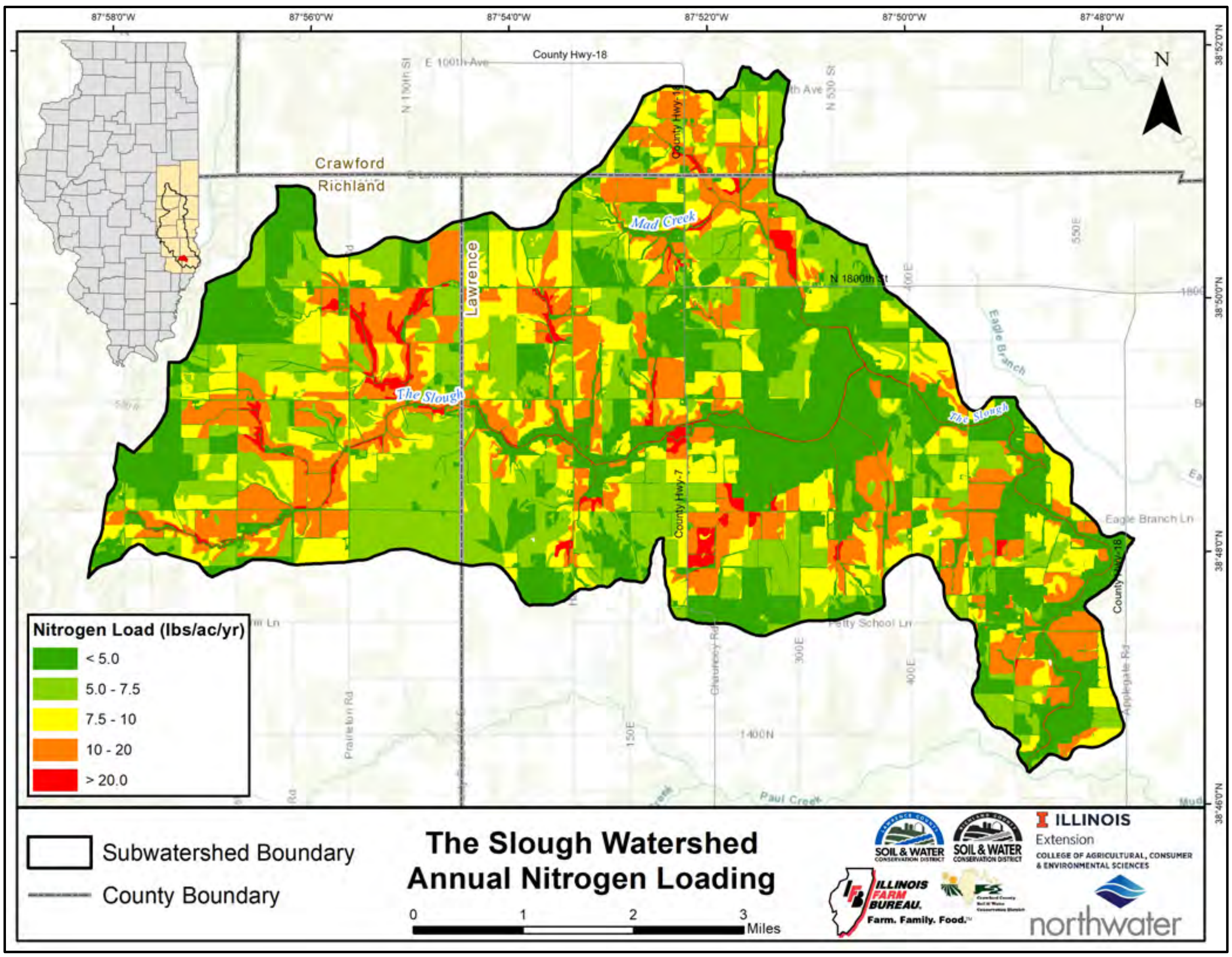


Figure 29 – Annual Nitrogen Loading Per Acre from Direct Surface & Subsurface Runoff

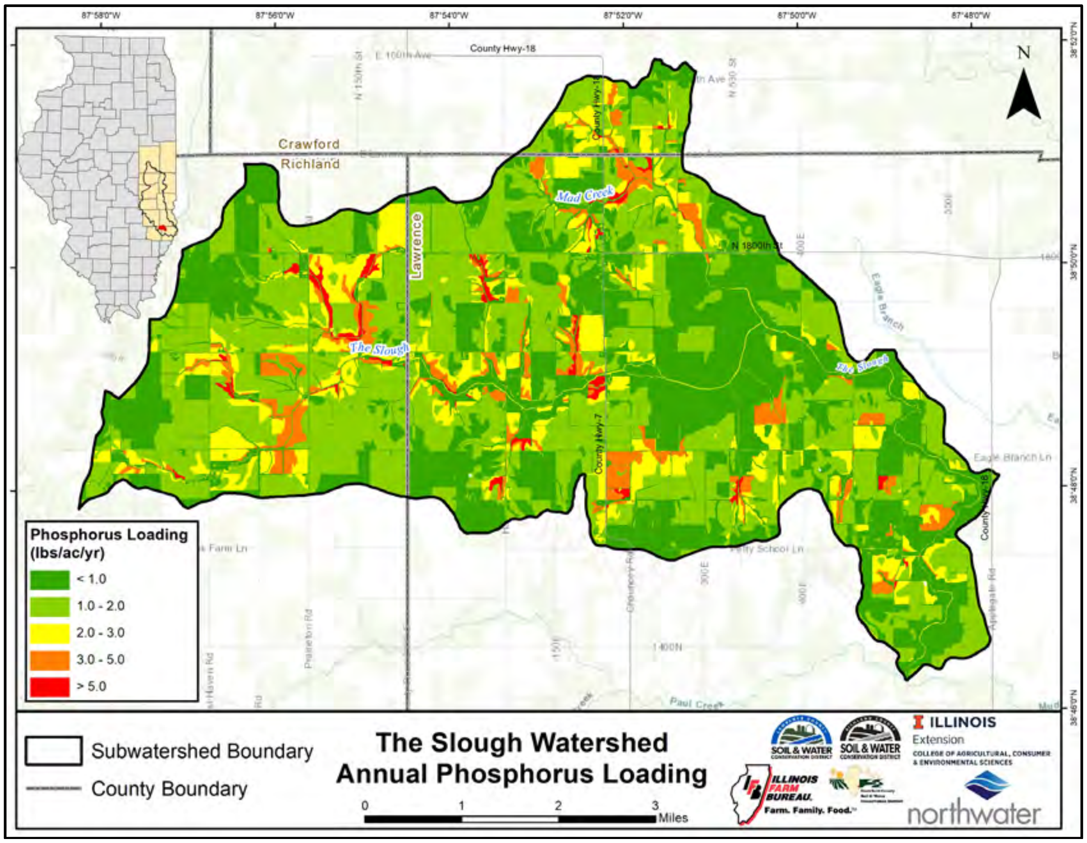


Figure 30 – Annual Phosphorus Loading Per Acre from Direct Surface & Subsurface Runoff

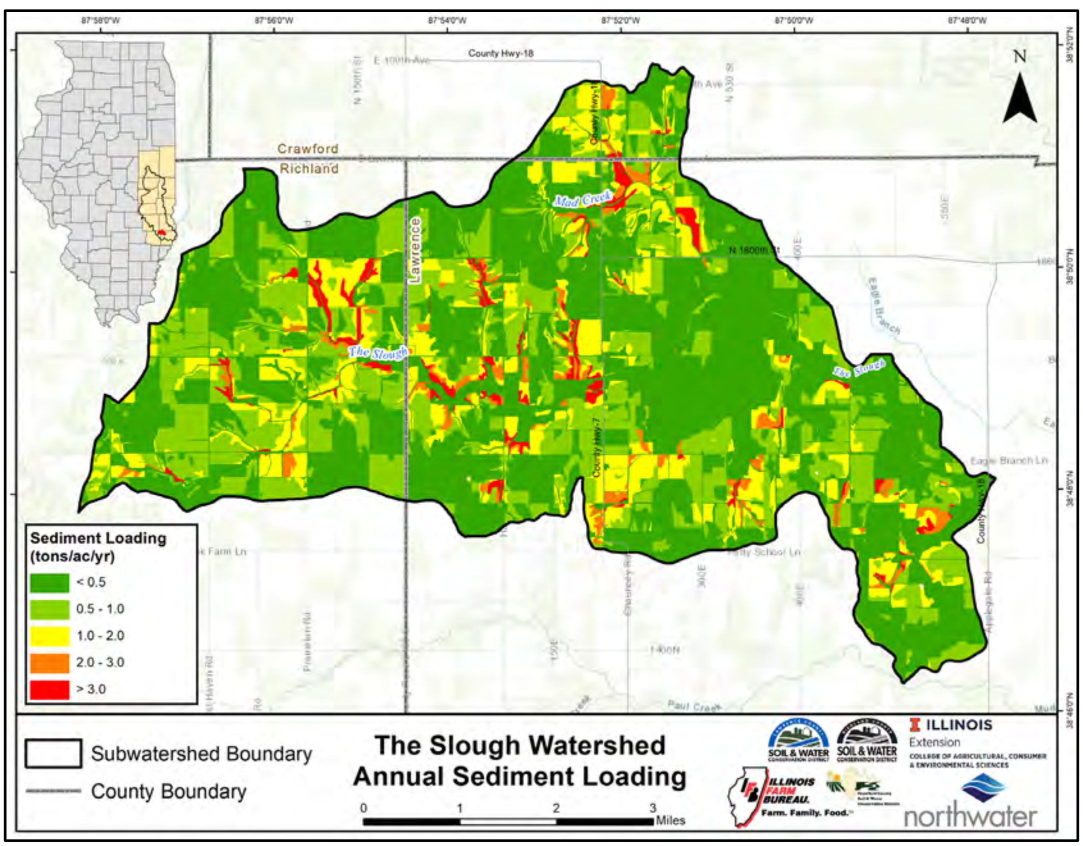


Figure 31 – Annual Sediment Loading Per Acre from Direct Surface Runoff

5.0 Sources of Watershed Impairments

Cropland Surface Erosion

Watershed impairments originate from either NPS or point source pollution. A description of point source pollution is given in Section 3.14. Nonpoint source 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, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters (USEPA, 2018).

In The Slough, sources of sediment are thought to be originating from cropland, streambank and gully erosion and, to a much lesser extent, developed areas. Nutrients are thought to be originating from cropland, leaking or improperly maintained septic systems and, to a lesser extent, residential areas and streambanks and gullies.

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

5.1 Nitrogen & Phosphorus

The largest source of nitrogen in the watershed is surface runoff from cropland. Tile nitrogen is responsible for only 1.9% and surface runoff 88% of the total nitrogen load. The largest source of phosphorus is surface runoff from cropland which is responsible for 87% of the total load. An additional 0.9% is believed to be originating from tile flow (Table 27). Other primary sources include eroding gullies (agricultural and non-agricultural), surface runoff from non-croplands, streambank erosion, and septic systems.

Table 27 – Primary Nutrient Loading Sources

Pollutant Source	Nitrogen Load (lbs/ac)	Phosphorus Load (lbs/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)
Surface Runoff: Cropland	119,773	22,972	88%	87%
Tile Flow: Cropland	2,567	229	1.9%	0.9%
Surface Runoff: Non-cropland	8,326	1,393	6.1%	5.3%
Streambank Erosion	1,729	765	1.3%	2.9%
Gully Erosion: Cropland	2,291	685	1.7%	2.6%
Gully Erosion: Non-cropland	565	221	0.4%	0.8%
Septic Systems	621	243	0.5%	0.9%
Grand Total	**135,874**	**26,509**	**100%**	**100%**

5.1.1 Cropland

The amount of nutrients originating from cropland depends on a whole host of complex factors and conditions including, but not limited to, weather, soil chemistry, nutrient application rates and timing, subsurface drainage or tiling, tillage practices, proximity to a receiving waterbody, or the presence or absence of conservation practices. To better understand the extent of nutrient loading from cropland, an analysis was performed on available and known watershed data. This includes an investigation of modeled loading from surface runoff versus tile flow, and tillage types.

Nitrogen – It is believed that most of the nitrogen load is surface runoff and tile flow from cropland or 90%. Tile nitrogen represents only 2% (Table 27).

Phosphorus – It is believed that much of the load (88%) is from surface runoff and closely tied to soil erosion from crop ground.

Tillage

The relatively small percentage of reduced till has the highest annual yield or per-acre loading of nutrients, followed closely by mulch-till. Although no-till yields less nutrients per acre, it covers the majority crop ground at 63% and, therefore, contributes about 64% of the nitrogen and 65% of total phosphorus from cropland (Table 28). Cover crops are responsible for 10% of the nitrogen and 8.5% of the phosphorus and covers 16% of watershed cropland.

Table 28 – Cropland Nutrient Loading by Tillage Type

Tillage Type	Area (ac)	Nitrogen Load			Phosphorus Load		
		lbs/yr	lbs/ac/yr	% Cropped Load	lbs/yr	lbs/ac/yr	% Cropped Load
No-Till	9,042	78,537	8.7	64%	15,128	1.7	65%
Mulch-Till	2,714	29,756	11	24%	5,699	2.1	25%
Cover Crops	2,328	11,751	5.0	10%	1,964	0.8	8.5%

Tillage Type	Area (ac)	Nitrogen Load			Phosphorus Load		
		lbs/yr	lbs/ac/yr	% Cropped Load	lbs/yr	lbs/ac/yr	% Cropped Load
Reduced-Till	196	2,261	12	1.8%	398	2.0	1.7%
Hay[1]	29	35	1.2	0.03%	14	0.5	0.1%
Total	**14,309**	**122,341**	**8.5**	**100%**	**23,202**	**1.6**	**100%**

[1] – Hay is not a tillage practice.

5.1.2 Gullies, Streambanks, & Septic Systems

Septic systems - If failing, septic systems are a relatively high contributor of phosphorus, but due to the low population in the watershed, only account for 0.9% compared to 0.5% for nitrogen (Table 27).

Streambank Erosion - Streambank erosion delivers 2.9% of the phosphorus and only 1.9% of the total annual nitrogen. Streambank erosion is more relevant in terms of sediment loading.

Gully Erosion – although low overall, nutrient loading from gully erosion is most significant from cropland, at 1.7% of the nitrogen and 2.6% of the phosphorus. As with streambank erosion, this source is more relevant in terms of sediment.

5.2 Sediment

The primary source of sedimentation in the watershed is cropland sheet and rill erosion, responsible for 77% of the entire sediment load (Table 29). Secondary sources include eroding gullies, streambank erosion, and surface runoff from non-croplands.

Table 29 – Sediment Loading from all Sources

Pollutant Source	Sediment Load (tons/yr)	Sediment Load (% total)
Surface Runoff: Cropland	11,683	77%
Surface Runoff: Non-cropland	154	1%
Streambank Erosion	1,537	10%
Gully Erosion: Cropland	1,146	7.6%
Gully Erosion: Non-cropland	585	3.9%
Grand Total	**15,105**	**100%**

5.2.1 Cropland

The amount of sediment originating from cropland depends on tillage practices, 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 loading by tillage practices and soil HEL/PHEL designation. Results are presented in Table 30 and Table 31.

Tillage

Mulch-till fields contribute 29% of the annual cropland sediment. This represents 40% of the total watershed load. Mulch till yields the highest per-acre or 1.2 tons/ac/yr. Reduced-till is also responsible for a relatively high percentage of the sediment load compared to total area. No-till contributes the greatest cropland sediment load at 64% but also covers the greatest cropland area at 63%. Cover crops are only responsible for 5.4% of the cropland sediment load, despite covering 16% of cropland.

Table 30 – Cropland Sediment Loading by Tillage Type

Tillage Type	Area (ac)	Area (% Cropped)	Sediment Load		
			tons/yr	tons/ac/yr	% Cropped Load
No-Till	9,042	63%	7,493	0.8	64%
Mulch-Till	2,714	19%	3,371	1.2	29%
Cover Crops	2,328	16%	631	0.3	5.4%
Reduced-Till	196	1.4%	186	0.9	1.6%
Hay[1]	29	0.2%	1.6	0.1	0.0%
Total	**14,309**	**100%**	**11,683**	**0.8**	**100%**

[1] – Hay is not a tillage practice.

Cropped HEL Soils

An analysis was performed to better understand the extent of sediment loading from sheet and rill erosion based on HEL and PHEL soils and tillage. Results are presented in Table 31.

Although HEL/PHEL soils make up 31% of watershed cropland area, they account for 4,715 tons or 40% of cropland sediment load and 31% of the entire sediment load. On average, cropped HEL soils deliver sediment at rates 32% higher than non-HEL.

No-till and mulch-till HEL/PHEL fields combined contribute 37% of the annual cropland sediment followed by cover crop and reduced-till. Mulch tillage of HEL/PHEL yields the highest per-acre, or 1.9 tons/ac/yr. Most cropped HEL/PHEL are being no-tilled, or 63% and yield 1.2 tons/ac/yr. A fairly large percentage of cover crops are responsible for only 3.1% of the total cropland sediment load. With only 4.1% of the total HEL/PHEL area, mulch tillage is responsible for almost 10% of the entire sediment load coming from cropland and 13% of the total HEL/PHEL load. Cover crops planted on HEL soils lose far less soil, per acre, on an annual basis.

Table 31 – Cropland Sediment Loading by HEL/PHEL Soils & Tillage Type

Tillage Type	Area HEL (ac)	% Cropped Area	% Crop HEL/PHEL	Sediment		
				tons/yr	tons/ac/yr	% Total Cropland Load
No-Till	2,771	19%	63%	3,202	1.2	27%
Cover Crops	1,006	7.0%	23%	357	0.4	3.1%
Mulch-Till	581	4.1%	13%	1,130	1.9	9.7%
Reduced-Till	17	0.1%	0.4%	26	1.5	0.2%

Tillage Type	Area HEL (ac)	% Cropped Area	% Crop HEL/PHEL	Sediment		
				tons/yr	tons/ac/yr	% Total Cropland Load
Hay[1]	5.6	0.04%	0.1%	0.5	0.1	0.004%
Total	**4,381**	**31%**	**100%**	**4,715**	**1.1**	**40%**

1 – Hay is not a tillage practice.

5.2.2 Gullies, & Streambanks

Gully erosion from crop ground and streambank erosion are the next most significant sources of sediment, followed by non-cropland.

Streambank Erosion - Streambank erosion delivers 10% of the total watershed sediment load.

Gully Erosion - Gully erosion in cropland delivers 7.6% of the total sediment and 66% of the entire gully contribution. Gully erosion in forested areas is only responsible for 2.7% of the total watershed load and 23% of all gully erosion. Forested gullies deliver 30.3 lbs/ft, cropland 10.9 lbs/ft, pasture 14.2 lbs/ft and all other 19.4 lbs/ft. Much of the forested contribution can be attributed to delivery rates as a relatively high percentage are very close to a receiving stream. Contributions from crop ground are relatively low due to low delivery rates and the presence of BMPs that either trap or filter sediment before entering a receiving stream.

6.0 Nonpoint Source Management Measures & Load Reductions

This section details recommended BMPs for the watershed, their quantities and expected annual pollution load reductions. Although reductions presented below include nitrogen, phosphorus and sediment, special attention is given to sediment and phosphorus. As these is the most common water quality concerns for the Embarras River, practices that address phosphorus and sediment loading should receive priority.

Best Management Practices 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 BMPs needed to achieve measurable reductions in nitrogen, phosphorus and sediment.

Expected reductions are calculated using average pollutant reduction efficiency percentages based on the INLRS, existing literature, and local expertise. Ranges of efficiencies used can be found in Table 32 and Table 33. It should be noted that addressing nutrient and sediment loading will take a substantial amount of effort and resources. Water quality improvements will not happen overnight, and time will be needed to realize results. Years of work by agencies, landowners and others have generated water quality benefits. Building off these efforts will help to accelerate improvements.

Table 32 – Pollutant Reduction Efficiency Ranges by BMP for Surface Runoff

BMP	Nitrogen Reduction %	Phosphorus Reduction %	Sediment Reduction %
Cover Crop	30%	30%	40%
Field Border	8 - 10%	10%	28 - 65%
Filter Strip	5 - 10%	10 - 40%	15 - 65%
Grade Control - Block Chute[1]	1 - 2%	2 - 4%	3 - 5%
Grade Control - Rock Check[1]	2 - 30%	3 - 25%	3 - 40%
Grass Conversion (any perennial vegetation)	90%	80%	90%
Livestock Stream Fencing and Pasture Management	45 - 50%	50 - 55%	55 - 60%
No-Till/Strip-Till	10%	50%	70%
Nutrient Management - Deep Placement Phosphorus	0%	20%	0%
Sediment Basin	10 - 20%	30 - 60%	35 - 70%
Streambed Stabilization - Riffle	50 - 75%	50 - 75%	100%
Terrace	20%	60%	70%
WASCB[1,2]	10 - 20%	50%	60 - 70%
Grassed Waterway[1]	8 - 30%	6 - 25%	9 - 40%
Wetland	12 - 40%	15 - 65%	17 - 80%

[1] = Controls 100% of gully erosion. [2] = Reduction percentage includes maintenance of existing structures.

Table 33 – Pollutant Reduction Efficiency Ranges by BMP for Subsurface Runoff

BMP	Nitrogen Reduction %	Phosphorus Reduction %
Bioreactor	40%	5%
Cover Crop	38%	10%
Grade Control - Block Chute[1]	1 - 2%	2 - 4%
Grade Control - Rock Check[1]	2 - 30%	3 - 25%
Grass Conversion (any perennial vegetation)	90%	80%
Wetland Creation[1]	12 - 40%	15 - 65%

[1] = Assumes tile flow is routed through BMP

6.1 Best Management Practices & Expected Load Reductions

Load reductions were calculated for each recommended BMP using the GIS-based loading model. Where applicable, a drainage area was delineated for each individual practice. Therefore, expected load reductions are spatially explicit and represent delivered pollutants. This section is organized into practices associated with agricultural ground and cover structural versus in-field. Recommended practices do not include those currently being implemented or in place in the watershed. To meet water quality targets, it is important that these existing practices continue. This is especially true for in-field practices such as no-till, cover crops and nutrient management that may be discontinued as economic conditions change or current funding support drops off.

Table 34 and lists all proposed BMPs, quantities, area treated, and expected annual reductions. Locations are shown in Figure 32, Figure 33, and Figure 34. The largest total expected reductions can be achieved from cover crops, tillage, nutrient management, and a select number of structural practices. These will require willing landowners to implement and large investments by other partners. Further information on BMP costs, reductions, critical practices, technical and financial assistance, and implementation goals can be found in Sections 7–11.

Table 34 – Recommended BMPs & 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	11,709 (ac)	11,709	33,135	6,323	4,662
	No-Till/Strip-Till	2,893 (ac)	2,893	3,143	3,030	2,560
	Nutrient Management - Deep Placement P	2,893 (ac)	2,893	0	1,212	0
In-Field Practices Subtotal			***17,494***	***36,278***	***10,565***	***7,222***
Structural Practices	Bioreactor	6 (locations), 12 (structures)	220	312	3.6	0
	Field Border	65 (locations), 76 (ac)	1,591	1,244	787	607
	Filter Strip	101 (locations), 131 (ac)	1,619	2,122	1,497	1,374
	Grade Control - Block Chute	6 (locations), 7 (structures)	236	55	18	23
	Grade Control - Rock Check	7 (locations), 28 (structures)	210	208	75	165
	Grass Conversion	82 (locations), 609 (ac)	609	4,857	813	442
	Livestock Stream Fencing and Pasture Management	2 (location), 2 (crossing), 2 (water system)	29	117	24	6.3
	Sediment Basin	28 (locations)	980	882	540	352
	Streambed Stabilization	6 (locations), 14 (riffles) 830 (ft. STP)	n/a	106	60	91

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
	Terrace	4 (locations), 3,050 (ft. terrace), 1,700 (ft. tile)	51	129	69	62
	WASCB	29 (locations), 92 (structures), 16,250 (ft. tile)	289	667	323	257
	Grassed Waterway	34 (locations), 86 (ac), 42,775 (ft. tile)	2,197	4,032	702	843
	Wetland	21 (locations), 77 (ac)	5,137	9,218	2,251	1,417
Structural Practices Subtotal			***13,170***	***23,950***	***7,162***	***5,639***
Grand Total			**30,664**	**60,228**	**20,396**	**12,861**

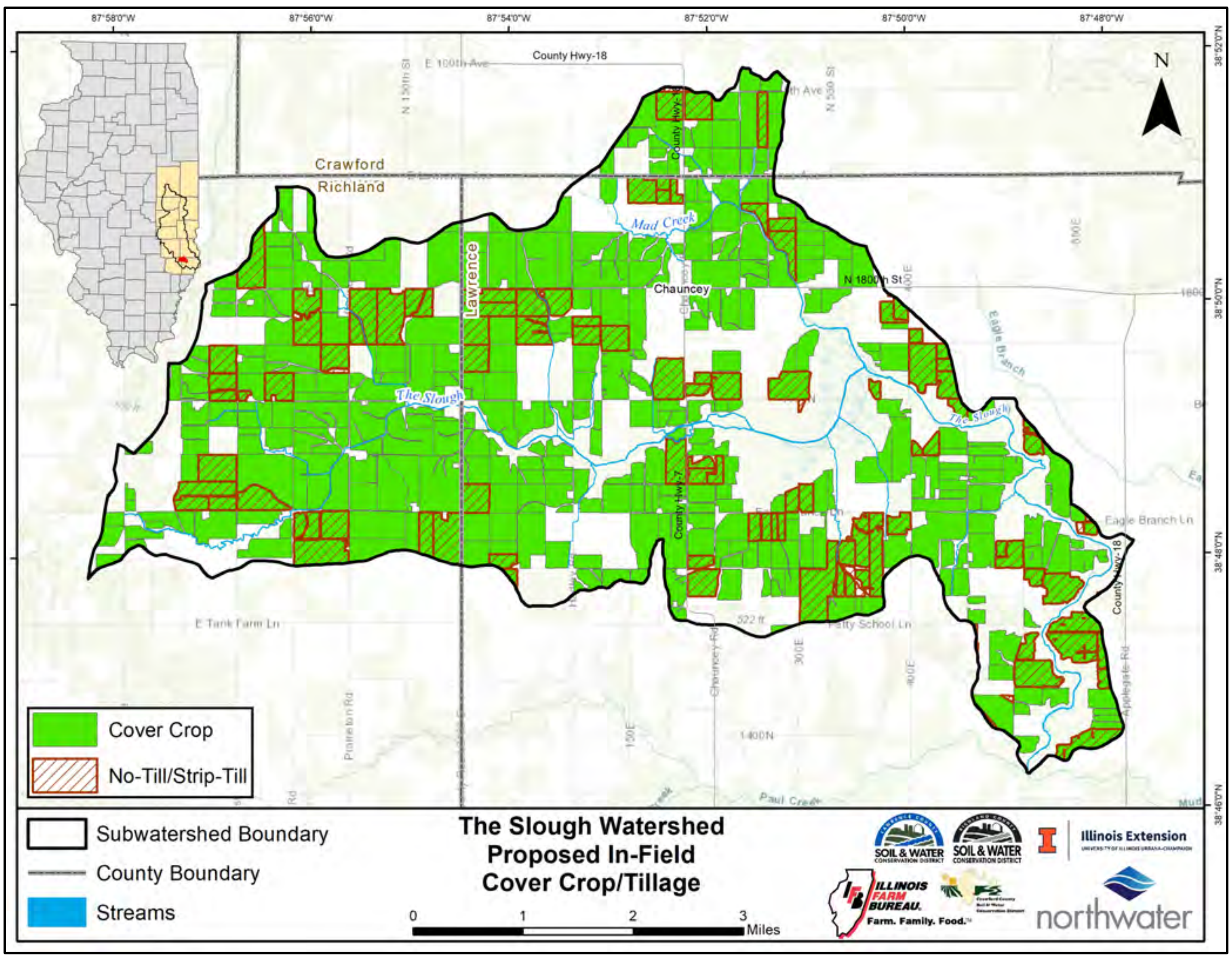


Figure 32 – Proposed BMPs – In-Field Cover Crop/Tillage

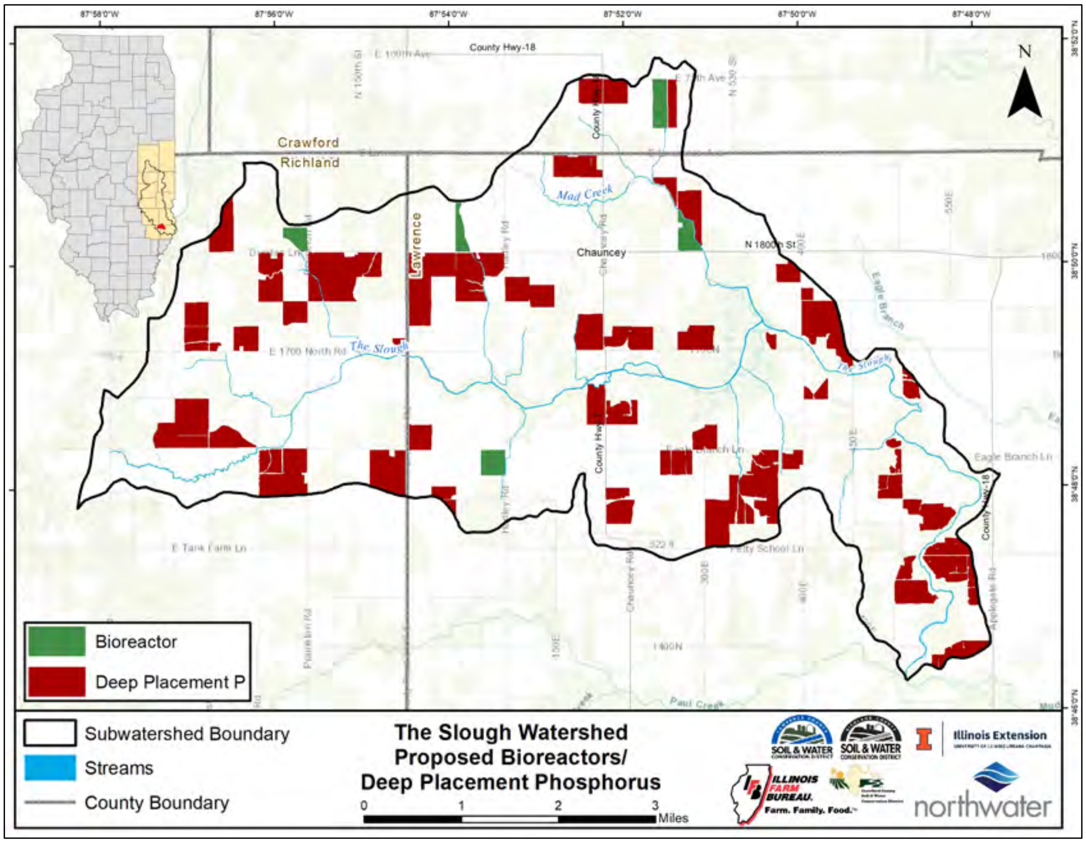


Figure 33 – Proposed BMPs – Bioreactors and In-Field Nutrient Management

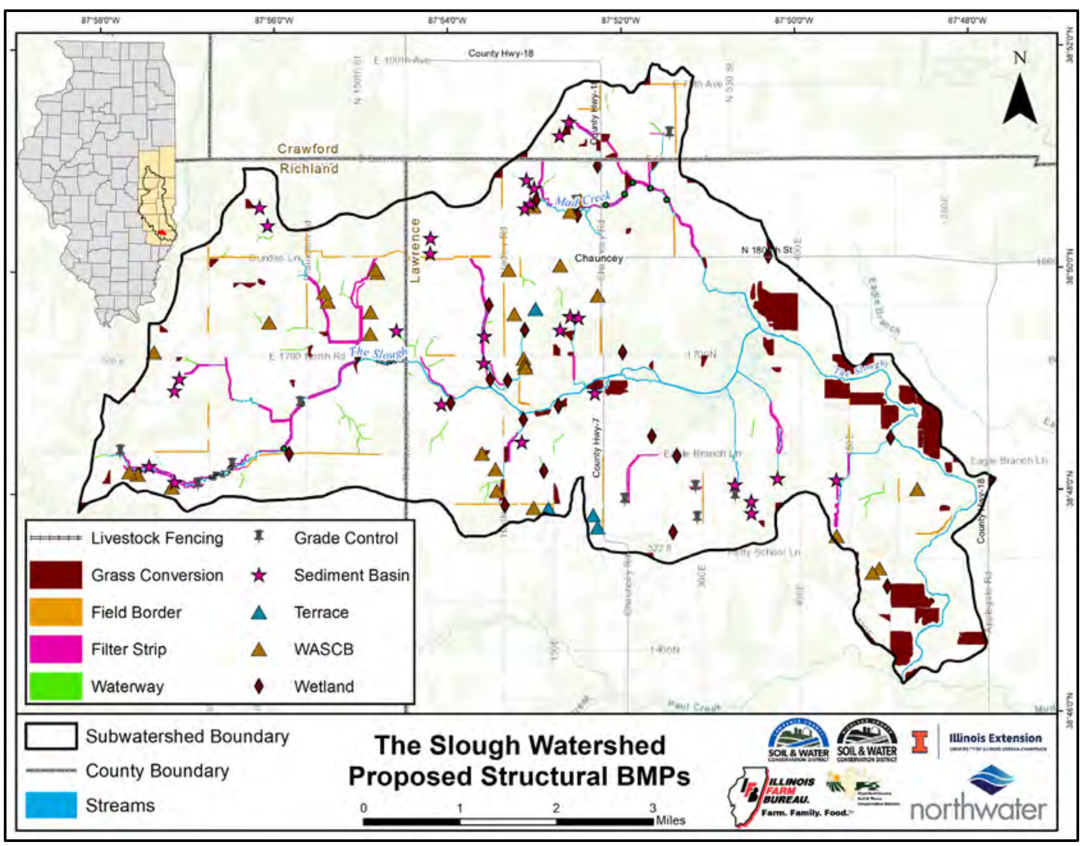


Figure 34 – Proposed Structural BMPs – Agricultural/Non-Urban

6.1.1 Agricultural - In-Field BMP Summary

In-field management measures are critical to achieving water quality targets. These measures focus on nutrient and sediment loading coming from cropland.

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 and are key to addressing nitrogen loading.

Cover Crop in the Watershed

All fields greater than 5 acres not currently in cover crops were selected and are proposed for 438 fields of 11,709 acres. If all acres are planted, the following annual load reductions are expected:

- 33,135 lbs nitrogen
- 6,323 lbs phosphorus
- 4,662 tons sediment

No-Till or Strip-Till

No-Till

No-till can be defined as farming where the soil is left relatively undisturbed from harvest to planting. During the planting operation, a narrow seedbed is prepared, or holes are drilled in which seeds are planted. A switch from conventional tillage to no-till is often a prerequisite for the installation of cover crops. Strip-till is a good alternative to no-till, especially for those producers that are not willing to move to no-till. 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.

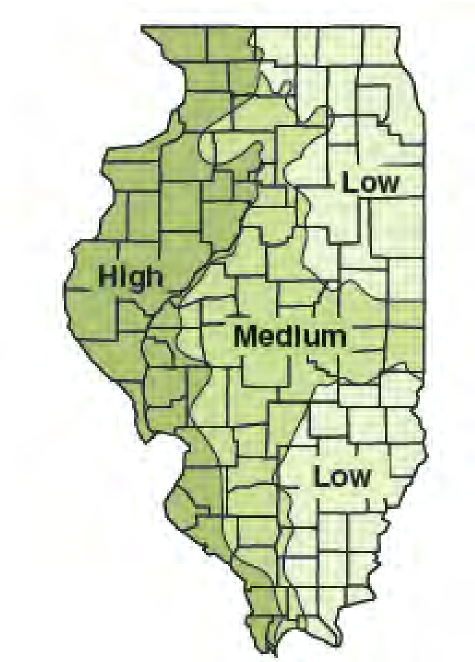
No-till or strip-till is proposed for fields greater than 5 acres in size where conventional, reduced or mulch tillage is employed. A total of 101 fields are recommended covering 2,893 acres. If all acres are treated, the following annual reductions are expected:

- 3,143 lbs nitrogen
- 3,030 lbs phosphorus
- 2,560 tons sediment

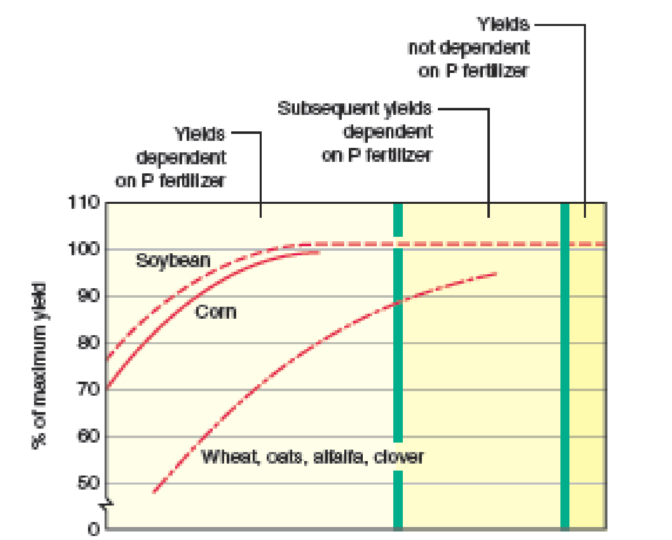
Nutrient Management

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. Nutrient management is a non-structural practice that can be applied to all fields in the watershed, primarily to address nitrogen; it is well-suited to the flat topography and productive nature of soils in the watershed although, if a field is being farmed, nutrient management should be practiced regardless of these factors. The nutrient management system now being promoted by Illinois agricultural organizations 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.



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.



P test (lb/A) for different subsoil phosphorus-supplying power regions

High	7	15	20	40	60
Medium	10	20	30	45	65
Low	20	30	38	50	70

As described in the Chapter 8 of the Illinois Agronomy Handbook, regional differences in P-supplying power shown in the adjacent figure 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. For example, soils developed under forest cover appear to have more available subsoil P than those developed under grass.

Minimum soil test levels required to produce optimal crop yields vary depending on the crop to be grown and the soil's P-supplying power (see adjacent figure). Near maximal yields of corn and soybeans are obtained when levels of available P are maintained at 30, 40, and 45 lbs/ac 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 lbs/ac 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: variable rate technology (VRT) and deep fertilizer placement. Variable rate technology can improve the efficacy of fertilization and promote more environmentally sound placement 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).

Shifting the fall application of nitrogen fertilizer to split applications in the spring can reduce tile nitrate losses by 20% (David, 2018). Split applying nitrogen involves two or more fertilizer applications during the growing season rather than providing all of the crop's nitrogen requirements with a single treatment. This makes nutrient uptake more efficient and reduces the risk of denitrification, leaching or volatilization. Field observations, combined with communication with local producers, indicate that no fall application of nitrogen occurs in the watershed.

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).

Deep Placement – P Fertilizer

Fields greater than 5 acres in size and without a known nutrient management plan were selected for the deep placement of phosphorus fertilizer. If applied to all 101 fields, or 2,893 acres, expected annual load reductions are:

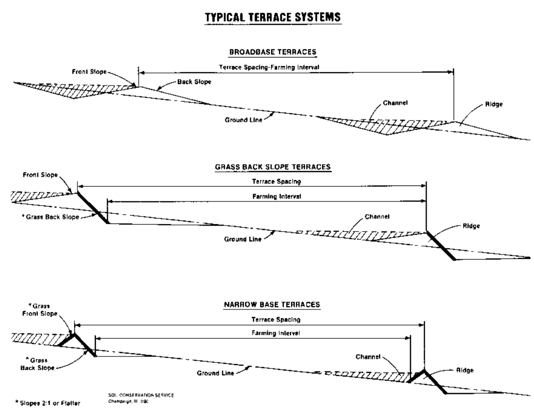
- 1,212 lbs phosphorus

6.1.2 Structural BMP Summary

This section provides a brief description of each structural BMP and their expected load reductions. Practices are for agricultural areas but do include locations in forested areas. For example, several large wetlands are recommended in forested draws or tributaries.

Water and Sediment Control Basins (WASCB) / Sediment Basins

Earth embankment and/or channel constructed across a slope to intercept runoff water and trap soil. WASCBs are often constructed to mitigate gully erosion where concentrated flow is occurring and where drainage areas are relatively small. Multiple basins are often placed along a flow line or at each site depending on drainage area and cropping systems. Similar to a WASCB, a sediment basin will treat a large drainage area. Locations to apply these practices are generally on steeper slopes in the watershed.



NRCS Detail – Terrace/WASCB

WASCBs are recommended at 29 locations, for a total of 92 individual basins and 16,250 feet (175-foot average per basin). This total includes the maintenance of 1 existing system. If all practices are installed, a total of 289 acres will be treated. Expected annual load reductions (including gully stabilization) will total:

- 667 lbs nitrogen
- 323 lbs phosphorus
- 257 tons sediment

Terraces can be applied at 4 locations totaling 3,050 ft. If all are installed, a total of 51 acres will be treated. Expected annual load reductions (including gully stabilization) will total:

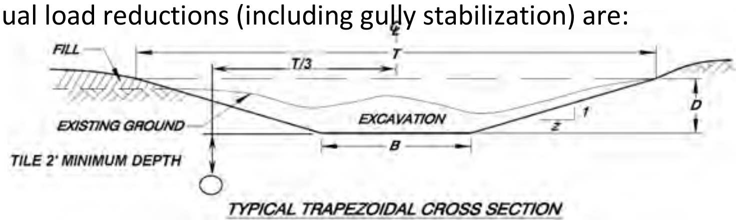
- 129 lbs nitrogen
- 69 lbs phosphorus
- 62 tons sediment

Grassed Waterways

A grass 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 areas with very large drainage areas and low-moderate slopes. These practices are well suited to the watershed.

Grassed waterways are recommended at 34 locations, for a total of 86 acres. If all are installed, a total of 2,197 acres will be treated. Expected annual load reductions (including gully stabilization) are:

- 4,032 lbs nitrogen
- 702 lbs phosphorus
- 843 tons sediment



NRCS Grassed Waterway Detail

Constructed Wetlands/Wetland Restoration

A constructed wetland is a shallow water area built by creating an earth embankment or excavation area. Constructed wetlands can include a water control structure and are designed to mimic natural hydrology, store sediment and filter nutrients. Wetland restoration, on the other hand, aims to improve existing structures or features by expanding their footprint. Wetlands have been identified in areas where soils support their establishment, where local topography does not allow for the construction of a pond, and where no substantial area of cropland is needed to be removed from production. Local watershed studies have shown that wetlands are reasonably efficient at treating nitrogen, especially from tile flow.

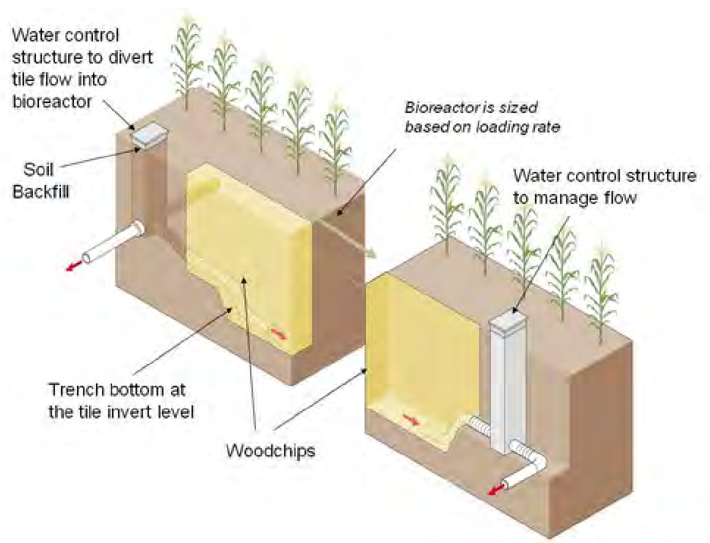
Wetlands have the potential to be important practices for improving water quality. They are recommended at 21 locations, for a total of 77 acres. If all wetlands are implemented, they will treat 5,137 acres and the annual expected load reductions (including gully and streambank stabilization) are:

- 9,218 lbs nitrogen
- 2,251 lbs phosphorus
- 1,417 tons sediment

Constructed Wetland

Denitrifying Bioreactor

A denitrifying bioreactor is a structure containing a carbon source, installed to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via enhanced denitrification. One bioreactor system will treat approximately 50 acres. Locations were identified by direct observation during the watershed windshield survey and by interpretation of aerial imagery and soils.



Bioreactor

Six bioreactors at 6 locations can likely be applied effectively and will treat 220 acres. Annual load reductions expected if all are implemented total:

- 312 lbs nitrogen
- 3.6 lbs phosphorus

Filter Strips, Field Borders, & Conservation Cover

A filter strip 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 strips. Field borders are like filter strips but are located along field edges or adjacent to timbered areas; they can range in width from 30 – 120 feet. Grass conversion or conservation cover plantings consist of removing land from production and planting native vegetation.

Field Border

Field borders are recommended at 65 locations for a total of 76 acres. If all borders are planted, they will treat 1,591 acres. Expected annual load reductions (including gully stabilization) are:

- 1,244 lbs nitrogen
- 787 lbs phosphorus
- 607 tons sediment

Filter Strip

Filter strips are recommended at 101 locations for a total of 131 acres. If all strips are planted, they will treat 1,619 acres. Expected annual load reductions (including gully stabilization) are:

- 2,122 lbs nitrogen
- 1,497 lbs phosphorus
- 1,374 tons sediment

Grass Conversion, or conservation cover plantings, are recommended at 82 locations totaling 609 acres of planting. If all are planted, expected annual load reductions (including gully stabilization) are:

- 4,857 lbs nitrogen
- 813 lbs phosphorus
- 442 tons sediment

Grade Control Structures

A grade control structure consists of a constructed berm, "rock checks" or a rock/modular block structure designed to address gully erosion and control vertical downcutting. These structures are recommended at locations where slopes are very steep and gully erosion is considered very severe; areas where other practices are just not feasible. Rock riffles are also possible at locations where grade control is required and can be used in place of the practices below; rock riffles are described in the streambank stabilization section.

Grade Control Structure – Block Chute

Grade control structures are recommended at 13 locations for a total of 35 individual structures. This includes 6 block chutes and 7 "rock checks". If all are installed, they will treat a total of 446 acres. Expected annual load reductions (including gully stabilization) are:

- 263 lbs nitrogen
- 93 lbs phosphorus
- 188 tons sediment

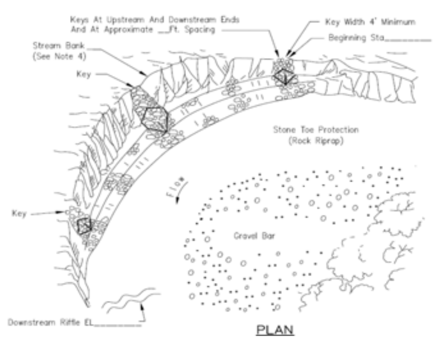
Streambank Stabilization: Stone-Toe Protection & Riffle

Streambank stabilization consists of both the placement of rock riffles and the installation of stone-toe protection (STP) to stabilize eroding streambanks and control stream grade, if necessary. Stream channel incision or deepening can lead to bank erosion and, oftentimes, grade control or rock riffles are needed in combination with STP. Fourteen stream riffles and 830 ft of STP are recommended at 6 locations. Locations were selected based on sediment load, accessibility and cost effectiveness.

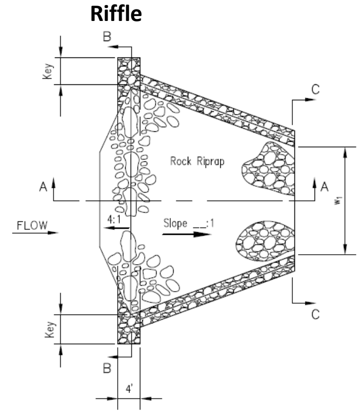
Riffle

If all sites are addressed, annual expected load reductions are:

- 106 lbs nitrogen
- 60 lbs phosphorus
- 91 tons sediment



NRCS STP Detail



NRCS Riffle Detail

Sediment Basins

A sediment basin is water impoundment made by constructing an earthen dam. A sediment basin is similar but designed to trap sediment and only hold water for a limited period. A total of 28 sediment basins are recommended to treat 980 acres. These structures will trap sediment and nutrients from runoff and will control gully erosion in steep forested draws.

If all sediment basins are installed, annual expected load reductions (including gully stabilization) are:

- 882 lbs nitrogen
- 540 lbs phosphorus
- 352 tons sediment

Pasture Management & Stream Fencing

Pasture management consists of stream fencing to exclude livestock from the stream, appropriate stream crossings for cattle use and an alternate water supply (if needed). Stream fencing is placed back from the stream edge to allow for a vegetated buffer to filter runoff.

Stream Fencing

Stream fencing is recommended at 2 pasture locations. Both include stream crossings and water systems. A total of 5,660 ft of fence is recommended.

If each system is installed, 29 acres would be treated. Expected annual load reductions are:

- 117 lbs nitrogen
- 24 lbs phosphorus
- 6.3 tons sediment

7.0 Cost Estimates

Practice costs were calculated based on professional judgment and expertise, cost-share rates provided by the NRCS and SWCD, and unit costs used in other watershed plans. Some of the estimates are based on field visits and known quantities for a given practice. Costs should be considered as estimates only and revisited during implementation, as required. Totals include some level of planning and/or engineering and a contingency for future increases. Maintenance and land acquisition costs are not included.

7.1 Unit Costs

Unit estimates and assumptions are presented in the following table:

Table 35 - Unit Costs & Assumptions

BMP	Unit Cost	Unit	Notes/Assumptions
Bioreactor	$9,500	each	Estimated $63.67 per cubic yard to install, including labor and materials. Based on a surface area of 20' x 50' and a 4' depth, the cost is $9,423.16 for a system sized to treat 50 acres
Cover Crop	$63.74	acre	Based on USDA-NRCS rates. Assumes 1 year of non-winter terminating crop
Field Border	$385	acre	Costs include land preparation, materials and seeding. Estimates do not include any annual rental payments or land acquisition costs
Filter Strip	$225	acre	Costs include land preparation, materials and seeding. Estimates do not include any annual rental payments or land acquisition costs
Grade Control Structure - Block Chute	$10,600	each	Based on professional judgement and USDA-NRCS rates and assumes rock or earth berm structure. Assumes 35' x 35' area
Grade Control Structure – Riffles	$7,000	each	Based on professional judgement and USDA-NRCS rates for "medium" riffles
Grade Control Structure - Rock Check	$3,020	each	Assumes 32 yd^3, based on USDA-NRCS cost share prices
Grass Conversion	$585	acre	Based on USDA-NRCS rates for Critical Area Planting. Includes land prep and seeding. Estimates do not include any annual rental payments or land acquisition costs
Grass Waterway	$4,200	acre	Based on USDA-NRCS rates for shaping and seeding.
Grass Waterway	$4.82	foot	Based on USDA-NRCS rates for waterway tile
No-Till/Strip-Till	$16.41	acre	Based on USDA-NRCS rates
Nutrient Management – Deep Placement P	$62.76	Acre	Based on USDA-NRCS rates. Includes soil testing
Nutrient Management Plan	$10	acre	Based on USDA-NRCS rates up to a maximum of $1,200
Pasture Stream Crossing	5,880	each	Based on professional judgement and USDA-NRCS rates. 30' x 50' ft
Pasture Stream Fencing	$1.96	foot	Based on USDA-NRCS rates

BMP	Unit Cost	Unit	Notes/Assumptions
Pasture Watering System	$50,000	each	Based on professional judgement and includes a source of water (well) and watering infrastructure
Sediment Basin	$14,375	each	Based on USDA-NRCS rates of $5.75 per yd^3 and 2500 yd^3
Streambank Stabilization (Riffle)	$7,000	each	Based on professional judgement and USDA-NRCS rates for “medium” riffles
Streambank Stabilization (STP)	$80	foot	Based on professional judgement and includes some engineering and permitting
Terrace	$4.05	ft length of terrace	Based on USDA-NRCS rates. Length of terrace
Terrace	$2.38	ft tile	Length of tile
Terrace Maintenance	$1000	each	Based on professional judgement.
Water and Sediment Control Basin	$1,920	each	Per basin and an average of 700 yd^3 soil. Based on professional judgement and USDA-NRCS rates.
Water and Sediment Control Basin	$4.82	foot	Water and sediment control basin tile. Based on professional judgement
Wetland Creation	$20,000	acre	Includes earthwork and seeding. Based on professional judgement and USDA-NRCS rates
Wetland Creation	$3,000	each	For water control structure and tile. Based on professional judgement and USDA-NRCS rates

7.2 Total Cost

Table 36 below provides a detailed breakdown of cost estimates for each BMP type and the cost per unit of loading reduced. The total of implementing all BMPs is estimated to be $5,113,311. These practices, (excluding very high cost or very low reduction for specific nutrient), average per pound of nitrogen removed is $405, phosphorus $653, and the average cost for a ton of sediment is $894. It should be noted that average cost increases substantially when exceptionally high value practices are incorporated (Table 36).

Per pound of nitrogen reduction, filter strips, conversion to no-till or strip-till, cover crops, and field borders are the most effective, followed by nutrient management, grass conversion, terraces, and grass waterways. Conversion to no-till or strip-till, filter strips and field borders are the most cost effective for phosphorus reduction, followed by cover crop and nutrient management. Conversion to no-till or strip-till, filter strips, and field borders are the most effective for reducing sediment. Those structural practices that treat larger drainage areas, such as wetlands and grassed waterways, will generate higher volume reductions.

In addition to the costs presented in this section for BMP implementation, there will be costs associated with outreach and addressing septic systems through education campaigns. It is estimated that 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.

Table 36 – BMP Cost Summary by BMP Type

BMP Class	BMP	Quantity	Total Cost	Cost/lb Nitrogen Reduction	Cost/lb Phosphorus Reduction	Cost/ton Sediment Reduction
In-field Practices	Cover Crop	11,709 (ac)	$746,307.52	$22.52	$118.03	$160.08
	No-Till/ Strip-Till	2,893 (ac)	$47,470.19	$15.10	$15.67	$18.55
	Nutrient Management - Deep Placement P	2,893 (ac)	$210,477.23	n/a	$173.68	n/a
In-field Practices Subtotal/ Av. BMP Reduction Cost			***$1,004,254.94***	***$12.54***	***$102.46***	***$89.31***
Structural Practices	Bioreactor	6 (locations), 12 (structures)	$114,000	$365.04	$31,868.68	n/a
	Field Border	65 (locations), 76 (ac)	$29,157.05	$23.44	$37.05	$48.04
	Filter Strip	101 (locations), 131 (ac)	$29,486.17	$13.89	$19.69	$21.46
	Grade Control - Block Chute	6 (locations), 7 (structures)	$74,200.00	$1,343.37	$4,101.91	$3,194.41
	Grade Control - Rock Check	7 (locations), 28 (structures)	$84,560.00	$405.70	$1,130.38	$511.63
	Grass Conversion	82 (locations), 609 (ac)	$355,013.67	$73.10	$436.73	$803.28
	Livestock Management and Pasture Stream Fencing	2 (locations), 2 (crossing), 2 (water system)	$122,853.84	$1,053.15	$5,092.77	$19,491.94
	Sediment Basin	28 (locations)	$704,375.00	$798.69	$1,304.35	$2,002.86
	Streambed Stabilization	6 (locations), 14 (riffles) 830 (ft. STP)	$163,790.86	$1,548.65	$2,724.68	$1,806.30
	Terrace	4 (locations), 3,050 (ft. terrace), 1,700 (ft. tile)	$16,398.50	$126.95	$237.79	$264.29
	WASCB	29 (locations), 92 (structures), 16,250 (ft. tile)	$254,005.00	$380.88	$786.81	$988.08
	Grassed Waterway	34 (locations), 86 (ac), 42,775 (ft. tile)	$568,215.50	$140.92	$809.53	$673.85
	Wetland	21 (locations), 77 (ac)	$1,593,000.00	$172.81	$707.82	$1,124.05
Structural Practices Subtotal/ Av. BMP Reduction Cost			***$4,109,055.60***	***$495.89***	***$1,116.74***	***$1,039.84***
Grand Total/ Av. BMP Reduction Cost			**$5,113,310.54**	**$405.26**	**$653.04**	**$893.61**

8.0 Water Quality Targets

This section describes water quality targets and those implementation actions required to meet them. The primary constituents of concern in The Slough are phosphorus, sediment and nitrogen. The Illinois Nutrient Loss Reduction Strategy calls for a 15% interim goal or reduction in nitrogen by 2025, while the Gulf Hypoxia Action Plan (2008, updated in 2015) calls for a 20% reduction by 2025 to address and reduce the hypoxic zone and achieve plan goals. Similarly, the ILNRS calls for a 25% interim goal or reduction in phosphorus loadings by 2025, while the Gulf Hypoxia Action Plan calls for a 20% reduction to achieve plan goals by 2025. Both the INLRS and the Gulf Hypoxia Action Plan have a long-term goal of 45% reduction for both nitrogen and phosphorus. The Slough targets of a 45% reduction in phosphorus and sediment and a 45% reduction in nitrogen are consistent with the INLRS long-term goal. The 45% sediment target is set to match the phosphorus.

Table 37 compares BMPs to targets. Results indicate that widespread and overlapping in-field and structural BMP implementation will meet, or exceed, targets with the exception of nitrogen. It should be noted that reductions do not account for the cumulative effect of upstream practices and, therefore, the totals achieved will likely be somewhat lower if all recommended practices are considered as a "system." It is estimated that this situation could reduce estimates by up to 30%. Despite this, it is still reasonable to assume that targets can be met or exceeded for sediment and phosphorus. Structural and in-field management practices recommended in this plan may not achieve the 45% reduction target for nitrogen. Additional conversion of crop ground to natural cover, such as native grasses, is therefore likely needed. It is estimated that 5,647 acres of grass conversion is needed to achieve the target and generate the additional annual 41,678 pounds of nitrogen reduction.

Cover crops, conversion to no-till or strip-till, wetlands, and field borders/filter strips, will likely provide the greatest potential for reductions. Combined, in-field practices will achieve significantly greater reductions in both sediment and nutrients compared to structural (Table 37). In-field management is less costly on an annual basis but requires a long-term commitment and landowner buy-in to ensure benefits are realized over multiple years.

Table 37 –Water Quality Targets & Load Reductions

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (% Total Load)	Phosphorus Reduction (% Total Load)	Sediment Reduction (% Total Load)
In-field Practices	Cover Crop	11,709 (ac)	11,709	24%	24%	31%
	No-Till/ Strip-Till	2,893 (ac)	2,893	2%	11%	17%
	Nutrient Management - Deep Placement P	2,893 (ac)	2,893	0%	5%	0%
In-Field Practices Subtotal			17,494	27%	40%	48%
Structural Practices	Bioreactor	6 (locations), 12 (structures)	220	0.2%	0.01%	0%
	Field Border	65 (locations), 76 (ac)	1,591	0.9%	3.0%	4.0%

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (% Total Load)	Phosphorus Reduction (% Total Load)	Sediment Reduction (% Total Load)
	Filter Strip	101 (locations), 131 (ac)	1,619	1.6%	5.6%	9.1%
	Grade Control - Block Chute	6 (locations), 7 (structures)	236	0.04%	0.1%	0.2%
	Grade Control - Rock Check	7 (locations), 28 (structures)	210	0.15%	0.3%	1.1%
	Grass Conversion	82 (locations), 609 (ac)	609	3.6%	3.1%	2.9%
	Livestock Management and Pasture Stream Fencing	2 (locations), 2 (crossing), 2 (water system)	29	0.09%	0.1%	0.04%
	Sediment Basin	28 (locations)	980	0.6%	2.0%	2.3%
	Streambed and Bank Stabilization	6 (locations), 14 (riffles) 830 (ft. STP)	n/a	0.08%	0.2%	0.6%
	Terrace	4 (locations), 3,050 (ft. terrace), 1,700 (ft. tile)	51	0.1%	0.3%	0.4%
	WASCB	29 (locations), 92 (structures), 16,250 (ft. tile)	289	0.5%	1.2%	1.7%
	Waterway	34 (locations), 86 (ac), 42,775 (ft. tile)	2,197	3.0%	2.6%	5.6%
	Wetland	21 (locations), 77 (ac)	5,137	6.8%	8.5%	9.4%
Structural Practices Subtotal			***13,170***	***18%***	***27%***	***37%***
Grand Total			**31,339**	**14% - 44% (target not met)[1]**	**37% - 67% (target likely exceeded)[1]**	**55% - 85% (target exceeded)[1]**

[1] – A range is provided to account for the cumulative effects of BMPs implemented as a "system"

9.0 Critical Areas

Critical areas are those BMP locations throughout the watershed where implementation activities should be prioritized. This includes locations targeted for in-field and structural practices. In-field management practices will provide the greatest "bang-for-the-buck" and benefit to water quality. They will improve soil structure and health, and overall farm profitability. Structural practices, although more costly upfront, will prove benefits over multiple years and address locations where other measures are infeasible. Critical areas focus on maximizing reductions primarily in sediment and nitrogen. Those that address phosphorus also maximize sediment reductions.

9.1 In-Field Management Measures

In-field practices recommended are nutrient management, no-till/strip-till, and cover crops. Critical areas are primarily based on expected sediment and nutrient load reductions. Specific selection criteria are provided by management practice type and are discussed in the following subsections.

9.1.1 Nutrient Management

Critical areas for nutrient management were selected based on the practices with lowest cost per pound reduced. As listed in Table 38 and depicted in Figure 35, critical areas are expected to achieve 42% of the total phosphorus reductions associated with these practices while only encompassing 18% of the recommended acres.

Deep placement of phosphorus fertilizer – fields that cost less than $130 per lb phosphorus reduced. This represents a total of 515 acres, or 16 fields.

Table 38 - Critical Areas - Nutrient Management

Critical Practice	Quantity	Total Nitrogen Reduction (lbs/yr)	Total Phosphorus Reduction (lbs/yr)	Percent of Total Practice Reduction - Nitrogen	Percent of Total Practice Reduction - Phosphorus
Nutrient Management – Deep Placement P	515 (ac)	0	514	n/a	42%

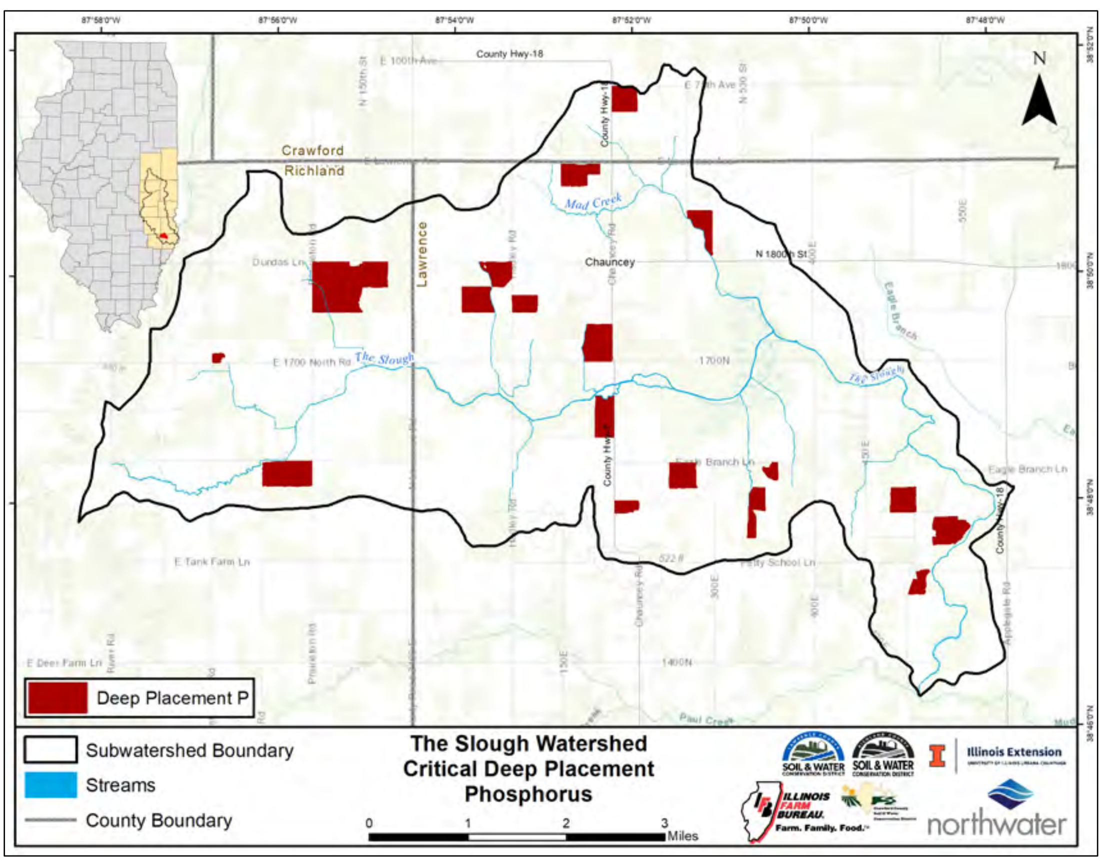


Figure 35 - Critical Areas - In-Field Nutrient Management

9.1.2 No-till or Strip-Till

No-till or strip-till critical areas were selected as those fields costing less than $13 per ton sediment reduced. A total of 15 fields, or 523 acres, were selected. If implemented, annual reductions of 858 lbs of nitrogen, 903 lbs phosphorus, and 916 tons of sediment are expected. As listed in Table 39 and depicted in Figure 36, critical areas for no-till or strip-till are expected to achieve 27% of the total nitrogen, 30% of the total phosphorus and 36% of the total sediment reductions associated with these practices, while only encompassing 18% of the total recommended acres.

9.1.3 Cover Crops

Cover crop critical areas were selected as those fields costing less than $70 per pound of phosphorus reduced. A total of 44 fields, or 1,043 ac, were selected. If implemented, annual reductions of 5,352 lbs of nitrogen, 1,136 lbs of phosphorus, and 1,050 tons of sediment are expected. As listed in Table 39 and depicted in Figure 36, critical areas for cover crops are expected to achieve 16% of the total nitrogen, 18% of the total phosphorus and 23% of the total sediment reductions associated with these practices, while only encompassing 9% of the total recommended acres.

No-till/strip-till critical areas were selected as those fields costing less than $13 per ton sediment reduced. A total of 15 fields, or 523 ac, were selected. If implemented, annual reductions of 858 lbs of nitrogen, 903 lbs of phosphorus, and 916 tons of sediment are expected. As listed in Table 39 and depicted in Figure 36, critical areas for no-till/strip-till are expected to achieve 27% of the total nitrogen, 30% of the total phosphorus and 36% of the total sediment reductions associated with these practices, while only encompassing 18% of the total recommended acres.

Table 39 – Critical Area – Tillage & Cover Crop

Practice	Quantity	Total Nitrogen Reduction	Total Phosphorus Reduction	Total Sediment Reduction	% Total Practice Load Reduction Nitrogen	% Total Practice Load Reduction Phosphorus	% Total Practice Load Reduction Sediment
Cover Crop	1,043 (ac)	5,352	1,136	1,050	16%	18%	23%
No-Till/Strip-Till	523 (ac)	858	903	916	27%	30%	36%
Grand Total		**6,210**	**2,039**	**1,965**	**17%**	**22%**	**27%**

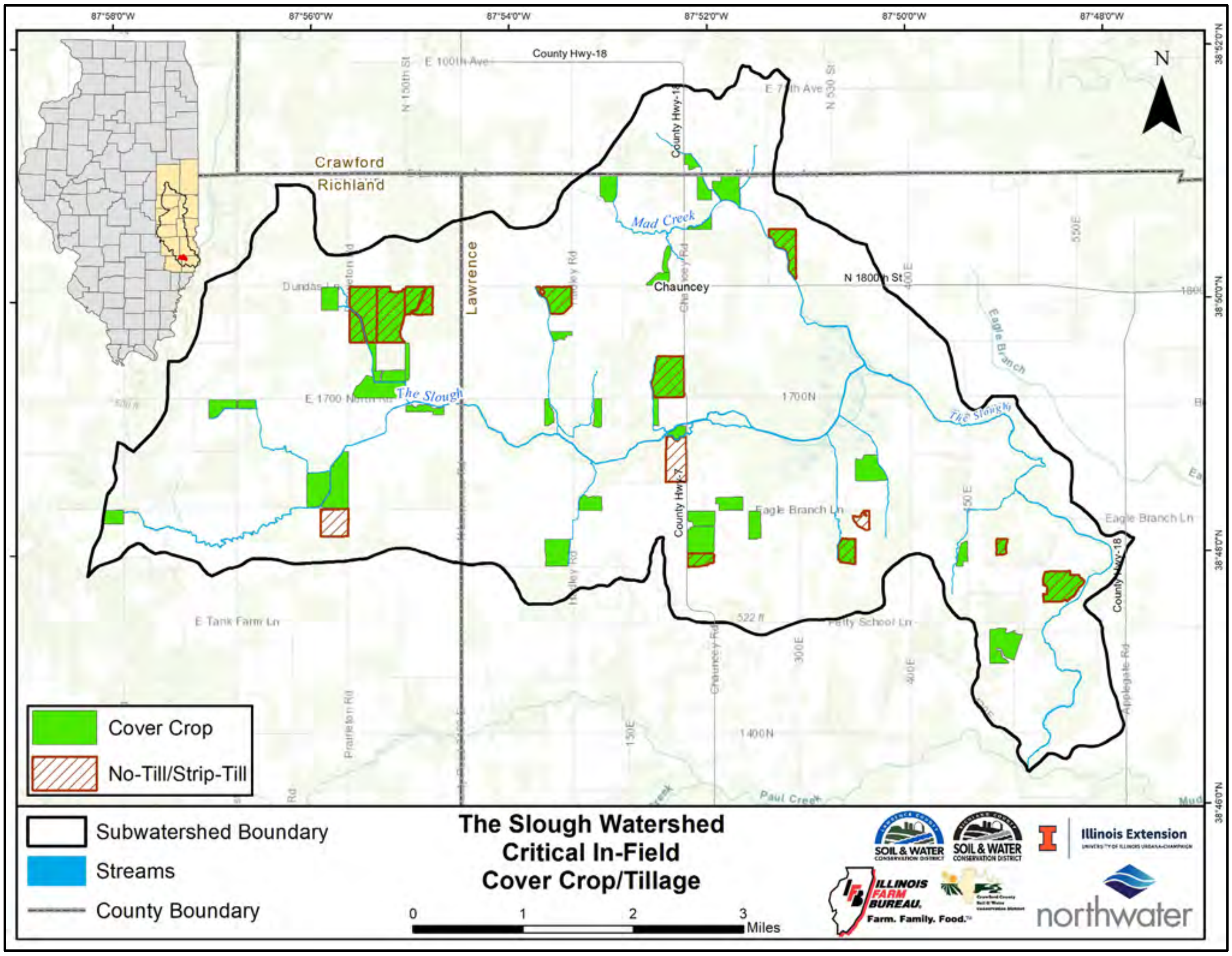


Figure 36 - Critical Areas - In-Field Cover Crop & No-Till/Strip-Till

9.2 Structural BMPs

A selection of structural practices are prioritized for implementation throughout the watershed and classified as critical (Table 40, Figure 37). Selection criteria included cost/benefit, or the amount of sediment or nutrients reduced per dollar of expenditures, greatest total expected load reductions and feasibility for implementation. If all critical structural practices are implemented, 38% of the total nitrogen, 28% of the phosphorus, and 40% of the sediment reductions associated with all recommended structural practices will be achieved.

Critical bioreactors – one site was selected based on the greatest expected nitrogen reduction. This site treats 36 acres.

Critical grass waterway – five locations were selected based on being the highest nitrogen loading practices. These waterways total 29 acres and treat 720 acres.

Critical field borders and filter strips – for field borders, those fields that cost less than $25 per ton sediment reduced. Eight sites were selected for a total of 8 acres to treat 374 acres. For filter strips, those that cost $12 or less per ton of sediment reduced. A total of 14 sites were selected, or 17 acres to treat 226 acres.

Critical grade control – Block Chute – one site and 2 structures were chosen based on the largest expected sediment reduction.

Critical grade control – Rock Check – one site and 4 structures were chosen based on the largest expected sediment reduction.

Critical grass conversion – are those locations that cost less than $275 per ton sediment reduced. Nine fields for a total of 29 acres were selected.

Critical livestock management – the pasture that will generate the greatest total reductions was selected. It will treat 81 acres and generate 70% of the total reductions associated with both recommended sites.

Critical sediment basins – locations were chosen based on cost per ton sediment reduced. At a cost of less than $1,400/ton, 4 sites were selected to treat 29 acres.

Critical streambank – Riffles – one stream segment was chosen due to having the greatest total loading. This practice is responsible for 34% of total practice sediment loading.

Critical terrace – one site was chosen as critical based on the greatest expected load reduction. If implemented, this practice will treat 19 acres.

Critical WASCB – sites were selected based on the greatest total reductions and low cost per ton sediment reduced. Five locations were chosen. If implemented, these critical practices will treat 102 acres.

Critical wetlands – are those that cost less than $152 per pound nitrogen reduced. A total of 3 sites are considered as critical. If implemented, these practices will treat 3,571 acres.

Table 40 - Critical Area - Structural Practices

Practice	Quantity	Total Nitrogen Reduction	Total Phosphorus Reduction	Total Sediment Reduction	% Total Practice Reduction Nitrogen	% Total Practice Reduction Phosphorus	% Total Practice Reduction Sediment
Bioreactor	1 (locations), 2 (structures)	63	1	0	20%	19%	n/a
Field Border	8 (locations), 8 (ac)	334	211	152	27%	27%	25%
Filter Strip	14 (locations), 17 (ac)	347	317	374	16%	21%	27%
Grade Control - Block Chute	1 (locations), 2 (structures)	32	12	10	59%	66%	44%

Practice	Quantity	Total Nitrogen Reduction	Total Phosphorus Reduction	Total Sediment Reduction	% Total Practice Reduction Nitrogen	% Total Practice Reduction Phosphorus	% Total Practice Reduction Sediment
Grade Control - Rock Check	1 (locations), 4 (structures)	71	44	108	34%	59%	65%
Grass Conversion	9 (locations), 29 (ac)	418	97	86	9%	12%	20%
Livestock Management	1 (location), 1 (crossing), 1 (water system) 1,932 (ft. fencing)	81	18	6	70%	73%	88%
Sediment Basin	4 (locations)	162	118	102	18%	22%	29%
Streambank Stabilization - Riffles	1 (locations), 4 (riffles)	31	27	31	30%	45%	34%
Terrace	1 (locations), 750 (ft. terrace), 200 (ft. tile)	45	23	17	35%	33%	27%
WASCB	5 (location), 15 (structures), 2,750 (ft. tile)	218	105	81	33%	32%	32%
Grassed Waterway	5 (location), 29 (ac), 14,350 (ft. tile)	1,300	235	335	32%	33%	40%
Wetland	3 (locations), 21 (ac)	6,051	1,527	939	66%	68%	66%
Grand Total		**9,156**	**2,734**	**2,240**	***38%***	***28%***	***40%***

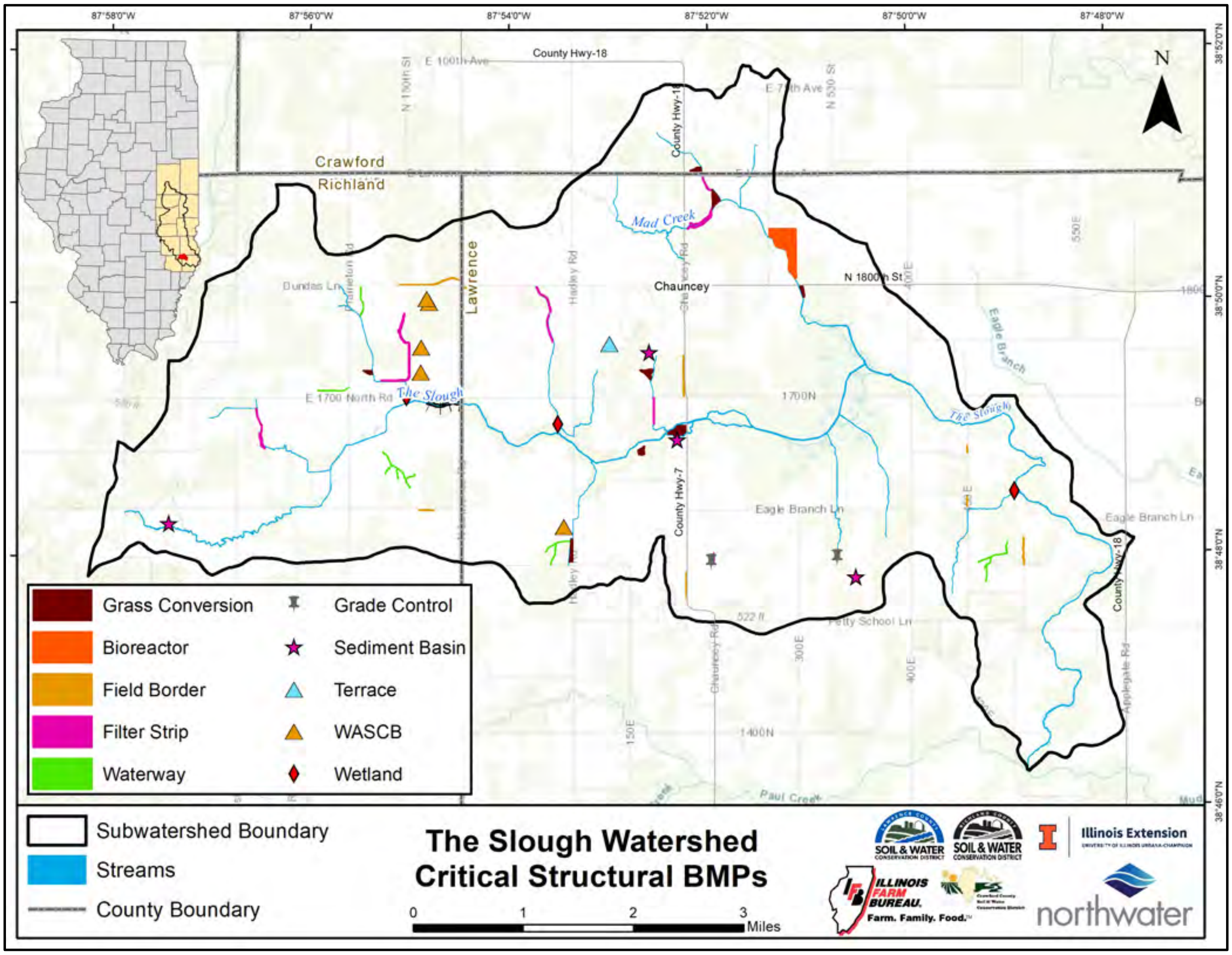


Figure 37 – Critical Areas – Structural Practices

10.0 Technical & Financial Assistance

Watershed plan implementation is largely based on the availability of funding and technical assistance for projects and other plan recommendations. Resources to help execute projects in The Slough watershed are potentially available through a variety of entities, both public and private. Conservation technical assistance, financial assistance for practice implementation, and other in-kind contributions to efforts are available through a variety of publicly accessible programs at the local, regional, state, and federal levels of government - including USEPA Section 319 grants. Technical or financial assistance may also be available through non-profit organizations or private professional consultants such as Certified Crop Advisers (CCA) or Technical Service Providers (TSP), which many producers rely upon.

It is important to remember that implementation of practices recommended in the plan is completely voluntary. Therefore, primary responsibility for implementation lies with the landowner. Any agency or entity also providing a role in implementation will need to work with willing landowners as the entities do not have the primary decision-making authority.

Entities listed below are potentially available for technical or financial assistance. For those that can provide funding specific to The Slough watershed, descriptions of the programs or financial assistance mechanisms are provided. This list of technical and financial resources is not all-inclusive, and some of the resources may not be available on the subwatershed scale or for the duration of the plan.

American Farmland Trust (AFT)

The mission of AFT is to protect farmland, promote sound farming practices, and keep farmers on the land. The AFT advocates for programs and policies that protect farmland, food, and the environment, and conduct education and outreach and promote conservation.

Ducks Unlimited (DU)

Ducks Unlimited is an American nonprofit organization 501(c) dedicated to the conservation of wetlands and associated upland habitats for waterfowl, other wildlife, and people. Ducks Unlimited takes a continental, landscape approach to wetland conservation. Since 1937, DU has conserved almost 15 million acres of waterfowl habitat across North America. While DU works in all 50 states, the organization focuses its efforts and resources on the habitats most beneficial to waterfowl.

Illinois Clean Energy Foundation

The Illinois Clean Energy Community Foundation was established in December 1999 as an independent foundation with a $225 million endowment provided by Commonwealth Edison. Their mission is to improve energy efficiency, advance the development and use of renewable energy resources, and protect natural areas and wildlife habitat in communities across Illinois. Over the past sixteen years, the Foundation has provided financial support for clean energy investments in Illinois through a variety of programs. The Illinois Clean Energy Community Foundation has six categories within their Natural Areas Program for funding. Categories that could potentially be applicable to watershed planning and the broader mission of conservation include Capacity Building, Community Stewardship Challenge Grant, Land Acquisition, and Planning for Land Acquisition.

Illinois Corn Growers Association (ICGA)

Established in 1972, ICGA is a grassroots membership organization with approximately 5,000 members. ICGA also runs the Precision Conservation Management Program described in greater detail in following sections.

Illinois Department of Agriculture (IDOA)

The IDOA Bureau of Land and Water Resources distributes funds to Illinois' 97 SWCDs 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 to tolerable levels.

Partners for Conservation Program (PFC)

The PFC program, formerly known as CPP, is a long-term, state-supported initiative to protect natural resources and enhance outdoor recreational opportunities in Illinois. Through this program, several state agencies share responsibility for administering the funds, with IDOA overseeing the program's agriculture-related components. The program promotes the construction or adoption of practices that conserve soil and protect water quality. The PFC program provides funding for the following agriculture-related programs: the sustainable agriculture grant program, the conservation practices cost-share program, the stream bank stabilization and restoration program, and the soil and water conservation district grants program. Through these programs, cost-share assistance may be available for practices such as waterways, cover crops, and sealing of abandoned wells.

Stream Bank Stabilization and Restoration Program (SSRP)

The SSRP provides cost-share assistance or demonstration project funding to landowners who implement streambank stabilization projects that demonstrate effective and inexpensive solutions to soil and stream bank erosion. Funding partners for this program are the IDOA, Illinois' SWCDs, and USDA-NRCS. Recipients must maintain the selected bank stabilization practices for at least 10 years.

Sustainable Agricultural Grant Program

This program provides funding to organizations, educational institutions, nonprofits, governmental agencies, and individuals who demonstrate comprehension of sustainable agriculture systems and implement conservation practice projects. Illinois' SWCDs prioritize and select projects that will receive cost-share funding. To be eligible, the land on which the conservation practice is to be applied must have erosion rates greater than one and one-half times the tolerable soil loss level, which varies by soil type.

Vegetative Filter Strip Assessment Law

On January 1, 1997, the Vegetative Filter Strip Assessment Law (35ILCS 200/10-152) became effective. The Vegetative Filter Strip Assessment Law provides tax incentives for the development of filter strips for the primary reason of reducing soil erosion. Qualifying vegetative filter strips must meet NRCS standards and specifications to be assessed at a reduced rate. Soil and Water Conservation Districts hold authority in certifying vegetative filter strips meet NRCS requirements.

Illinois Department of Natural Resources (IDNR)

The IDNR provides technical assessments of streams for the IDOA's SSRP. The request for local assessment assistance comes through local county SWCDs. The 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 Emergency Management Agency (IEMA)

The primary responsibility of the IEMA is to better prepare the State of Illinois for natural, manmade or technological disasters, hazards, or acts of terrorism. Relevant to watershed planning, this responsibility includes flood mitigation and response. The IEMA coordinates the State's disaster mitigation, preparedness, response and recovery programs and activities, functions as the State Emergency Response Commission, and maintains a 24-hour Communication Center and State Emergency Operations Center. The IEMA assists local governments with multi-hazard emergency operations plans and maintains the Illinois Emergency Operations Plan and administers several grant programs.

Illinois Environmental Protection Agency (Illinois EPA)

The Illinois EPA Bureau of Water is committed to ensuring that Illinois' rivers, streams, and lakes will support all uses for which they are designated including protection of aquatic life, recreation, drinking water supply and fish consumption. The Bureau of Water provides several loan and grant programs designed to upgrade existing and build new wastewater, stormwater treatment and public water supply infrastructure, reduce nonpoint source pollution, conduct green infrastructure projects, and protect and restore Illinois' inland lakes and streams, including programs led by the Watershed Management Section, such as the Section 319 program.

Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program

Funds may be used for the development, update, and implementation of watershed-based management plans including the development of information/education programs and for the installation of best management practices. Section 319 requires a minimum 40% match and is a reimbursement program.

Clean Water State Revolving Fund and Drinking Water State Revolving Fund

This program funds green projects, wastewater treatment, NPS, watershed management, restoration, and protection of groundwater. Also included is the Water Pollution Control Loan Program and the Public Water Supply Loan Program that supports wastewater and drinking water infrastructure improvements and stormwater–related projects that benefit water quality [e.g., green infrastructure, water and energy efficiency improvements, other environmentally innovative activities as directed by federal law (see 33 U.S. code 1274)].

Green Infrastructure Grant Opportunities Program (GIGO)

is funded through the Rebuild Illinois Capital Plan. The Agency seeks proposals for projects to construct green infrastructure best management practices (BMPs) that prevent, eliminate, or reduce water quality impairments by decreasing stormwater runoff into Illinois' rivers, streams, and lakes. Projects that implement treatment trains (multiple BMPs in series) and/or multiple BMPs within the same watershed may be more effective and efficient than a single large green infrastructure BMP.

Illinois Farm Bureau (IFB)

Since 1916, IFB has provided education and information to help farmers, while supporting legislation and lobbying efforts about agricultural issues. Founded by farmers as the Illinois Agricultural Association, one of the first activities of the new organization was to bring soil and crop specialists to each county to supply farmers with the latest agricultural research information and recommendations. In more recent years, the IFB Board of Directors has set environmental action as an organization priority, which includes supporting watershed planning and implementation projects, following through by committing significant resources to do the job. The IFB specifically supports watershed planning by committing financial match and in-kind resources, as well as developing resources and programs for County Farm Bureaus (CFB) throughout the state.

Illinois Soybean Association

The Illinois Soybean Association 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 primary roles: the state soybean checkoff and legislative and regulatory advocacy efforts. The Association supports watershed planning efforts by promoting watershed events, completing farmer profiles, and providing media coverage of watershed events.

Illinois Stewardship Alliance (ISA)

The 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. Staff can assist with landowner outreach and education programs related to conservation.

Illinois Sustainable Ag Partnership (ISAP)

Illinois Sustainable Ag Partnership's 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.

Lumpkin Family Foundation

The Lumpkin Family Foundation's mission is to support education, preserve and protect the environment and foster opportunities for leadership, with special consideration to Central Illinois. They accomplish this mission through several grant programs, two of which most-closely align with the implementation of The Slough – Embarras River Watershed Management Plan: Nature-Based Climate Action Program and Land, Health, Community.

McKnight Foundation

The McKnight Foundation uses their resources to "restore the water quality and resilience of the Mississippi River." It provides funding support for projects and management practices that restore and protect floodplains and wetlands and reduce agricultural pollution within the Mississippi River Basin including Illinois.

National Fish and Wildlife Foundation (NFWF)

The NFWF supports conservation support in all 50 states and US territories. Their projects are rigorously evaluated and awarded to some of the nation's largest environmental organizations, as well as some of the smallest. The NFWF focuses on bringing all partners to the table, getting results, and building a future for our world.

5 Star Wetland and Urban Waters Restoration Grant Program

Environmental education and training for students, conservation corps, youth groups, citizen groups, corporations, landowners, and government agencies through projects that restore wetlands and streams.

National Great Rivers Research and Education Council (NGRREC)

The NGRREC was formed in 2002 from a unique partnership between the Illinois National History Survey, University of Illinois at Urbana-Champaign and Lewis and Clark Community College. The NGRREC is dedicated to the study of great river systems and the communities that use them. Most relevant to The Slough - Embarras River watershed is their goal of continuing research and policy development and promoting adaptive management to continuously improve strategies by applying new knowledge learned to ongoing sustainable management practices.

National Wild Turkey Federation

National Wild Turkey Federation's mission is to ensure robust wild turkey populations, while benefiting healthy forests, waterways, and communities, and championing the soul of the American hunting lifestyle. While most of their programs and outreach revolve around the mission to preserve our hunting heritage, programs also are offered that focus on the conservation of the wild turkey and the overall education on the need for Healthy Habitats for all wildlife species.

National Wildlife Federation

The common agenda for National Wildlife Federation is to increase America's fish and wildlife population and expand their capacity. It also aims to protect wildlife habitats by restoring damaged habitats which include protected lands, working lands, waterways, coasts, and communities. The National Wildlife Federation is involved in many environmental issues, particularly in the areas of land stewardship, air quality, water resources, and wildlife conservation.

Pheasants Forever and Quail Forever

Pheasants Forever and Quail Forever is a non-profit, grassroots, volunteer, membership-based organization. Members are a diverse group of hunters, farmers, ranchers, landowners, conservation enthusiasts, and wildlife officials. Pheasants Forever's mission is to conserve pheasants, quail, and other wildlife through habitat improvements, public access, education, and conservation advocacy.

Precision Conservation Management (PCM)

Precision Conservation Management 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. Specialists with PCM work with farmers to identify conservation needs and use data from agronomic management practices, economic models, and sustainability metrics to develop customized solutions.

Soil & Water Conservation Districts (SWCD) – Lawrence and Richland County

Soil & Water Conservation Districts provide education leadership and assistance to protect and to promote the wise use of natural resources, including soil, water, air, plant, and animal. They host educational events and seminars, provide landowners and operators with free technical assistance on different conservation issues, and partner with local, state, and federal sources to provide information for landowners and operators in the county that they serve. County SWCDs also administer several cost-share programs, in partnership with other entities including IDOA.

Trees Forever

A nonprofit charitable organization headquartered in Marion, Iowa, with a mission to plant and care for trees and the environment by empowering people, building community, and promoting stewardship. To date, they have helped plant more than 3 million trees and shrubs throughout Iowa and Illinois.

Illinois Buffer Partnership

Promotes and provides cost-share funding to the voluntary conservation efforts of Illinois farmers and landowners with the goal of improving water, air, and soil quality. Buffer projects help to reduce erosion, sequester carbon, provide wildlife and pollinator habitat, and can also create additional income for landowners. This program is a collaborative partnership of Trees Forever, GROWMARK, state and federal government agencies, Trees Forever members and participating landowners.

United States Army Corps of Engineers

The United States Army Corps of Engineers (USACE) works in partnership with other federal and state agencies, non-governmental organizations, and academic institutions to find innovative solutions to challenges that affect everyone – sustainability, climate change, endangered species, environmental cleanup, ecosystem restoration and more.

Continuing Authorities Program (CAP)

At the Federal level, the USACE Continuing Authorities Program (CAP) provides the U.S. Army Corps of Engineers with the authority to solve water-resource, flood-risk mitigation, and environmental restoration problems in partnership with local sponsors without the need to obtain specific Congressional authorization. CAP projects include Section 14 Emergency Streambank and Shoreline Protection, Section 205 Flood Risk Management, Section 206 Aquatic Ecosystem Restoration, and others.

United States Department of Agriculture Service Centers (USDA) – Lawrenceville and Olney Service Centers

United States Department of Agriculture Service Centers are designed to be a single location where customers can access the services provided by the Farm Service Agency (FSA), Natural Resource Conservation Service (NRCS), and the Rural Development (RD) agencies. In Illinois, most USDA Service Centers also house the County SWCD.

USDA-FSA

The USDA-FSA supports farmers through a variety of Credit and Commodity Programs designed to stabilize and enhance rural landscape. The FSA administers and manages farm commodity, credit, disaster and loan programs, and conservation as laid out by Congress through a network of federal, state and county offices. Programs are designed to improve the economic stability of the agricultural industry and to help farmers adjust production to meet demand. Economically, the desired result of these programs is a steady price range for agricultural commodities for both farmers and consumers.

Conservation Reserve Enhancement Program (CREP)

For over 20 years, Illinois' Conservation Reserve Enhancement Program (CREP) has been a successful partnership between the USDA-FSA, IDNR, the SWCDs, and private landowners. The goals of CREP are to reduce sediment and nutrient runoff, improve water quality, and create and enhance critical habitat for fish and wildlife populations on private lands.

In CREP, landowners enroll frequently flooded and environmentally sensitive cropland in a Federal CREP contract with FSA. IDNR extends the terms of that Federal contract by enrolling the land into an Illinois CREP Grant of Conservation Right and Easement Agreement (Easement) for 15 years or in perpetuity beyond the expiration of the Federal contract. In exchange for voluntarily removing land from production, landowners received compensation to implement conservation practices that contribute to the goals of CREP. With over 90% of land in Illinois privately owned, programs like CREP are essential to effectively address important environmental issues.

Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP) is a voluntary program that helps agricultural producers use environmentally sensitive land for conservation benefits. CRP participants plant long-term, resource-conserving covers to improve the quality of water and air, control soil erosion and enhance wildlife habitat. In return, FSA provides participants with rental payments and cost-share assistance.

Emergency Conservation and Emergency Forest Restoration Programs

Through USDA FSA, these programs offer funding and technical assistance to restore lands that have been damaged by natural disasters.

USDA-NRCS

The USDA-NRCS provides financial and technical assistance to assist agricultural producers and landowners who implement and maintain conservation practices that help protect agricultural land and natural resources.

Agriculture Management Assistance

Agricultural Management Assistance helps agricultural producers manage financial risk through diversification, marketing, or natural resource conservation practices. The NRCS administers the conservation provisions while the Agricultural Marketing Service and the Risk Management Agency implement the production diversification and marketing provisions.

Agricultural Land Easement Program (ACEP)

The 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.

Environmental Quality Incentives Program (EQIP)

The 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.

Conservation Innovation Grants

Projects targeting innovative on-the-ground conservation, including pilot projects and field demonstrations.

Conservation Stewardship Program (CSP)

The CSP is a voluntary program that helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities.

Emergency Watershed Protection Program

The Emergency Watershed Protection Program addresses watershed impairments, including debris-clogged stream channels, undermined and unstable streambanks, jeopardized water control structures and public infrastructures, wind-borne debris removal, and damaged upland sites stripped of protective vegetation by fire or drought.

Healthy Forests Preserve Program

This program offers 10-year restoration agreements and 30-year permanent easements for specific conservation actions.

Mississippi River Basin Healthy Watersheds Initiative (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.

Regional Conservation Partners Program (RCPP)

The RCPP promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. The NRCS aids producers through partnership agreements and through program contracts or easement agreements. Assistance is delivered in accordance with the rules of other NRCS programs. The 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.

United States Fish and Wildlife Service (USFWS)

The USFWS is an agency within the United States Department of the Interior whose primary responsibility is the conservation and management of fish, wildlife, plants, and their habitats for the American people. The USFWS, working with others, is responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people through Federal programs relating to migratory birds, endangered species, interjurisdictional fish and marine mammals, and inland sport fisheries. They issue financial assistance through grants and cooperative agreement awards to a variety of groups and organizations.

North American Wetlands Conservation Act Grants

A competitive, matching grants program that supports public-private partnerships carrying out projects in the United States that further the goals of the North American Wetlands Conservation Act. These projects must involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefit of all wetlands-associated migratory birds.

Partners for Fish and Wildlife

The Partners for Fish and Wildlife Program provides free technical and financial assistance to landowners, managers, tribes, corporations, schools, and nonprofits interested in improving wildlife habitat on their land.

United States Geological Survey (USGS)

The USGS is the nation's largest water, earth, and biological science and civilian mapping agency. The USGS collects, monitors, analyzes, and provides information about natural resource conditions, issues, and problems.

University of Illinois Extension (U of I)

The U of I Extension leaders work with a network of local stakeholders to define annual priorities that allow us to respond to evolving and emerging needs while still ensuring meaningful progress toward key outcomes in each of the five grand challenge areas: Community, Economy, Environment, Food, and Health. As part of the nationwide Cooperative Extension System, U of I Extension can draw on research-based expertise from land-grant universities all across the country. Volunteers who serve on local advisory councils provide direction for U of I Extension programming, ensuring that programs continue to meet critical needs.

Walton Family Foundation (WFF)

The 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.

11.0 Implementation Milestones, Objectives & Schedule

Implementation milestones and goals are intended to be measured by USDA-NRCS contracts, Illinois EPA Section 319 and SWCD funded measures largely because these represent the most common cost-share programs applicable to the watershed and plan recommendations. 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 implementation schedule is presented in Table 41 (short term, 1-2 years), Table 42 (medium term, 3-5 years), and Table 43 (long term, 6-10 years). The milestones or objectives presented are intended to be achievable and realistic over each time period, though actual implementation will depend on interested landowners and funding availability. The schedule takes into consideration agency staff capacity and incorporates acres and practices necessary to achieve water quality targets. A reasonable number of critical in-field and structural BMPs (Section 9.0) are considered prioritized for implementation within 5 years. The plan and milestones should be revisited and updated after 10 years. Consistent throughout each period is the need for outreach, communication, partnerships, grant applications, water quality monitoring, and tracking of progress.

Table 44 summarizes BMP milestones or objectives, those responsible entities and the primary technical/financial assistance available. The implementation milestones or objectives needed to meet water quality targets are those that are realistic within a 10-year period. 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. This plan, milestones and objectives will be revisited and updated after 10 years.

In the first 5 years of plan implementation, priorities focus on critical areas or those locations and practices in the watershed where management measures will achieve the greatest sediment and nutrient reductions.

Table 41 – Yeas 1-2 - Implementation Milestones

Timeframe	Milestone
Years 1–2	1. Initiate targeted outreach and one-one-one communication with producers. 2. Apply for program funding and secure local corporate sponsors. 3. Plant 500 acres of critical or high priority cover crops. 4. Convert conventional or other tillage to strip-till or no-till on 250 critical or high priority acres. 5. Complete 200 critical or high priority acres of deep placement P fertilizer. 6. Install 2 critical or high priority grassed waterways. 7. Install 5 acres of critical or high priority filter strips. 8. Install 4 acres of critical or high priority field borders. 9. Install 10 acres of critical or high priority grass conversion. 10. Install 1 critical or high priority bioreactor. 11. Install 1 critical or high priority wetland. 12. Install 2 critical or high priority sediment basins. 13. Install 2 critical or high priority grade control structure projects.

Timeframe	Milestone
	14. Stabilize 1 critical or high priority stream segment (riffles). 15. Install 4 critical or high priority WASCB systems. 16. Install 1 critical or high priority terrace system. 17. Initiate water quality monitoring.

In years 3-5 of plan implementation, priorities continue with a focus on critical areas or those locations and practices in the watershed where management measures will achieve the greatest nutrient reductions.

Table 42 – Years 3-5 - Implementation Milestones

Timeframe	Milestone
Years 3–5	1. Continue targeted outreach and one-one-one communication with producers. 2. Apply for program funding and secure local corporate sponsors. 3. Plant 1,000 acres of cover crops, 543 being critical or high priority. 4. Convert 1,000 acres of conventional or other tillage to strip-till or no-till, 273 being critical or high priority. 5. Complete 323 acres of critical or high priority deep placement P fertilizer. 6. Install 12 acres of critical or high priority filter strips. 7. Install 4 acres of critical or high priority field borders. 8. Install 19 acres of critical or high priority grass conversion. 9. Install 3 critical or high priority grass waterways. 10. Install 5 bioreactors. 11. Install 3 terrace systems. 12. Install 2 critical or high priority wetlands. 13. Install 5 sediment basins, 2 being critical or high priority. 14. Install 5 WASCB systems, 1 being critical or high priority. 15. Complete 5 grade control projects. 16. Install 1 critical or high priority livestock pasture management system. 17. Stabilize 2 stream segment (STP and riffles). 18. Continue water quality monitoring.

In years 6-10, priorities continue to be on in-field management measures and other structural practices.

Table 43 – Years 6-10 - Implementation Milestones

Timeframe	Milestone
Years 6–10	1. Continue targeted outreach and one-one-one communication with producers. 2. Plant 5,000 acres of cover crops. 3. Convert conventional or other tillage to strip-till or no-till on 1,000 acres. 4. Complete 1,000 acres of deep placement P fertilizer. 5. Install 30 acres of filter strips. 6. Install 15 acres of field borders. 7. Install 100 acres of grass conversion. 8. Install 10 grassed waterways. 9. Install 15 sediment basins. 10. Install 15 WASCB systems. 11. Install 5 wetlands. 12. Complete 5 grade control projects. 13. Install 1 livestock pasture management system. 14. Stabilize 3 stream segments (riffles). 15. Continue water quality monitoring.

Beyond 10 years, broad implementation should continue, and the watershed plan and milestones should be revisited and updated to accommodate changes over time.

Table 44 – Implementation Objectives, Responsible Parties & Technical Assistance

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
Watershed BMPs/Education and Outreach (1–10 years)		
BMP: Cover Crops **Objective:** Plant 6,500 acres	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/AFT/PCM/ISA/ ISAP/UofI Extension **Funding Mechanism**: Private Funds/NRCS and State Programs/ Private Funds
BMP: No-Till/Strip-Till **Objective**: Convert 2,250 acres	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/AFT/PCM/ISA/ ISAP/UofI Extension **Funding Mechanism**: Private Funds/NRCS and State Programs/ Private Funds
BMP: Grassed waterway **Objective:** Install 15	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/FSA **Funding Mechanism**: 319 Grant/Private Funds/NRCS and State Programs
BMP: Wetlands **Objective:** Install 8	Landowner/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/IDNR/Consultants /DU/USFWS **Funding Mechanism**: 319/Private Funds/ NRCS and USDA Programs/USFWS/USACE/Private Funds
BMP: Filter strips **Objective:** Install 47 acres	Landowner/SWCD/NRCS/ FSA	**Technical Assistance:** SWCD/NRCS/FSA **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/State Cost Share/ Trees Forever/ Pheasants and Quail Forever/Private Funds
BMP: Field Borders **Objective:** Install 23 acres	Landowner/SWCD/NRCS/ FSA	**Technical Assistance:** SWCD/NRCS/FSA **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/State Cost Share/ Trees Forever/ Pheasants and Quail Forever/Private Funds
BMP: Grass Conversion **Objective:** Install 129 aces	Landowner/SWCD/NRCS/ FSA	**Technical Assistance:** SWCD/NRCS/FSA/Pheasants and Quail Forever **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/State Cost Share/ Pheasants and Quail Forever/ Illinois Clean Energy
BMP: Livestock Pasture System **Objective:** Install 2	Landowners/NRCS/SWCD	**Technical Assistance:** NRCS/UofI Extension **Funding Mechanism:** NRCS and USDA Programs/319 Grant
BMP: Sediment Basin **Objective:** Install 22	Landowners/SWCD/NRCS	**Technical Assistance:** NRCS/SWCD/Consultants **Funding Mechanism:** 319 Grant/NRCS Programs /State Cost Share/Private Funds
BMP: Streambank/bed Stabilization **Objective:** 6 segments/locations	Landowners/SWCD	**Technical Assistance:** SWCD/Consultants **Funding Mechanism:** 319 Grant/State Cost Share/ Private Funds
BMP: WASCB **Objective:** Install 24 systems	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS **Funding Mechanism:** 319 Grant/NRCS Programs /State Cost Share/Private Funds

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
BMP: Terrace **Objective:** Install 4 systems	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS **Funding Mechanism:** 319 Grant/NRCS Programs /State Cost Share/Private Funds
BMP: Grade Control **Objective:** Install 12 locations	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism:** 319 Grant/NRCS Programs /State Cost Share/Private Funds
BMP: Education and Outreach **Objective:** Stakeholder engagement	SWCD/Farm Bureau/UofI Extension/Landowners	**Technical Assistance:** SWCD/NRCS/AFT/Farm Bureau ISA/ISAP/PCM/UofI Extension **Funding Mechanism:** 319 Grant/Private Funds/Farm Bureau

12.0 Information & Education

Information, education and outreach is critical for plan implementation and was a component of plan development itself. Moving forward stakeholder involvement will help to improve water quality and protect and enhance natural resources. To accomplish this, watershed managers and partners will develop education and outreach opportunities for stakeholders, focused on watershed issues at the subwatershed scale, as well as the ongoing and future planning and implementation process. These efforts will help to gather valuable feedback which can be used to track stakeholder-driven priorities, goals, and objectives.

In preparation of updating a broader Embarras River Watershed Management Plan and developing subwatershed scale plans including this one, several education and outreach activities were held to help educate stakeholders, as well as to gather input on concerns and other feedback. These education and outreach events - which included watershed planning meetings, Nutrient Stewardship Field Days, and subwatershed meetings - primarily targeted farmers and landowners. Municipalities, local politicians, and agencies were also invited to these stakeholder events. These education and outreach opportunities allowed for two-way communication between a working group and watershed stakeholders, allowing stakeholders to prioritize subwatersheds with high degrees of interest and for updates to be shared, feedback and ideas to be collected and incorporated into this and other plans.

Watershed Planning Meetings - In January 2020, University of Illinois Extension, 10 CFBs, IFB, and 10 SWCDs hosted a series of 9 watershed planning meetings across the Embarras River Watershed with funding from an IFB Nutrient Stewardship Grant and support for the effort from the Illinois EPA. These planning meetings gave farmers and landowners the opportunity to share their concerns and interests across the entire Embarras watershed, as well as what tools they desired to help address those concerns. The feedback received from the meetings has been incorporated in this plan and was considered when selecting The Slough for further planning. A summary report of the findings from the January 2020 meetings was published on the Coles County SWCD website and publicized through press releases and social media.

Nutrient Stewardship Field Day - In partnership with the IFB, a nutrient stewardship field day was held in April 2021. Partners from Richland and Lawrence CFBs, University of Illinois Extension, Northwater Consulting, Lawrence and Richland County SWCDs, and NRCS worked alongside the IFB to host a field day near Bridgeport, Illinois. Information was shared about the progress on updating the larger Embarras plan, creation of one for The Slough, and additional topics such as the INLRS and improving soil health. Four farmers from Richland and Lawrence counties also participated in a panel discussion, sharing their experiences with cover crops.

Subwatershed Field Day: The Slough - More direct engagement occurred in The Slough in early 2022 with a field day hosted in February. At the event, attendees were presented with updates on the watershed planning process, a summary of the watershed resource inventory report, informed about recommended agricultural conservation practices such as reduced tillage, cover crops, WASCBs, edge-of-field practices, and others, as well as provided information about potential funding sources for plan implementation. Large format maps were presented, and landowners were invited to mark locations where they had existing resource concerns or where they were interested in a specific practice. This feedback, along with feedback from one-on-one meetings with landowners, was incorporated into this subwatershed plan.

Future Education and Outreach - To improve the water quality of The Slough, stakeholders and the general public must be informed about this new plan and engaged in implementing its recommended practices. This will require a multi-practice, multi-partner approach with on-the-ground, local outreach as a key component. A strategy will utilize partnerships to ensure that all landowners and producers receive consistent and coordinated information from trusted messengers, and highlight multiple benefits (environmental, economic, social, etc.) of increased conservation in all parts of the subwatershed. It is expected that increased public understanding of improved water quality will encourage landowner participation, inspire beneficial policy actions, and motivate future involvement in watershed improvement efforts.

A schedule of activities is summarized in Table 45. Audiences targeted for education and outreach activities include:

1. Local government offices/agencies.
2. Farmers and landowners.
3. Local businesses or agencies with interest in The Slough.
4. Community residents, professionals, and partners.

Table 45 - Watershed Planning Education & Outreach Activities

Timeframe	Activities	Target Audiences	Lead Organization(s)
Short-term	• Develop and distribute factsheet • Develop and distribute executive summary • Distribute watershed plan	• Local government offices/agencies • Farmers and landowners • Local businesses or agencies with interest in watershed • Community residents, professionals, and partners	• SWCD

Timeframe	Activities	Target Audiences	Lead Organization(s)
Medium-term	• Field days	• Farmers and landowners • Community residents, professionals, and partners • Volunteers/ non-profit groups • Local businesses or agencies with interest in watershed	• IFB/CFB • SWCD
Long-term	• Watershed planning meetings	• All stakeholders	• SWCD • IFB/CFB
Ongoing	• Watershed protection awareness • Community outreach • Subwatershed Planning	• Community residents, professionals, and partners • Students/ Parents • Teachers/ administrators • Farmers and landowners	• SWCD • IFB/CFB

Short-term Education & Outreach Activities - Subwatershed Plan Outreach

Short-term education and outreach in years 1-3 will focus on "subwatershed plan outreach" and will be directed towards the following target audiences:

1. Local government offices/agencies.
2. Farmers and landowners.
3. Local businesses or agencies with interest in watershed.
4. Community residents, professionals, and partners.

Strategies:

1. Produce an updated subwatershed fact sheet that provides information on watershed planning history, implementation progress, 319 grants and other funding opportunities, the INLRS, and efforts that have been made on the watershed plan.
2. Distribute the fact sheet to landowners and stakeholders through many avenues, such as an IFB FarmWeek excerpt, through the county SWCD websites, and through social media channels.

Desired Outcomes:

1. Watershed stakeholders and public are knowledgeable about planning efforts and grants.
2. Stakeholders are aware of next steps to move forward with plan implementation.

Develop and Distribute Executive Summary & Watershed Plan

Strategies:

1. Create a high quality and distributable executive summary of The Slough plan.
2. Distribute executive summary to stakeholders through mail, e-mail, social media, and other channels.

3. Make full plan accessible online with continual progress updates and information about future planning meetings or activities.

Desired Outcomes:

1. Subwatershed residents gain an understanding of the current subwatershed conditions.
2. All stakeholders learn about possible subwatershed improvements and access key contacts to get involved in the implementation of BMPs.

Medium-Term Education & Outreach Activities

Medium-term education and outreach strategies will focus on years 4-6 of the plan. These activities will be directed towards the following stakeholder groups:

1. Farmers and landowners.
2. Community residents, professionals, and partners.
3. Volunteers/non-profit groups.
4. Local businesses or agencies with interest in watershed.

Field Days

Strategies:

1. Host demonstrations and tours of recommended practice projects within the subwatershed
2. Presentations from a variety of agriculture, urban, and conservation professionals on recommended practice implementation recommendations.

Desired Outcomes:

1. Landowners and farmers learn about recommended agricultural practices and can visualize implementing them on their land.
2. Subwatershed residents gain an understanding of recommended urban practices such as stormwater management, raingardens, etc.
3. Landowners and farmers make connections with municipalities and developers who can support implementation of recommended practices via technical and financial resources.

Long-term Education & Outreach Strategies

The long-term education and outreach strategies will focus on years 7-10 of the plan. These activities will be focused on reaching all stakeholders within the watershed.

Subwatershed Planning Meetings

Strategies:

1. Host landowner watershed planning meetings throughout the watershed to inform landowners and farmers about recommended agricultural conservation practices that have been implemented such as reduced tillage, cover crops, water and sediment control basins, edge of field practices, etc. These meetings will be targeted toward landowner and farmers within the subwatershed.

2. Present updates on plan implementation progress along with other relevant information that would be beneficial to the landowners.
3. Provide the opportunity for landowners to discuss their resource and implementation concerns along with sharing what their hopes would be for the next plan revision/update.

Desired Outcomes:

1. Producers and landowners learn about different conservation practices, as well as how to access funding and program support.
2. Landowners and other stakeholders can visualize conservation practices on their property, leading to increased implementation of them.
3. Public is knowledgeable on subwatershed management plan implementation and future planning efforts and understand the importance of a healthy watershed.
4. Input is incorporated into a plan update/revision.

Ongoing Education & Outreach Activities

The ongoing education and outreach activities are activities that happen throughout the entirety of the 10 years that this subwatershed plan is viable. Activities will be focused on watershed residents, students, parents, teachers, and administrators.

Watershed Protection Awareness

Strategies:

1. Post informational signs along the boundary of the watershed including information about a wide range of watershed conservation and improvement efforts.
2. Provide information for educational booths, including information about the watershed plan, water quality, stormwater management, flooding, recommended practices, etc. at various events throughout the year including, but not limited to, county fairs, environmental festivals, and local markets.

Desired Outcomes:

1. Residents understand the importance of a healthy watershed.
2. Stakeholders gain an understanding of what a subwatershed is and what the importance is for maintaining and monitoring the water quality.

Subwatershed stakeholders can seek funding for future implementation projects from local partners and professionals.

13.0 Monitoring & Tracking Strategy

Four components comprise of the monitoring and tracking strategy described in this section:

1. Programmatic monitoring, tracking investments and progress towards goals.
2. Watershed water quality monitoring.

13.1 Programmatic Monitoring

Tracking watershed investments is one of the simplest and most effective means to monitor progress towards achieving watershed plan goals. Keeping track of projects across diverse partners and stakeholders can be as simple as an organized system where each agency or responsible implementation entity monitors and reports what is happening related to their programs or expenditures. For example, the County SWCDs could track and report state cost-share expenditures or practices funded through grant awards. Communicating and reporting progress towards goals is equally as important as tracking them in the first place.

The following recommendations are included to help track progress and achieve the goals with plan implementation.

- Establish a watershed committee that meets at least quarterly to discuss activities and progress towards goals. A list of completed actions, proposed and in-progress actions should be tracked.
- The plan should be evaluated every five years to assess the progress made as well as to revise, if appropriate, based on the progress achieved. The plan should also have a comprehensive review and update after 10 years. As goals are accomplished and additional information is gathered, efforts may need to be shifted to issues of higher priority.
- A watershed committee or managers could request that each agency or project partner in the watershed provide an annual update, which could be in the form of a "scorecard" that tracks progress towards goal objectives via measurable milestones presented in Section 11. The scorecard system is an easy and effective way to compile and track progress and evaluate the effectiveness of achieving short, medium, and long-term goals. They are an effective way to identify what needs attention and what stakeholders should focus on in the next year.

Regardless of the specific methodologies or programs applied, it is pertinent to establish a system of working with watershed partners and stakeholders to track efforts in the watershed and their water quality benefits.

13.2 Water Quality Monitoring

Water quality monitoring is an effective means to evaluate the health of The Slough, and to directly measure plan effectiveness and progress towards water quality goals. This data also supports science and research enabling practitioners to better understand the watershed and stream dynamics to guide future investments and interventions.

The strategy is to build a sustainable monitoring program. No water quality or biological monitoring has occurred in the watershed.

The purpose of the water quality monitoring strategy is to utilize one existing monitoring station (Illinois EPA station – biological data only), establish a baseline for the watershed, and continue to collect data in a consistent manner over time. In addition, the strategy seeks to add one stream station to isolate flows from the only other named tributary in the watershed.

13.2.1 Water Quality & Biological Monitoring

One Illinois EPA monitoring station exists on The Slough (Table 46 and Figure 38). No additional sites are proposed. No historical data exists for The Slough, so monitoring should be initiated to evaluate watershed and stream conditions and establish a baseline. Given the lack of historical data, efforts should be coordinated with the Illinois EPA. The proposed monitoring categories and associated recommendations are summarized in Table 47. Additional resources should be sought, such as the RiverWatch program through the National Great Rivers Research and Education Center (NGRREC) or through volunteers, as needed. Physical and biological data should be collected at the proposed Dudley Branch monitoring site to augment water quality information, since no biological data exists.

Due to the uncertainty in securing resources for edge-of-field monitoring to measure the effectiveness of BMPs, it is recommended that a more detailed plan be developed alongside future implementation actions, if funding permits.

Table 46 – Existing/Proposed Monitoring Site & Description

Station ID	Site Description	Notes
IL_BEAA-01	The Slough 4.5 miles Southeast of Chauncey TWP Rd on 1500N Rd	Illinois EPA monitoring site – no available historical data

Table 47 - Summary of Monitoring Categories & Recommendations

Monitoring Category	Summary of Recommendations
Stream flow	Measure stream flow during every sample event if conditions permit. Consider installation of a permanent staff gauge or level logger.
Ambient water quality	Utilize Illinois EPA and local volunteers or other agency staff to perform regular monitoring for water quality at all stream sites.
Physical & biologic assessment	Perform stream monitoring for fish, macroinvertebrates, habitat, and channel morphology on Dudley Branch in coordination with Illinois EPA. Initiate fish and macroinvertebrate monitoring on The Slough.
BMP effectiveness	Monitor BMP effectiveness of specific practices or cluster of practices. Develop a detailed monitoring plan in combination with implementation activities.
Storm event runoff monitoring	Conduct monitoring during storm event at each stream site.
Trends in water quality	Establish baseline conditions for stream sites. Monitor/track changes and trends in water quality

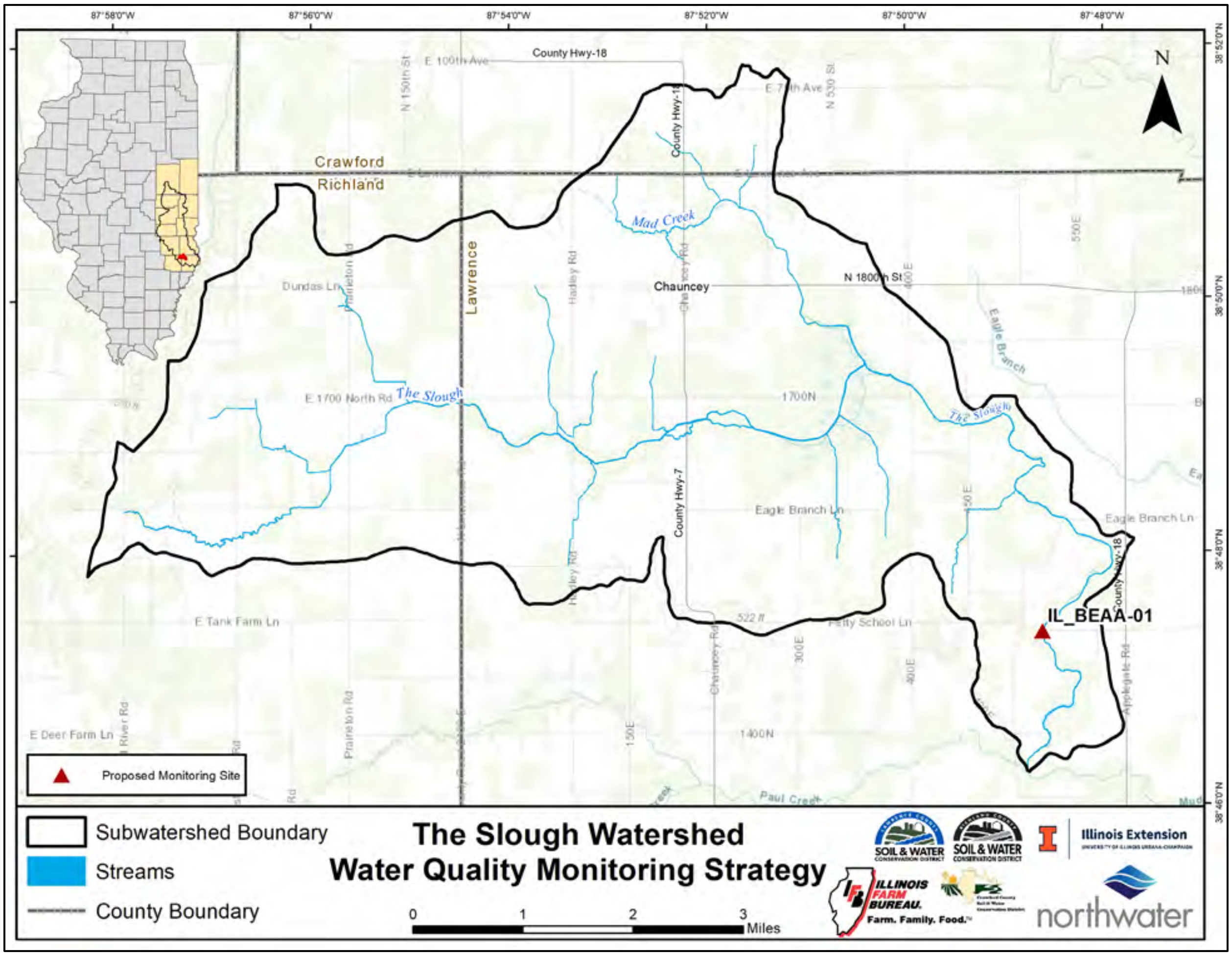


Figure 38 – Proposed Water Quality Monitoring Location

Seasonal or monthly and storm-event water quality monitoring should be considered for all stations in the watershed. Efforts should focus initially on collecting base-flow and storm-event data, followed by a regular sampling program. Regular monitoring should occur at a minimum of three times per year to capture seasonal variations in water quality. Monthly monitoring is preferred if funding permits. Routine sampling serves to document ambient water quality which captures climatic, land-use, and seasonal differences and effects on quality. Low- and high-flow events, known as base-flow and storm-event sampling, are critical conditions to document. Storm event samples should be collected between 6–8 times per year.

Table 48 includes the minimum parameters that should be considered. Quantitative benchmarks that indicate impairment conditions are also noted. The establishment of baseline conditions is important to evaluate trends and changes in water quality over time and resulting from implementation. Parameters, such as total phosphorus, total suspended sediment, fecal coliform, and total nitrogen, should be analyzed considering flow volumes to make relative comparisons year to year, as concentrations vary with flow volumes. The water quality monitoring results may also be used to calibrate the nonpoint source pollution load model and make revised annual loading estimates throughout implementation.

Table 48 - Baseline Water Quality Analysis Parameters

Analyte	Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/L (Illinois EPA standard) or 0.113 mg/L (INSAC guideline for streams)
Total Nitrogen	Less than 10 mg/L (Illinois EPA standard) or 3.8 mg/L (INSAC guideline for streams)
Fecal Coliform	Less than 200 CFU/100 mL (Illinois EPA standard)
Total Suspended Sediment (TSS)	116 mg/L (Illinois EPA guideline)
Turbidity	Less than 14 NTU (IL Lake Assessment Criteria)
Dissolved Oxygen	No less than 5.0 mg/L (Illinois EPA standard)
Temperature	Less than 90° F (Illinois EPA standard)
pH	Between 6.5 – 9.0 (Illinois EPA standards)
Flow	--

Quality assurance and control should be conducted as part of the sampling routine and through laboratory analysis. Field-based quality control consists of quarterly to semi-annual sample replicates. Sample blanks should be used to assess contamination potential from deionized water and sample processing equipment. All samples should be taken in accordance with and adhere to Illinois EPA laboratory requirements; laboratory quality control measures include procedures such as measuring precision and accuracy.

Recommended data analysis deliverables:

1. Calculations of annual sediment, phosphorus, fecal coliform and nitrate loads from the discrete sample and streamflow data.
2. Basic statistical summaries of measured and sampled concentrations and loadings, including storm-event samples.

Aquatic stream monitoring should be considered on The Slough every 5 years in alignment with the Illinois EPA schedule for basin surveys. Table 49 shows the typical stream bioassessment techniques that can be applied to the monitoring program.

Table 49 - Stream Bioassessment Metrics

Monitoring	Definition	Benchmark Indicators
Fish Index of Biologic Integrity (fIBI)[1]	Index based on presence and populations of non-native and native fish species and their tolerance to degraded stream conditions.	**No Impairment** (≥41) – good resource quality and fully supporting aquatic life **Moderate Impairment** (<41 and >20) – fair resource quality and not supporting aquatic life **Severe Impairment** (≤20) – poor resource quality and not supporting aquatic life
Macroinvertebrate Index of Biologic Integrity (mIBI)[1]	Index indicative of stream quality based on the macroinvertebrate species and populations.	**No Impairment** (≥41.8) – good resource quality and fully supporting aquatic life **Moderate Impairment** (<41.8 and >20.9) – fair resource quality and not supporting aquatic life **Severe Impairment** (≤20.9) – poor resource quality and not supporting aquatic life

Monitoring	Definition	Benchmark Indicators
Qualitative Habitat Evaluation Index (QHEI)[2]	Index indicative of habitat quality that incorporates substrate, in-stream cover, channel morphology, riparian zone, bank erosion and riffle/pool condition.	**Excellent** (>70) **Good** (55-69) **Fair** (43-54) **Poor** (30-42) **Very Poor** (<30)
Channel Morphology	Establish fixed cross-section and longitudinal profile of channel along a 1,500-foot-long fixed reach. Monitor regularly to assess changes in channel.	Entrenchment ratio Width/depth ratio bankfull Bed material Cross-sectional area Water slope

1 – From: IEPA Illinois Integrated Water Quality Report and Section 303(d) List, 2016; Guidelines for using Biological Information

2 – From: State of Ohio Environmental Protection Agency Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)

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