MEMORANDUM REPORT NO. 272

A NINE KEY ELEMENT PLAN FOR UPPER TURTLE CREEK

WALWORTH COUNTY, WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Special acknowledgement is due to Dr. Justin Poinsatte, Principal Specialist – Biologist; Aaron Owens, Principal Planner; Dr. Thomas Slawski, Chief Biologist; and Megan Deau, Principal Graphic Designer for their contributions to the conduct of this study and the preparation of this report.

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WALWORTH COUNTY, WISCONSIN

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Credit: Commission Staff

PLAN PURPOSE AND GOALS 1

Turtle Creek (Creek) is a 44-mile stream beginning at Turtle Lake in western Walworth County and ending with a confluence with the Rock River near Beloit in Rock County near the Illinois-Wisconsin border. Water from the Creek discharges into the Rock River, from which it moves downstream into the Mississippi River before ultimately discharging into the Gulf. Approximately seven miles downstream from its headwaters, the Creek is impounded to form the 131-acre Lake Comus (Lake), which is located almost entirely within the City of Delavan, Wisconsin. The Creek's 33 square mile watershed, hereafter referred to as the Upper Turtle Creek watershed, roughly corresponds to the watershed delineated by the United States Geological Survey as hydrologic unit code 070900021403. The Lake Comus Protection and Rehabilitation District (LCPRD) manages Lake Comus and is proactive in studying issues affecting the Lake, Turtle Creek, and the Upper Turtle Creek watershed. The LCPRD requested the assistance of the Southeastern Wisconsin Regional Planning Commission (SEWRPC or Commission) in preparing this plan to improve water quality and aquatic life conditions within Turtle Creek and Lake Comus.

1.1 BACKGROUND

In 2019, the LCPRD tasked the Commission with developing a lake management plan that addressed concerns regarding hydrology, water quality, aquatic plants, aquatic organisms and their habitat, and to conduct an inventory of the Lake's watershed. The Commission's Community Assistance Planning Report (CAPR) 341, *A Lake Management Plan for Lake Comus, Walworth County, Wisconsin*, provides an inventory of the watershed's characteristics (e.g., soils, geology, land use, wetlands), water quality conditions, and biotic surveys (e.g., aquatic plants, macroinvertebrates, fisheries) as well as recommendations to protect and enhance these natural resources.[1] In part due to the CAPR 341 planning process, the LCPRD have been conducting measurements to quantify water quality conditions in Turtle Creek, several of its tributaries, and Lake Comus itself. The Lake is highly eutrophic with low water clarity, algal blooms, and a depauperate aquatic plant community while the Creek exceeds state standards for total phosphorus and is frequently highly turbid with a substantial buildup of flocculent sediment along the bottom. The Lake and the Creek were both listed as impaired from non-point source total phosphorus on the 2022 303(d) list.

[1] *SEWRPC CAPR No. 341,* A Lake Management Plan for Lake Comus, Walworth County, Wisconsin*, December 2022*.

Excessive soil runoff and nutrient loading from the Lake's watershed contribute to the ongoing water quality problems in the Lake and Turtle Creek. Non-point source pollutant modeling estimates from watershed land uses were presented in CAPR 341. These estimates indicated the agricultural land uses are the predominant total phosphorus and sediment sources to the Lake and the Creek, although residential and transportation uses are also significant sources. CAPR 341 provided recommendations to reduce pollutant loads, such as implementing best management practices like cover crops, nutrient management plans, rain gardens, and reducing fertilizer on lawns. The lake management plan identified priority areas and conservation practices to help reduce pollutant loads delivered to the Lake. These practices included utilizing cover crops and conservation tillage, ensuring that all agricultural lands are following a nutrient management plan, retrofitting drain tile systems, restoring wetlands, and expanding riparian buffers. Recognizing the importance of these efforts, the LCPRD contracted the Commission to develop a watershed plan that refines the total phosphorus and sediment load sources as well as parcel-level prioritization strategies and practices introduced in the lake management plan.

1.2 PLAN PURPOSE AND OVERVIEW

The LCPRD retained the assistance of the Commission to prepare a watershed-based nine-key element (9KE) plan for the upper Turtle Creek watershed (hydrologic unit code 070900021403) that builds upon and supplements CAPR 341. Commission staff utilized preliminary feedback by Wisconsin Department of Natural Resources (WDNR) staff to expand upon the lake management plan to meet the requirements of a 9KE plan as detailed by the Environmental Protection Agency. This 9KE plan will serve as a guide to the water quality monitoring, information and education, and best management practices necessary to make progress towards the pollutant load reductions set by the Rock River Total Maximum Daily Load program. The nine minimum elements that are proposed to be examined as part of the 9KE plan are listed below:

- Identify water pollution causes and sources
- Estimate pollutant loading in watershed and expected load reductions
- Describe management measures to reduce pollutant loads
- Approximate the technical and financial assistance as well as the responsible parties required to implement the plan
- Create an informational and educational component
- Develop a project schedule
- Create measurable interim milestones
- Select indicators to mark progress towards milestones
- Design a monitoring component

This 9KE plan represents an ongoing commitment by the LCPRD to sound environmental planning pursuant to recommendations set forth in the regional and river basin water quality management plans. This plan was prepared by the Commission in cooperation with the LCPRD, the City of Delavan, Walworth County Land Use & Resource Management, WDNR, and other stakeholders.

1.3 PLAN SETTING

In addition to CAPR 341, there are several other watershed plans that provide important context for the goals, recommended management practices, and funding opportunities detailed in this 9KE plan. The most important plans are the 1981 Turtle Creek Priority Watershed Plan, the 2011 Rock River Recovery (hereafter referred to as the Rock River Total Maximum Daily Load (TMDL)), the 2020 Walworth County Land and Water Conservation Plan, and the 2022 Walworth County Farmland Preservation plan.[2,3,4] These plans and their relevance to this 9KE plan are summarized in this section.

Turtle Creek Priority Watershed Plan

In 1981, the Turtle Creek watershed was selected for development of a priority watershed plan in part due to the severity of its water quality problems, which were recognized as stemming from non-point source pollutants, and in part based on the capacity and willingness of government agencies to implement the plan. Published in 1984, the Turtle Creek Priority Watershed Plan had two major parts. Part I inventories water resources and water quality conditions within the Turtle Creek watershed as well as sets the goals and objectives for water quality in the watershed. Part II identifies the tasks, agencies, time frame, estimated hours, and administrative procedures necessary to implement the plan to achieve the goals identified in Part I.

While water quality conditions have improved throughout much of the Turtle Creek watershed since the publication of the plan, the upper Turtle Creek watershed still suffers from poor water quality conditions stemming from non-point source pollutants.[5] Consequently, several of the objectives and recommendations from the Priority Watershed Plan are still relevant and will be referenced and reinforced throughout this 9KE plan. The water quality objectives listed in the plan that are particularly relevant to the upper Turtle Creek watershed are as follows:

- Improve the smallmouth bass fishery in the mainstem of Turtle Creek by decreasing suspended sediment and siltation in the stream.

- Protect and improve the fish habitat and water quality of the tributaries to Turtle Creek. Reducing suspended sediment within the stream was identified as the most important water quality improvement.

- Slow the eutrophication process occurring within Lake Comus.

The recommendations to attain these water quality objectives that are particularly relevant to the upper Turtle Creek watershed are as follows:

- Cropland erosion was identified as the most important sediment source to Turtle Creek and the lakes within the watershed. Best management practices that reduce soil loss to a target of 5 tons per acre per year should be implemented throughout the watershed.

- Livestock waste runoff was identified as the most important source of organic wastes to surface waters within the watershed. Controlling runoff from barnyards would minimize organic pollutant loads to surface waters.

- Wind erosion was identified as a major source of nutrients and sediments to Turtle Creek and Lake Comus. Installing wind erosion controls within and near the watershed would improve pollutant loads to both waterbodies.

To attain these objectives and implement these recommendations, the Priority Watershed Plan identifies numerous best management practices and responsible agencies. These practices and agencies will be referenced throughout Chapter 3 of this plan.

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[2] *Rock County Department of Land Conservation,* Turtle Creek Priority Watershed Plan*, April 1984*

[3] *dnr.wisconsin.gov/topic/TMDLs/RockRiver/index.html.*

[4] *Walworth County Land Use and Resource Management,* Walworth County Land and Water Resource Management Plan: 2021 - 2030*, 2020.*

[5] *SEWRPC CAPR No. 341, 2022,* op. cit.

Rock River TMDL

Excessive sediment and nutrient loading to the Rock River has led to increased algal blooms, oxygen depletion, water clarity issues, and degraded habitat. Algal blooms can be toxic to humans and costly to a local economy. Estimated annual economic losses due to eutrophication in the United States are as follows: recreation ($1 billion), waterfront property value ($0.3 to $2.8 million), recovery of threatened and endangered species ($44 million), and drinking water ($813 million). Due to the impairments of the Rock River Basin, a TMDL study for phosphorus and sediment was developed for the Rock River basin and its tributaries and was approved in 2011.[6] This TMDL establishes phosphorus and sediment load reduction goals for Reach 80, a section of the Rock River Basin that comprises all lands contributing to Turtle Creek upstream of County Hwy C, which includes the Delavan Lake and the Jackson Creek watersheds as well as Lake Comus and the upper Turtle Creek watershed.

The TMDL pollutant load reduction goals for the upper Turtle Creek watershed are adopted from the TMDL Reach 80 goals. Achieving the targeted instream concentrations in Turtle Creek requires annual total phosphorus reductions from baseline loads of 75 percent for wastewater treatment facilities and 49 percent for non-point sources. It also requires baseline sediment load reductions of 1 percent from WWTFs and 25 percent from non-point sources. Of these nonpoint source loads, non-permitted urban sources contributed 19 percent of the total phosphorus and 15 percent of the sediment. This plan adopts these total phosphorus and sediment non-point source load reduction goals as a minimum target to achieve the desired water quality conditions within Turtle Creek and Lake Comus.

Walworth County Land and Water Resource Management Plan

As required by *Wisconsin State Statute* 92.10, all Counties within Wisconsin must prepare a land and water resource management plan. This plan must assess water quality and soil conditions throughout the County, lists water quality objectives, identifies best management practices and performance standards for non-point source pollution and soil loss, and, among other things, provides a strategy and activities to coordinate, monitor, and implement these best management practices throughout the County. Walworth County completed its most recent land and water resource management plan in 2020. This plan inventories conditions within the County, including information on agriculture, natural resources, water quality, and land use; document natural resource management concerns within the County; and sets goals for natural resources in the County. The goals within the Land and Water Resource Management Plan that are particularly relevant for the upper Turtle Creek watershed are as follows:

- Protect Walworth County lakes, streams, and wetlands from agricultural runoff by achieving compliance with state agricultural runoff performance standards and by implementing recommendations in river basin and watershed plans

- Protect Walworth County lakes, streams, and wetlands from urban runoff by achieving compliance with County construction site erosion control and stormwater management ordinances

- Prevent the introduction and dispersal of invasive species within Walworth County

- Protect Walworth County's productive agricultural land

- Preserve and restore Walworth County's environmental corridors, natural areas, critical species habitat sites, wetlands, floodplains, and groundwater

- Protect Walworth County's watersheds by seeking collaboration and partnerships

- Initiate solution-based information and education outreach programs to encourage the support and use of conservation practices

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[6] *USEPA and WDNR,* Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids in the Rock River Basin Columbia, Dane, Dodge, Fond du Lac, Green, Green Lake, Jefferson, Rock, Walworth, Washington, and Waukesha Counties, Wisconsin*, prepared by the CADMUS Group, July 2011.*

These goals are intended to be accomplished through a five-year work plan, which identifies objectives, actions, funding sources, and means to assess progress in achieving these goals. These objectives, actions, and funding sources will guide management recommendations in this plan, particularly regarding agricultural best management practices and outreach programs. It is the understanding of Commission staff that this plan will be updated in 2025.

Walworth County Farmland Preservation Plan

The Walworth County Farmland Preservation Plan was first approved by the Wisconsin State Legislature in 1978 and was most recently updated in 2022.[7] This plan, in conjunction with the Land and Water Resource Management Plan and County zoning ordinances, preserves agricultural lands within the County and enables farmers on these lands to claim tax credits if comply with state soil and water conservation standards. Elements within the Farmland Preservation Plan that are particularly relevant for the Upper Turtle Creek watershed plan are as follows:

- Designates essentially all agricultural lands within watershed as farmland preservation areas
- Recommends the use of best management practices to limit agricultural impacts on the environment
- Supports working with producer-led groups to promote best management practice use
- Presents the farmland preservation tax credit rates for eligible landowners complying with state soil and water conservation standards
- Establishes the conservation compliance requirements to claim farmland preservation tax credits, including:
  - Develop and follow a conservation plan to meet minimum tolerable soil loss standards
  - Develop and follow a 590 nutrient management plan on fields where fertilizers are applied[8]
  - Control gully erosion on croplands
  - Prevent significance discharge from feedlots and limit livestock access to riparian areas
  - Maintain manure storage areas and meet standards for new or modified structures
  - No manure stacking in unconfined piles within a Water Quality Management Area
  - Divert clean water away from feedlots, manure storage areas, and barnyards within a Water Quality Management Area

[7] Walworth County Farmland Preservation Plan Update*, Walworth County, 2022. wi-walworthcounty.civicplus.com/389/Farmland-Preservation-Plan.*

[8] *USDA Natural Resources Conservation Service,* Conservation Practice Standard: Nutrient Management Code 590*, 2015. datcp.wi.gov/Documents/NM590Standard2015.pdf.*

Credit: Commission Staff

2.1 WATERSHED SETTING

Watershed characteristics, including topography, geology, soils, civil divisions, and land uses, were thoroughly characterized in CAPR 341.[9] Consequently, this section will only describe summarized and/or updated information that provides relevant context for other elements in the plan.

Water Resources

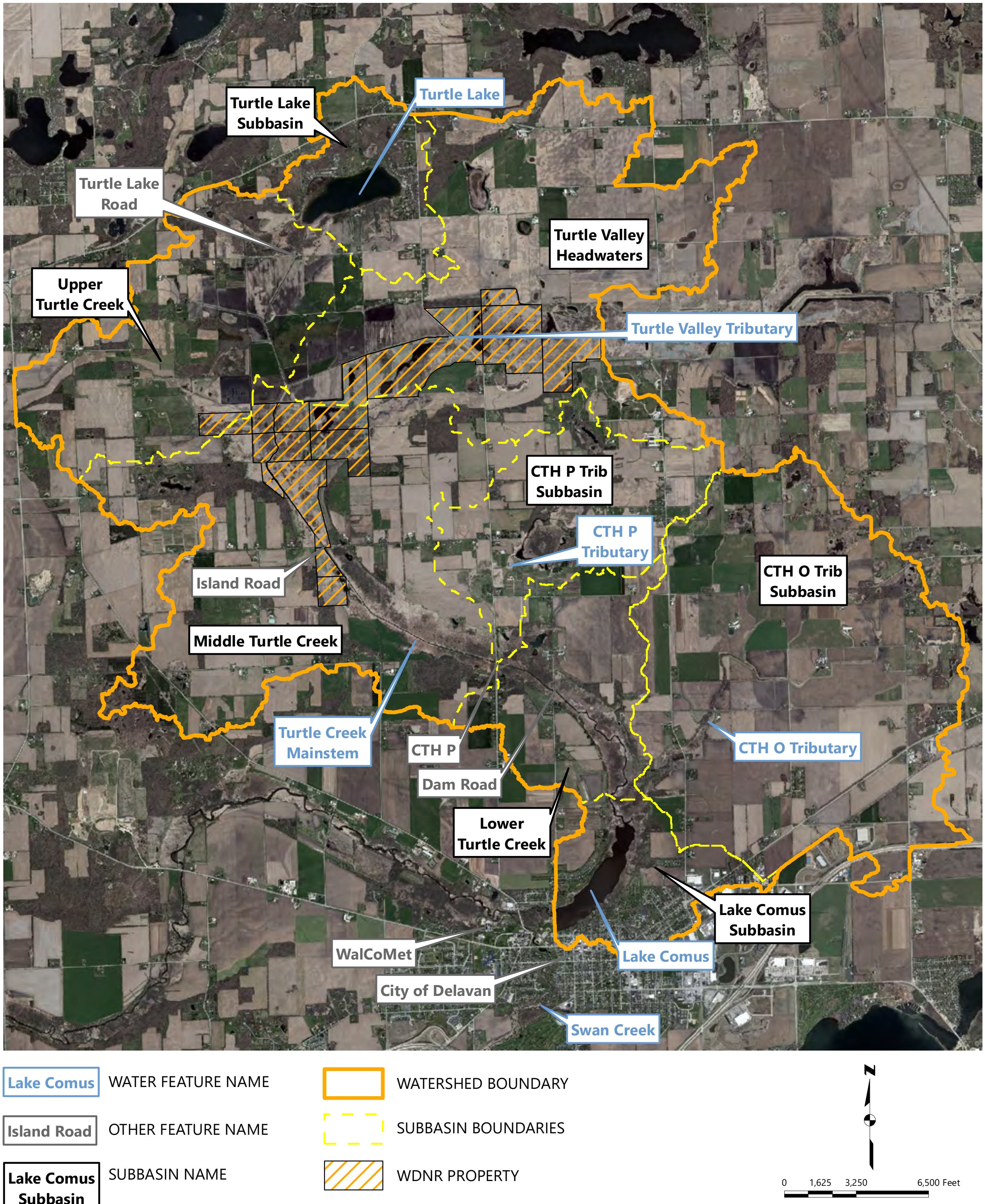
The Upper Turtle Creek watershed is a 21,009-acre watershed draining west-central Walworth County.[10] Southeastern Wisconsin Regional Planning Commission (SEWRPC or Commission) staff delineated the entire watershed and several subbasins of the watershed, which are illustrated in Map 2.1 along with the names of several prominent tributaries, roads, and other important features. The watershed's upstream reaches are located north of Turtle Lake in the Town of Richmond, an area over six miles to the north of Lake Comus (Lake). Much of the watershed is in the Turtle Valley, through which Turtle Creek (Creek) flows in a largely northwestern to southeastern direction. Several internally draining areas, which do not contribute surface water runoff to Turtle Creek, are located are located along the watershed's western and northern borders. These internally draining areas total 661 acres in extent.

Turtle Creek begins at an uncontrolled outlet through the wetlands south of Turtle Lake near the northern edge of the watershed. From its headwaters, Turtle Creek flows largely south and east through farmed areas and wetlands until it enters the northern boundary of Lake Comus. Beginning as a first order stream, the Creek becomes a second order stream about a mile downstream of the Turtle Lake outlet when it joins with a tributary draining the Wisconsin Department of Natural Resources (WDNR) Turtle Valley Wildlife Area

[9] *SEWRPC CAPR No. 341,* A Lake Management Plan for Lake Comus, Walworth County, Wisconsin*, December 2022.*

[10] *The Lake Comus watershed boundary was delineated using two-foot interval ground elevation contours developed from a 2006-2007 digital terrain model.*

Map 2.1
Subbasins and Place Names of the Upper Turtle Creek Watershed



Source: SEWRPC

(hereafter referred to as the Turtle Valley tributary).[11] At the confluence with another tributary near the State Highway P bridge (hereafter referred to as the CTH P tributary), the Creek becomes a third order stream until it its confluence with another major tributary entering from the northeast near CTH O (this tributary is referred to as the CTH O tributary). Following this confluence, Turtle Creek meanders through a wetland before entering Lake Comus from the north. Lake Comus is essentially a wide and deep segment of Turtle Creek formed when the Creek was dammed in the 1830s. Turtle Creek becomes a fourth-order stream just downstream of the Lake after joining with Swan Creek flowing from the outlet dam on Delavan Lake.

Much of the Creek and its tributaries have been highly modified and channelized, largely to improve drainage for agricultural production in the watershed. Plat maps produced in 1837 show an approximate streamline of Turtle Creek with many more meanders than the current streamline (see Figure 2.1). These modifications are likely contributing to water quality problems in the Creek and the Lake. Hydrologic modifications to the Creek are described in greater detail in Section 2.2.

The Commission used ground-water table elevations to estimate the area where water infiltrating into the land surface ultimately reaches Lake Comus in CAPR 341 (see Map 2.2).[12] This area, the groundwatershed, is the source for water issuing as springs and seeps to Turtle Creek, Lake Comus, Turtle Lake, tributary streams, and associated wetlands. Groundwater supplies are generally replenished by precipitation soaking into the ground and entering aquifers, a process called "groundwater recharge." Based upon groundwater contour lines, springs and seeps are likely especially prevalent along the eastern portions of Turtle Creek and Lake Comus. In the headwater portions of Turtle Creek, springs and seeps are fed by extensive high to moderate groundwater recharge areas in the eastern uplands. Further downstream, much of the spring and groundwater seep flow entering the eastern shore of the Lake and adjacent marshland likely originates as lake water infiltrating into the bed and shoreline of Delavan Lake. Aside from the Turtle Lake headwater area, all groundwater recharge feeding Lake Comus originates east of Turtle Creek. Water table elevation contours for watershed are also shown in Map 2.2. In and near waterbodies and wetlands, the water table is near or at the land surface, whereas it can be over 100 feet or more below the land's surface in upland areas near the periphery of the watershed.[13]

Topography and Soils

The ground-surface elevation in the watershed varies by roughly 165 feet, with elevations of approximately 875 feet above National Geodetic Vertical Datum, 1929 adjustment (NGVD 29) found along the shoreline of Lake Comus to elevations of 1040 feet above NGVD 29 at the crest of prominent hills and ridges in the northern, eastern, and western portions of the watershed (see Map 2.3).

The topography of land surfaces, as well as the composition and layering of underlying soil, can significantly affect the type and amount of pollutants and sediment washed into the lakes, streams, and wetlands by rainfall and snowmelt. Steeper slopes translate to more erosive potential and a greater ability to carry pollutants and sediment to receiving waters, with significant erosion observed at slopes greater than four percent.[14] Slopes in the watershed range from less than one percent to greater than 20 percent. As shown on Map 2.4, most areas within the watershed are relatively level, with 46 percent of the watershed underlain by land surfaces sloping at 2 percent or less. The lowest slopes are generally found in lowland areas along Turtle Creek and its tributaries, with Turtle Creek only dropping 11 vertical feet in the 5.5 miles between Turtle Lake and Lake Comus.[15] Upland

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[11] *Stream order refers to a stream classification concept developed by Arthur Strahler and Robert Horton during the 1940s and 1950s. Headwater perennial tributaries are assigned a stream order of one and are labelled first order streams. When two first order streams converge, a second order stream is formed, when two third order streams converge, a third order stream is formed, and so on. When a lesser order stream converges with a higher order stream, the larger stream's order remains unchanged.*

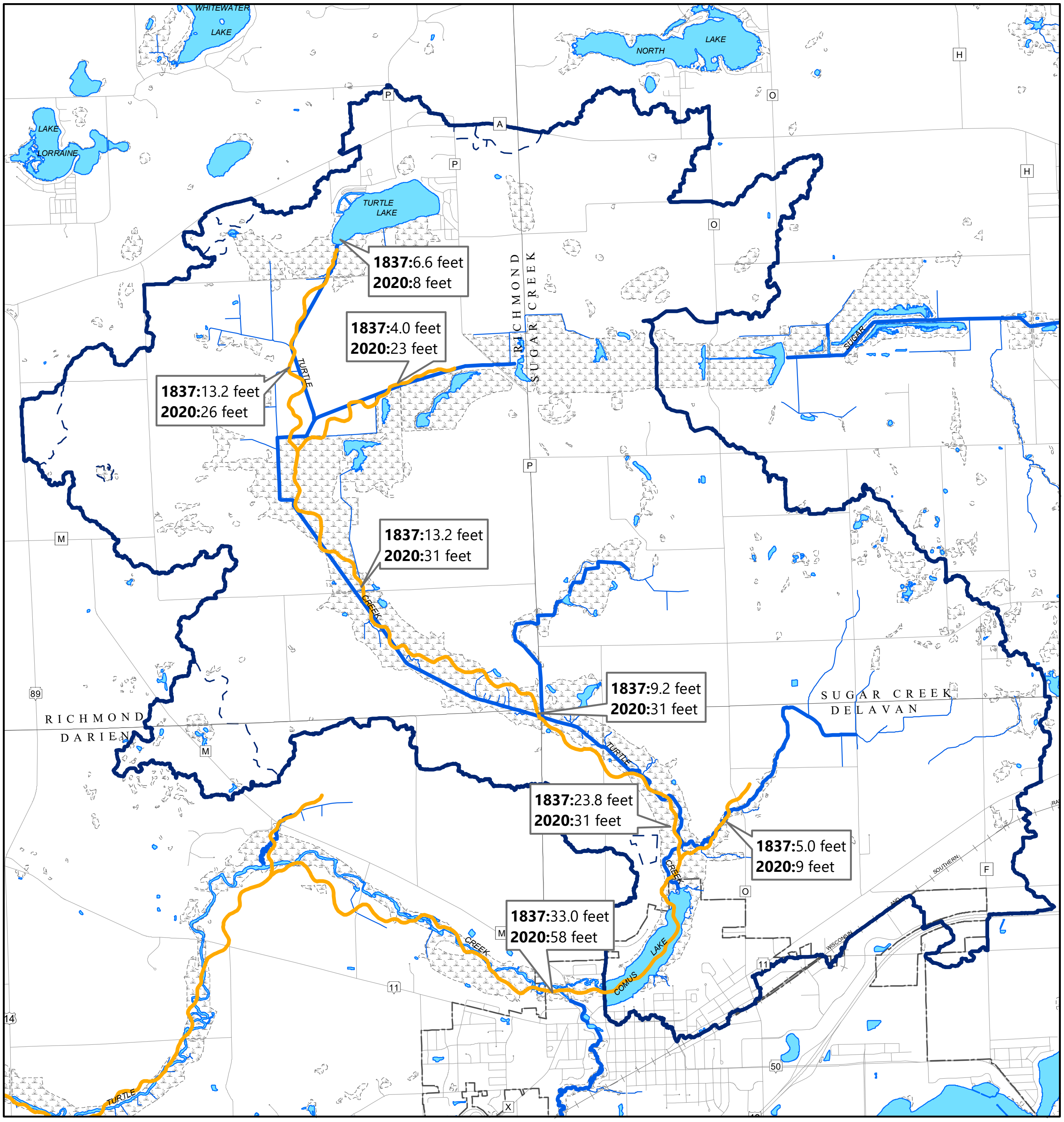
[12] *For a more detailed discussion of surface and groundwater interactions as well as the groundwater characteristics of the watershed, see Section 2.1 of CAPR 341.*

[13] *The depth to groundwater for a particular location can be estimated by subtracting groundwater elevation values from surface topography values.*

[14] *F.L. Duley and O.E. Hays, "The Effects of Degree of Slope on Run-off and Soil Erosion,"* Journal of Agricultural Research*, 45(6): 349-360, 1982.*

[15] Turtle Creek Priority Watershed Plan*, Department of Land Conservation, Rock County, Wisconsin, 1984.*

Figure 2.1
1837 Stream Widths and Thalweg Location Compared to 2020 Streamline



2020 THALWEG: TURTLE CREEK AND MAJOR TRIBUTARIES

1837 THALWEG: TURTLE CREEK AND MAJOR TRIBUTARIES (APPROXIMATED FROM PLAT MAP)

SURFACE WATER

WATERSHED BOUNDARY

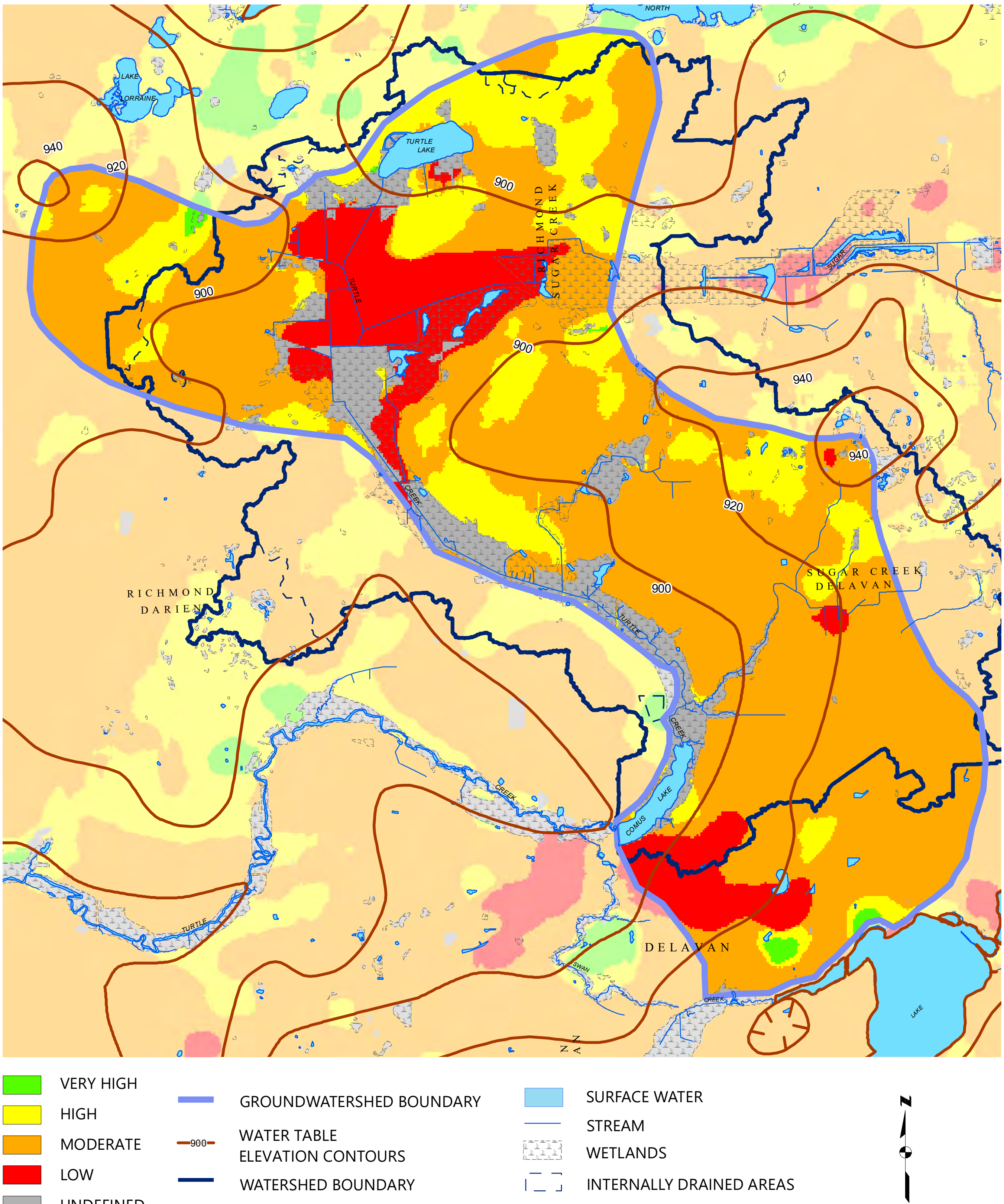
INTERNALLY DRAINED AREAS

WETLANDS

Note: The 1837 streamlines of Turtle Creek and its major tributaries have been digitized from 1837 plat maps based on land surveying. Thus, the actual streamline between Public Land Survey System Section lines may just be a representation of the actual streamline. 1837 stream widths are converted from the widths reported as chain links on the 1837 plat maps. Each chain link is 7.92 inches.

Source: SEWRPC

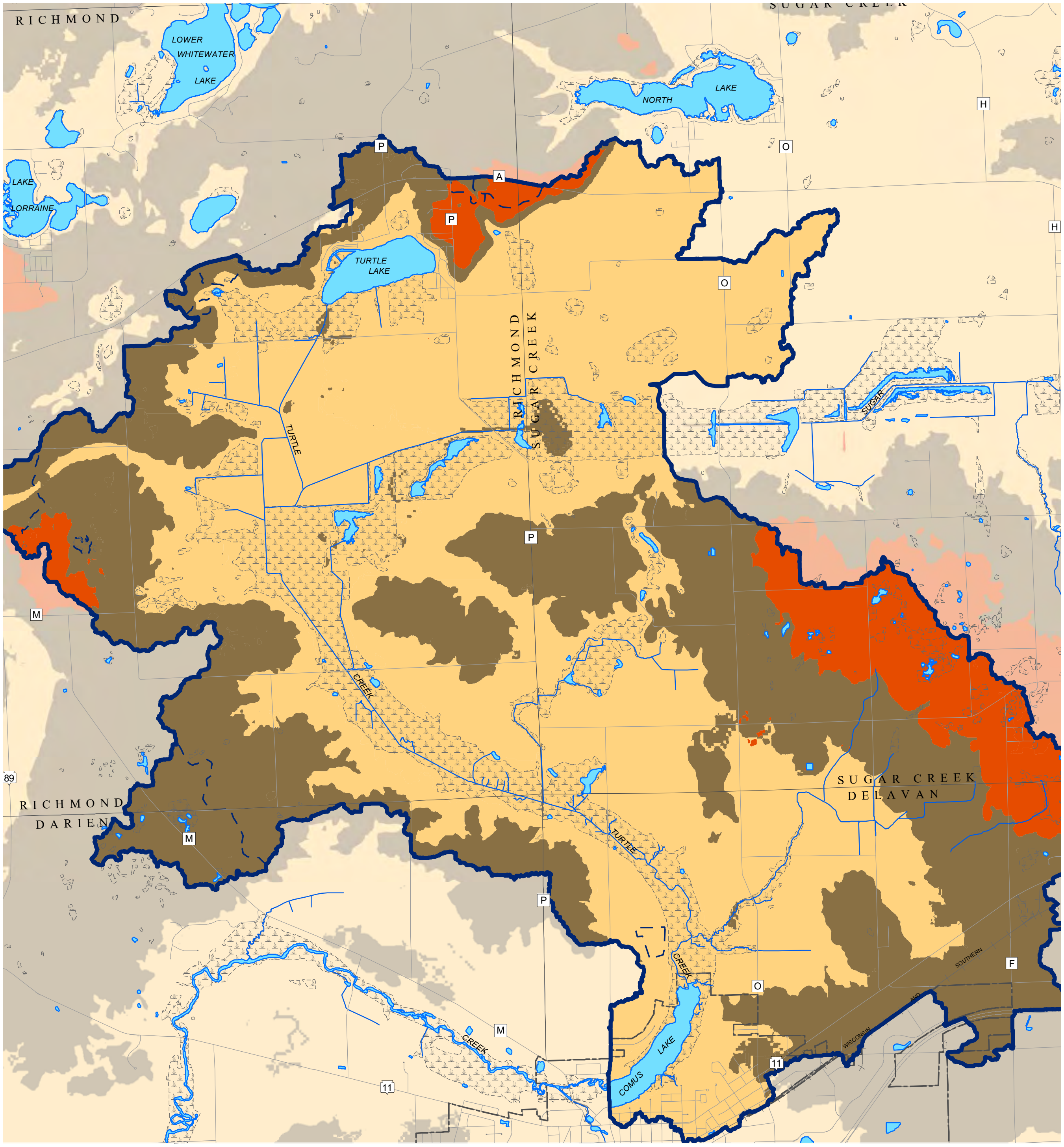
Map 2.2
Groundwater Elevation Contours and Recharge Potential Within the Turtle Creek Groundwatershed



Note: Colors outside the watershed boundary are reduced in intensity to show the adjacent extent and distribution of each legend category.

Source: USGS and SEWRPC

Map 2.3
Upper Turtle Creek Watershed Physiography



850 - 950

975 - 1000

1025

ELEVATION IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM, 1929 ADJUSTMENT

SURFACE WATER

STREAM

WATERSHED BOUNDARY

INTERNALLY DRAINED AREAS

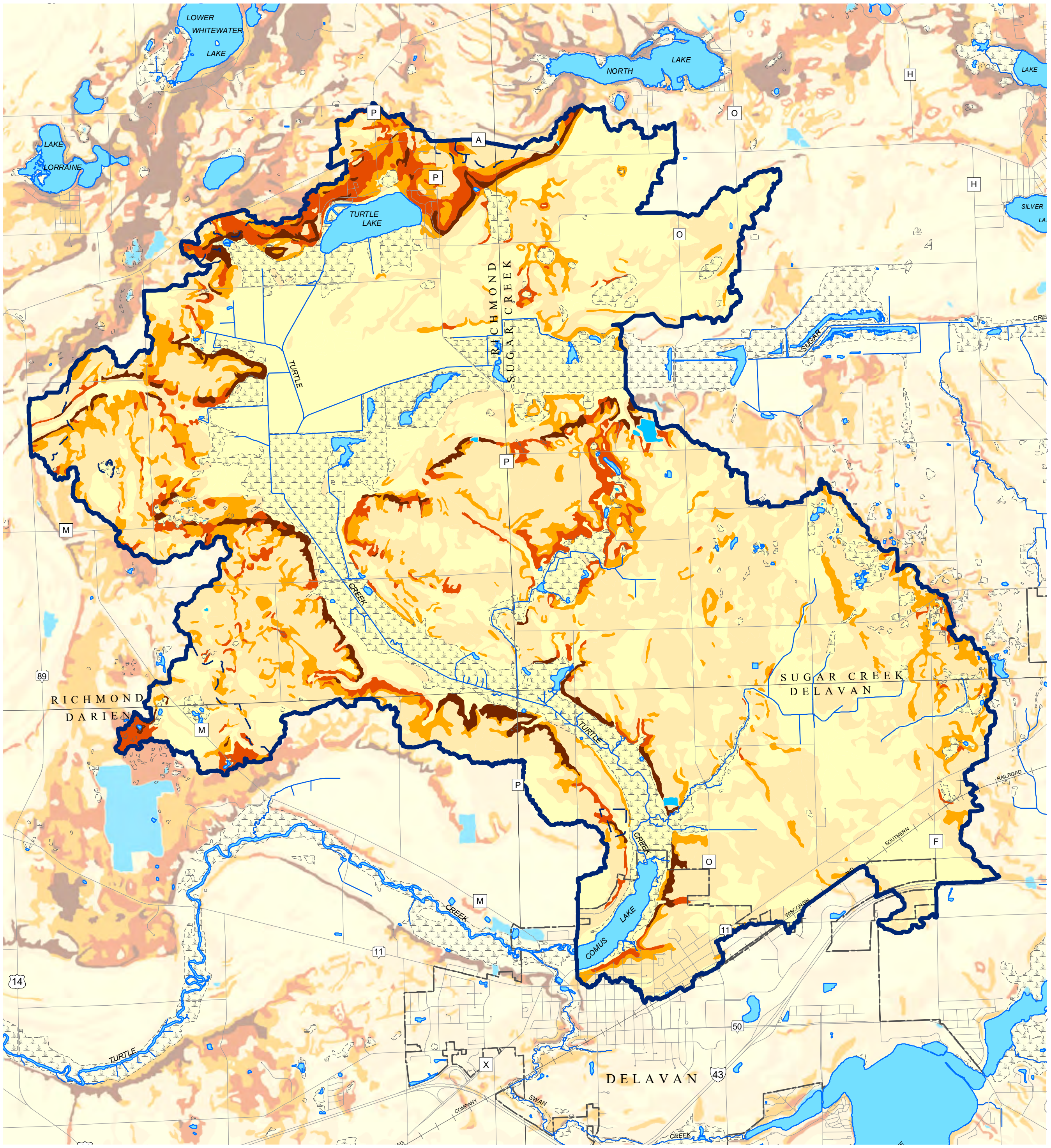
Colors outside the watershed boundary are reduced in intensity to show the adjacent extent and distribution of each legend category.

N

0 2,500 5,000 Feet

Source: SEWRPC

Map 2.4
Land Surface Slope Within the Upper Turtle Creek Watershed



SOILS HAVING SLOPES RANGING FROM 0 TO 2 PERCENT

SOILS HAVING SLOPES RANGING FROM 2 TO 6 PERCENT

SOILS HAVING SLOPES RANGING FROM 6 TO 12 PERCENT

SOILS HAVING SLOPES RANGING FROM 12 TO 20 PERCENT

SOILS HAVING SLOPES OF 20 PERCENT OR GREATER

SURFACE WATER

STREAM

WATERSHED BOUNDARY

INTERNALLY DRAINED AREAS

Colors outside the watershed boundary are reduced in intensity to show the adjacent extent and distribution of each legend category.

N

0 2,800 5,600 Feet

Source: Natural Resources Conservation Service and SEWRPC

areas are generally comprised of gently rolling hills with slopes between 2 to 6 percent. Steeply sloping land is found throughout the watershed, particularly along drop-offs into the valley through which Turtle Creek now flows as well as in hilly areas along the northern edge of the watershed.

The watershed has a diversity of soils, with soils of the Miami-McHenry Association, Plano-Griswold Association, and the Casco-Fox Association predominant in upland areas while soils of the Houghton-Palms Association along Turtle Lake, Turtle Creek, and Lake Comus (see Map 2.5). The soils found in upland areas are predominantly well-drained and the majority of which are utilized for agriculture. The Houghton-Palms soils found in low-lying areas are largely either in wetlands or are being utilized for sod farming.

Hydric soils are formed when soils are saturated for extended periods of time. Approximately 17 percent of the watershed is underlain by soils exhibiting hydric characteristics. Most of these areas are located along in the Turtle Valley along Turtle Creek and its tributaries as well as adjacent to Lake Comus (see Map 2.6).

Over two-thirds of the watershed, including most of the upland areas, is covered by soils in the B hydrologic soil group, indicating that these soils are generally well-drained silty or loamy soils that provide a moderate amount of runoff (see Map 2.7). The areas around Turtle Creek, the Creek tributaries, and Lake Comus are generally covered by soils in the A/D and B/D groups, indicating these soils have low to moderate runoff when drained and very high runoff when undrained. Just over five percent of the watershed, scattered throughout upland areas, is covered by soils in the C and C/D groups which have moderately high to high runoff.

Land Use

The Commission periodically quantifies the ways humans use land in Southeastern Wisconsin and projects how land use will change over the near term. CAPR 341 summarized the 2015 land use for the watershed as that was the most recent land use inventory available for that planning effort. In the intervening years, the Commission completed its 2020 watershed inventory which is summarized in this subsection. Little change in land use occurred between 2015 and 2020. The watershed is still predominantly rural with agricultural uses constituting 66.3 percent of the watershed and the combined surface water, wetlands, and woodlands at 22.6 percent (see Map 2.8 and Table 2.1). Wetlands flank Turtle Creek and the lower portions of its major tributaries while most of the upland areas of the watershed are in agricultural uses. Nearly all the urban land uses are concentrated at the southern end of the watershed in the City of Delavan or along the shorelines of Turtle Lake in the northern end of the watershed.

Agricultural Uses

Given the predominance of agricultural land uses within the watershed and their significance in pollutant loading, as documented in CAPR 341, this plan provides an expanded inventory of the cultivated crops, farming practices, and animal operations utilized within the watershed.

Cropping Practices

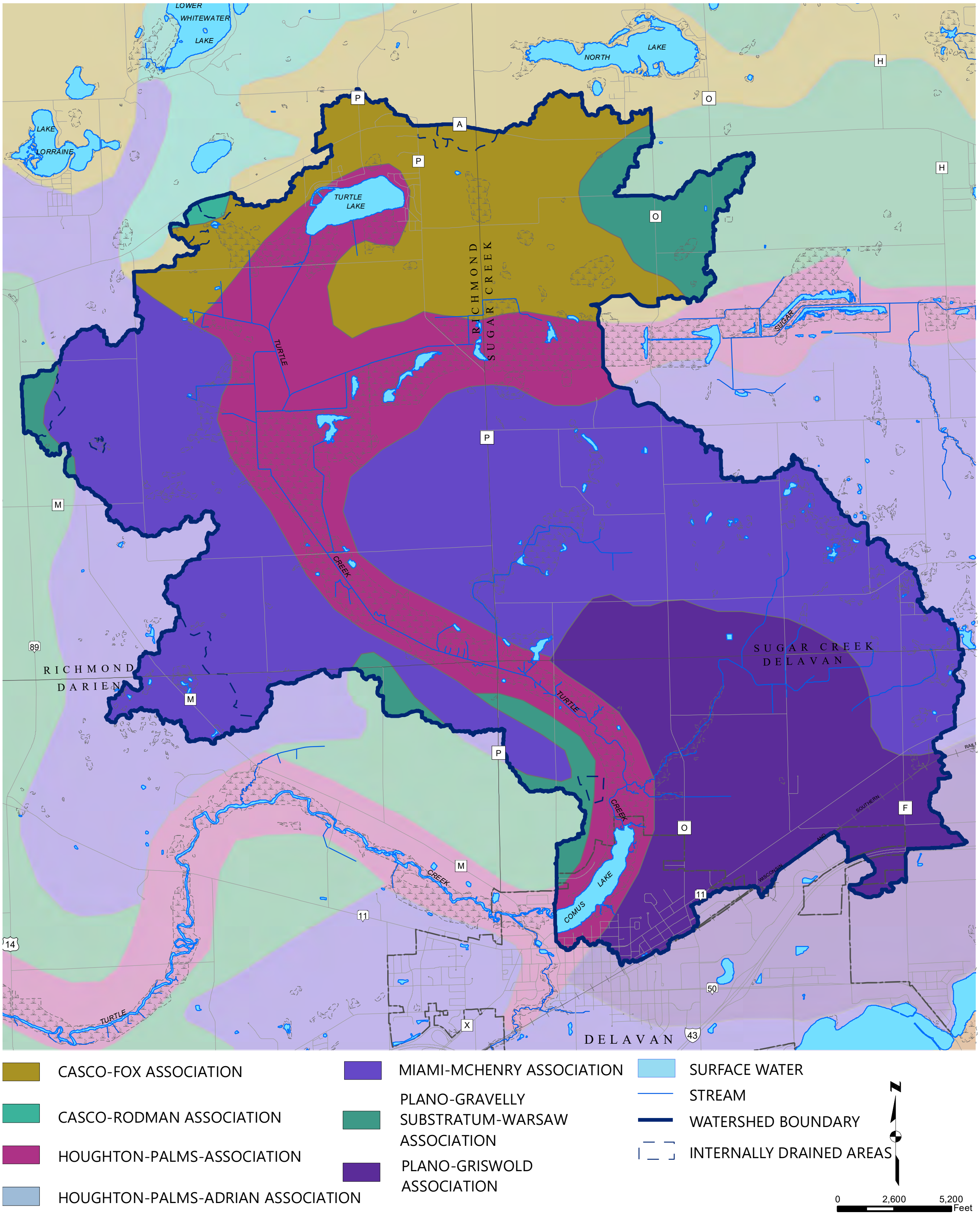
Commission staff utilized the USDA CropScape tool to analyze the cropping practices within the watershed in 2003, 2011, and 2023.[16] The CropScape tool allows users to view and download the USDA Cropland Data Layer, which is an annual spatial dataset that estimates land coverage by specific crops and other land uses at a 30-meter spatial resolution.[17] Using this dataset, Commission staff identified corn, soybeans, grassland/pasture, alfalfa, and winter wheat as the five most common crops within the watershed in 2003, 2011, and 2023 (see Map 2.9). Comprising between 27 and 29 percent of the watershed in 2003, 2011, and 2023, corn had the highest coverage of any land use type in all three years and only decreased by approximately one percent between 2003 and 2023. Grassland/pasture was identified as the second-most common land use type in 2003 and 2011 and the third-most common land use in 2023.[18] Soybeans were the third-most common land use in 2003 and 2011 and the second-most common land use in 2023. Alfalfa

[16] *2003 was the earliest year that CropScape data was available for the Upper Turtle Creek watershed.*

[17] *United States Department of Agriculture National Agricultural Statistics Service, Cropland Data Layer: USDA NASS, croplandcros.scinet.usda.gov.*

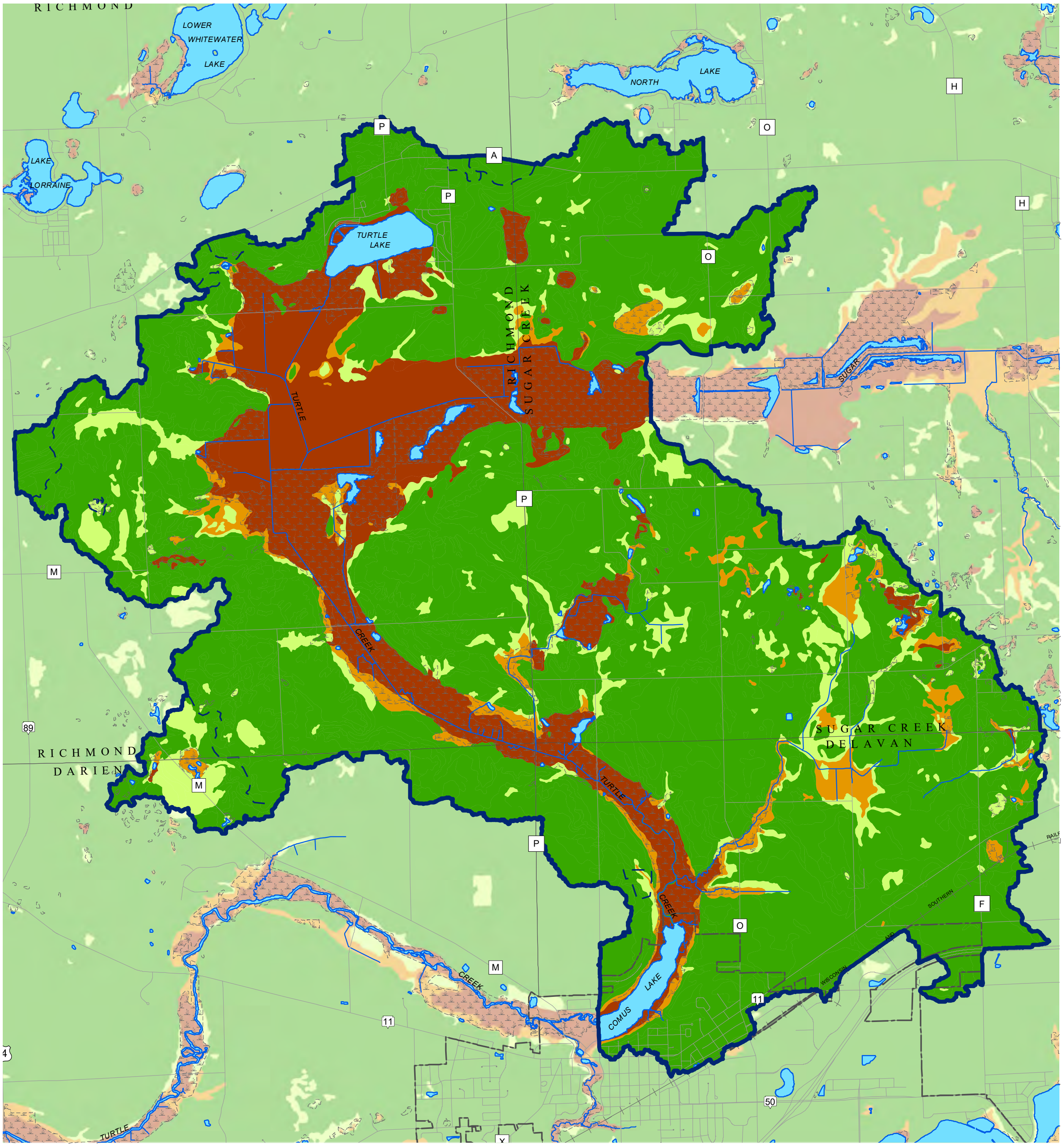
[18] *The land use classification categories and satellite imagery resolution used to develop the Cropland Data Layer varied between 2003 and 2011. Consequently, some of the grassland/pasture identified in 2003 may have been changed to another land use, such as "Herbaceous Wetlands" in 2011 and 2023.*

Map 2.5
Upper Turtle Creek Watershed Soil Associations



Source: Natural Resources Conservation Service and SEWRPC

Map 2.6
Hydric Soils Within the Upper Turtle Creek Watershed



HYDRIC

NON HYDRIC

PREDOMINANTLY HYDRIC

PREDOMINANTLY NON HYDRIC

SURFACE WATER

STREAM

WATERSHED BOUNDARY

INTERNALLY DRAINED AREAS

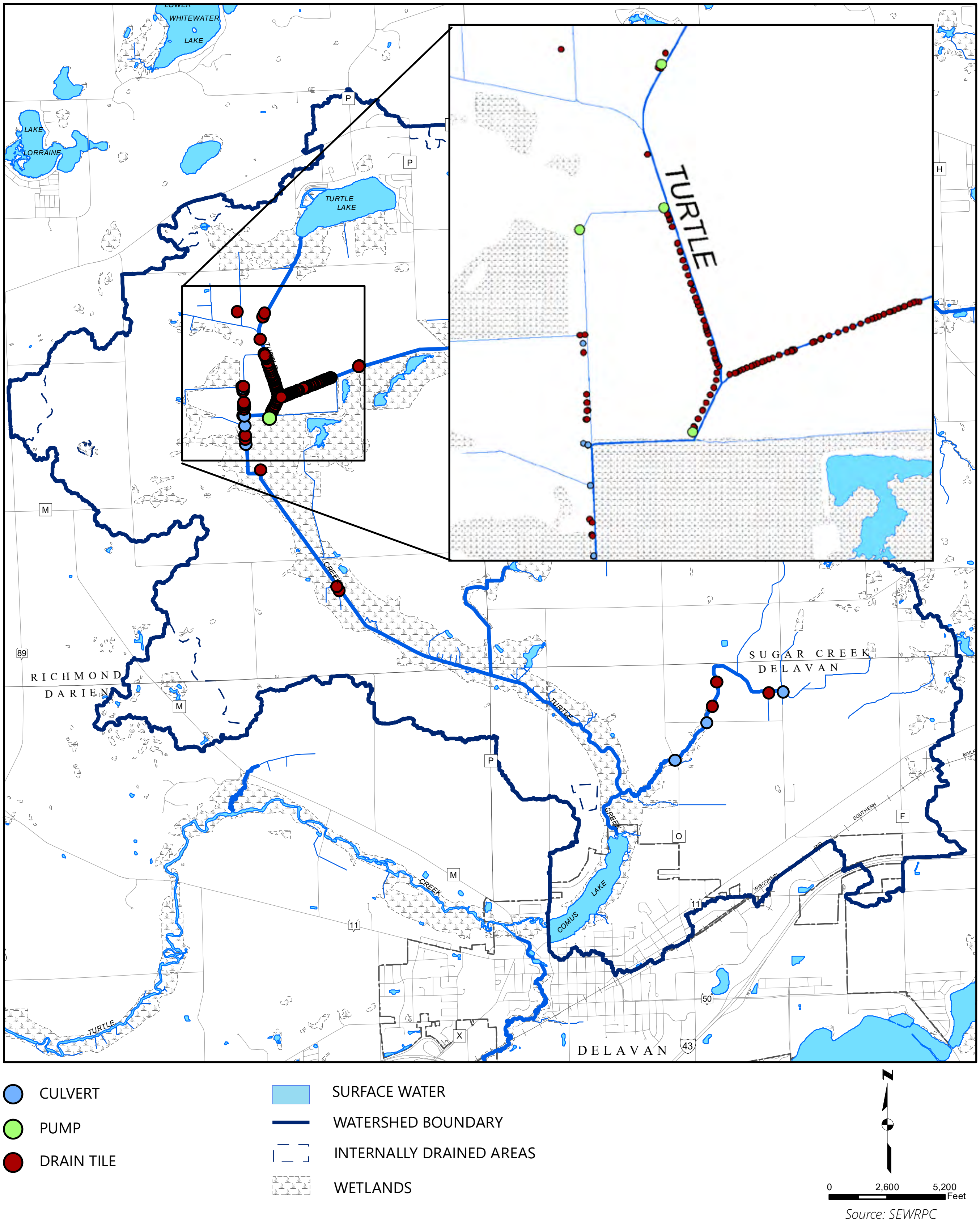
Colors outside the watershed boundary are reduced in intensity to show the adjacent extent and distribution of each legend category.

N

0 2,600 5,200 Feet

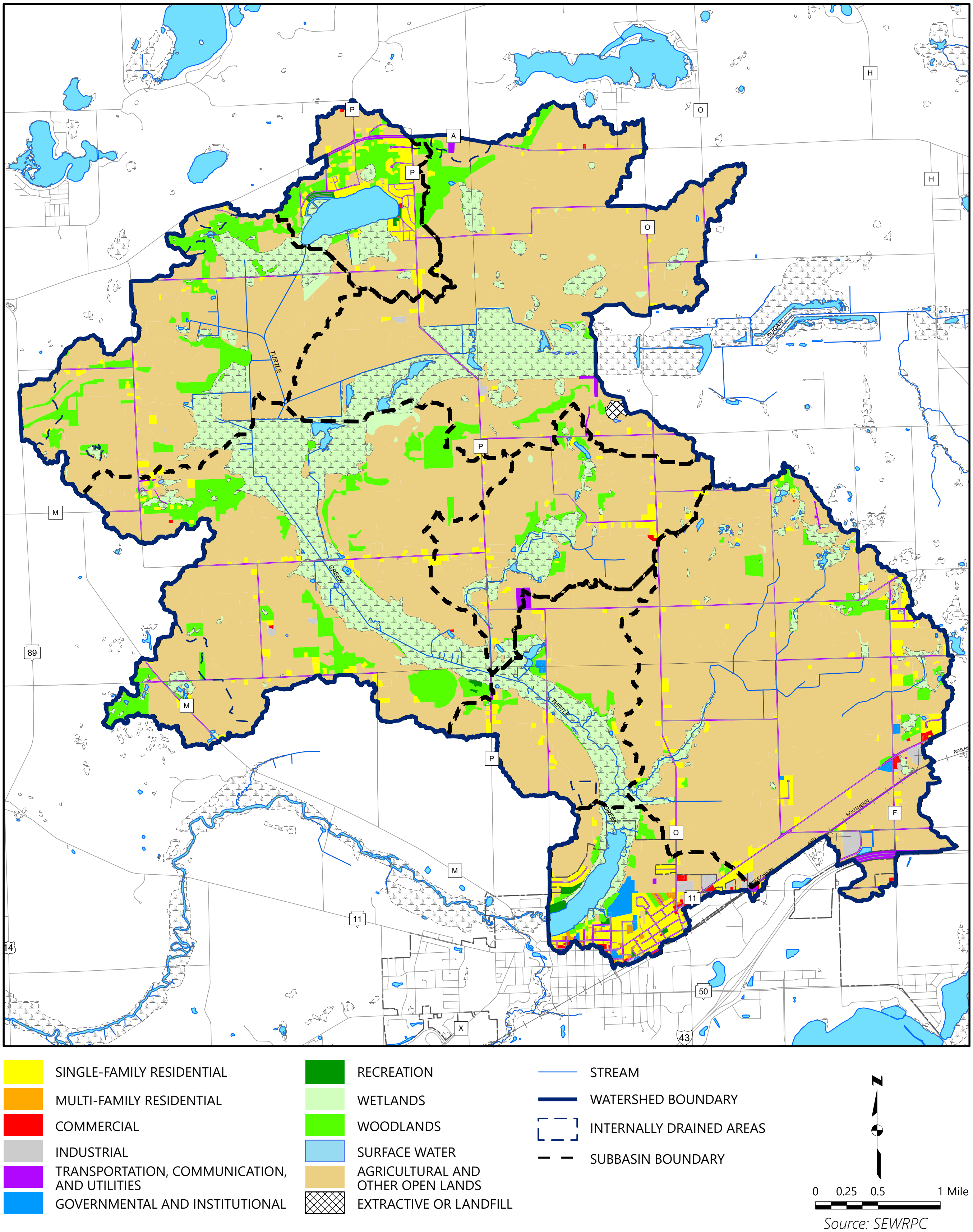
Source: Natural Resources Conservation Service and SEWRPC

Map 2.7
Hydrologic Modifications Observed During 2023 Turtle Creek Survey



Source: SEWRPC

Map 2.8
Land Use for the Upper Turtle Creek Watershed: 2020



Source: SEWRPC

Table 2.1
Land Use in the Lake Comus Watershed: 2020 and Planned

Land Use Categories[a]	2020 Acres	2020 Percent of Total	Planned Acres	Planned Percent of Total
Urban				
Residential				
Single-Family - Rural Density	223	1.1	215	1.0
Single-Family - Suburban Density	44	0.2	47	0.2
Single-Family - Low Density	301	1.4	358	1.7
Single-Family - Medium Density	199	0.9	235	1.1
Single-Family - High Density	0	0.0	0	0.0
Multifamily	20	0.1	26	0.1
Commercial	40	0.2	107	0.5
Industrial	81	0.4	134	0.6
Governmental and Institutional	55	0.3	62	0.3
Transportation, Communication, and Utilities	617	2.9	652	3.1
Recreational	33	0.2	33	0.2
Urban Subtotal	1,613	7.6	1869	8.8
Rural				
Agricultural	14,012	66.3	13,802	65.4
Other Open Lands	720	3.4	799	3.8
Wetlands	3,057	14.5	2,941	13.9
Woodlands	1,398	6.6	1,331	6.3
Water	326	1.5	326	1.5
Extractive	14	0.1	72	0.3
Landfill	0	0.0	0	0.0
Rural Subtotal	19,527	92.4	19,271	91.2
Total	21,140	100.0	21,140	100.0

[a] *Parking included in associated use.*

Source: SEWRPC

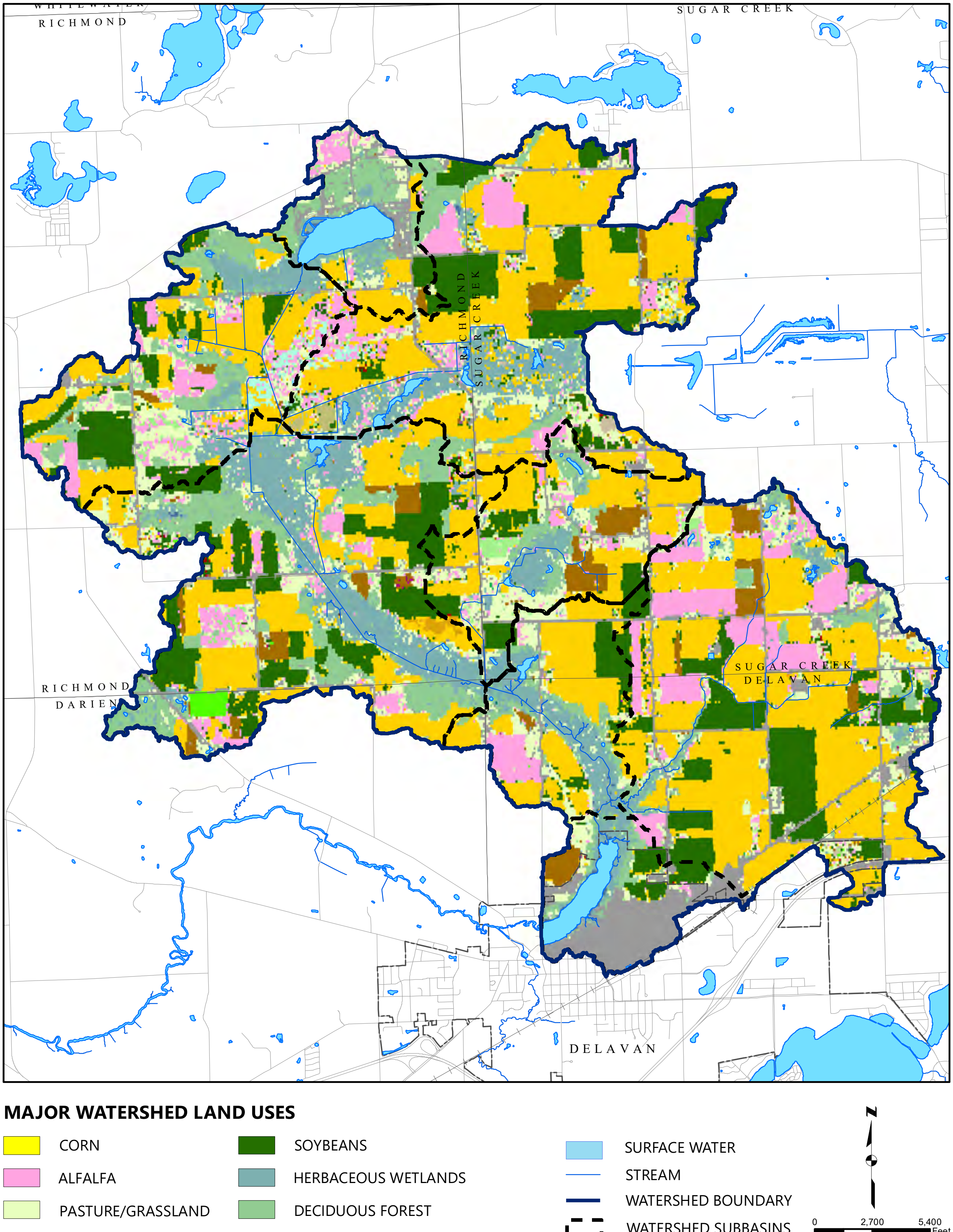
and winter wheat were the fourth and fifth most common crop types in all three years. Various categories of woodlands, wetlands, and developed land uses were also common land uses in each year. Several other crops were identified as occurring on between 10 and 100 acres in 2011 and 2023, including sod/grass seed, oats, peas, fallow/idle cropland, sweet corn, and dry beans.

Walworth County staff described common farming practices within the County as preparation for the forthcoming Fox River Total Maximum Daily Load (TMDL).[19] These practices were confirmed with County staff to also be representative of farming practices with the Upper Turtle Creek watershed.[20] An estimated 75 percent of farms use a cash grain rotation, where corn and soybeans are rotated every year or corn for two years followed by soybeans for one year. A continuous corn rotation is used by an estimated 10 percent of farms. Fall tillage is utilized when a corn planting follows a previous corn crop but fall tillage or no tillage is used when soybeans follow a corn crop. Soybean residue is lightly tilled in the spring. For continuous corn, fall chisel plow and fall chisel and disk plow were the two most common tillage strategies while farms with a cash grain rotation may use one of several strategies, including fall chisel plow, spring vertical till, fall disk and chisel plow, no-till, or cultivating in spring. Average fertilizer application rates for cash grain rotations are 60 pounds of phosphorus per acre and 120 pounds of nitrogen per acre while rates for continuous corn are 40 pounds of phosphorus per acre and 170 pounds of nitrogen per acre. Responses regarding dairy manure applications indicated that daily haul farms with corn grain and corn silage will apply an estimated 25 tons of solid manure every day during the non-growing season without soil incorporation while manure storage farms will apply 15,000 gallons of liquid manure two to three times per year and will incorporate manure into the soil. Manure is rarely applied to alfalfa fields. Soil phosphorus concentrations on farms

[19] *Wisconsin Department of Natural Resources,* Agricultural Survey Results for the Fox Illinois River Basin TMDL*, October 2023. dnr.wisconsin.gov/sites/default/files/topic/TMDLs/FOXILTMDLAg-SurveyResults.pdf.*

[20] *Personal communication between Commission and County staff in September 2024.*

Map 2.9
Agricultural Land Uses Within the Upper Turtle Creek Watershed: 2023



Source: SEWRPC

range from 25 to 80 parts per million with a note that phosphorus levels are generally higher in areas with large dairy farms than in areas without them.

In addition to the more common agricultural operations described above, there are several specialty operations within the watershed. Some of these operations are listed below:

- An approximately 860-acre sod farm (DeBuck's Sod Farm) located at the confluence of Turtle Creek and the Turtle Valley tributary covering parts of the Turtle Lake, Turtle Valley Headwaters, North Turtle Creek, and Middle Turtle Creek subbasins[21]

- A 200-acre wholesale tree nursery growing ornamental and shade trees as well as shrubs located partially within the Middle Turtle Creek subbasin[22]

- A certified organic crop and vegetable farm utilizing regenerative agricultural practices on 20 acres with another 60 acres for hog and cattle pasture in the Middle Turtle Creek subbasin; this farm is part of the Turtle Creek Gardens Community Supported Agriculture (CSA) program[23]

- A certified organic vegetable farm in the CTH P Tributary subbasin; this farm is part of the LotFotL CSA program[24]

- A 40-acre wholesale and retail nursery growing ornamental trees, shrubs, and grasses located partially in the Lake Comus subbasin[25]

Animal Operations

Walworth County staff provided a map of animal operations within the watershed as of 2021 (see Map 2.10). Apart from one animal operation in the CTH O Tributary subbasin, which is described in greater detail below, this inventory is still representative of estimated animal counts and animal operation locations within the watershed. The subbasins with the highest numbers of animal operations are the CTH O Tributary, Middle Turtle Creek, and the Turtle Valley Headwaters subbasins. Dairy cattle are the most common livestock with dairy operations located across the watershed (see Figure 2.2). At least two operations produce beef cattle; both these operations are in the Middle Turtle Creek subbasin. Other animal operations include a horse ranch located in the CTH P Tributary subbasin, hogs raised on pasture in the Middle Turtle Creek and CTH O Tributary subbasins, and sheep, goats, and chickens at several farms throughout the watershed.

In Wisconsin, an animal feeding operation with 1,000 or more animal units is defined as a Concentrated Animal Feeding Operation (CAFO).[26] Under state and federal law, CAFOs must have a WDNR-issued Wisconsin Pollutant Discharge Elimination System (WPDES) permit to protect surface and ground waters from excessive runoff and animal waste. Consequently, CAFOs are more stringently monitored and regulated than smaller animal feeding operations. Among the requirements are that CAFOs have a nutrient management plan developed as part of the permit process; that response plans are developed for manure and non-manure spills; that manure spreading limits and setbacks are specified; and that additional inspection, monitoring, and reporting requirements are adhered to.[27]

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[21] *www.debucksodfarmwi.com.*

[22] *www.turtlecreekwholesale.com.*

[23] *www.turtlecreekgardenscsa.com.*

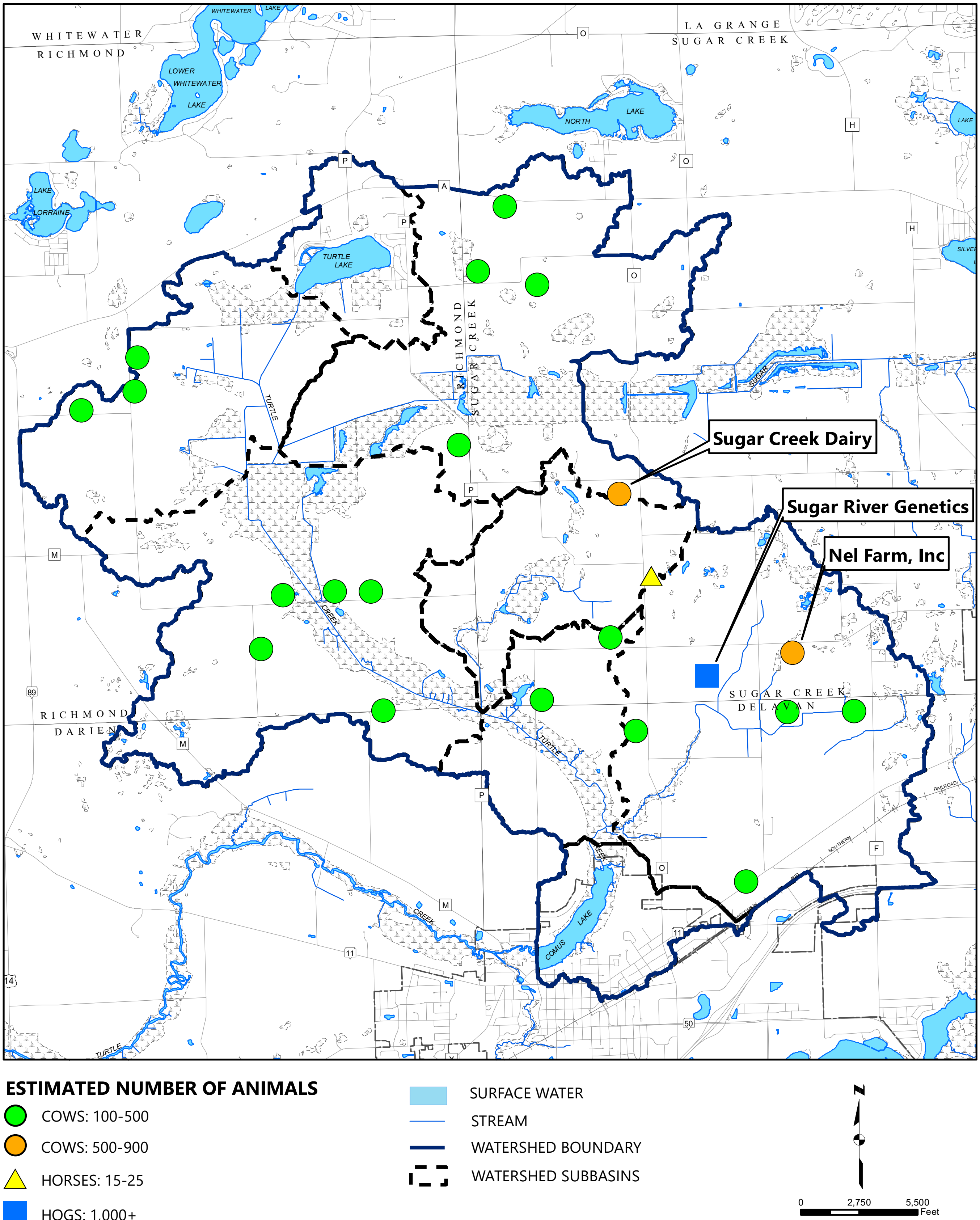
[24] *lotfotl.com.*

[25] *www.arbor-vista-nursery.com.*

[26] Wisconsin Administrative Code *NR 243 Animal Feeding Operations relates an animal unit to the impact of one beef steer or cow. Therefore, 1000 beef cattle are equivalent to 1000 animal units. Other animals have differing ratios. For example, the following numbers of animals are equivalent to 1000 animal units: 500 horses, 715 dairy cattle, 5,000 calves, 5,500 turkeys, 10,000 sheep.*

[27] *For more information, see www.dnr.wisconsin.gov/topic/CAFO/WPDESNR243.html.*

Map 2.10
Animal Operations Within the Upper Turtle Creek Watershed



Source: Walworth County and SEWRPC

Since the publication of CAPR 341, one CAFO (Nel Farm Inc.) was permitted and is operating within the watershed.[28] This CAFO is a dairy located on Elkhorn Road within the CTH O Tributary subbasin that reported 1,105 animal units as of January 1st, 2024.[29] As part of the WPDES permit application, Nel Farm Inc. was required by the WDNR to provide construction plans, manure storage calculations, livestock counts and plans, soil samples, manure application plans, identified fields for manure spreading, and maps of conduits to surface waters in relation to those fields. The permit requires 180 days of manure storage, but Nel Farm Inc. estimated approximately 267 days of manure storage in its nutrient management plan narrative.[30] At the end of 2023, all waste storage was built and was being utilized with approximately 10,394,457 gallons of manure and process wastewater as well as approximately 2,500 tons of solid manure.

Figure 2.2
Animal Operations in Upper Turtle Creek Watershed: 2023

Source: SEWRPC

To meet their permit requirements, the CAFO must conduct daily monitoring of water lines and systems; weekly monitoring of storm water controls, runoff controls, silage leachate contaminant and transfer system, liquid waste storage, sand settling lanes, and liquid storage depth; and quarterly inspection of production and feed storage areas. No discharge of manure or process wastewater is permitted from the CAFO production areas unless all the following apply:

- Precipitation causes an overflow from a containment or storage structure
- The containment or storage structure is properly designed to capture precipitation from a 25-year, 24-hour precipitation event for Walworth County (corresponding to a 4.8 inch rainfall)
- The production area is following inspection, maintenance, and record-keeping requirements
- The discharge complies with groundwater and surface water quality standards

According to the nutrient management plan, the CAFO can spread manure on 1,578.2 acres, some of which are located adjacent to the CTH O tributary to Turtle Creek.[31] The nutrient management plan approval letter from WDNR recognized that the CTH O tributary is on the 303(d) list as impaired for total phosphorus.[32] The WPDES permit does not prohibit discharge via land spreading activities to surface waters, which are considered agricultural stormwater runoff as long as these activities are in compliance with the permit, but instead strives to minimize the risk of surface water runoff. The CAFO is not permitted to spread manure when the forecast calls for precipitation within 24 hours nor can the CAFO spread manure in prohibited areas, including those within 1,000 feet of a community well, fields without a soil test, fields where soil test

[28] *Wisconsin Department of Natural Resources,* Conditional Approval of Nel Farm Inc. Nutrient Management Plan, WPDES Permit No. 0066298-01-0*, April 12th, 2022.*

[29] *The Delong Company,* 2023 Annual Report, NEL Farms, Elkhorn Wisconsin*, January 11, 2024.*

[30] *NEL Farms Nutrient Management Plan Narrative provided to WDNR as part of nutrient management plan checklist for WPDES permit application. permits.dnr.wi.gov/records/cafo1/SitePages/StreamAttachment.aspx?ListID=1aaae114-8c54-46a9-b098-0b8ea3321251&stream=true&ItemID={588E99EF-49D6-4B8D-AB6A-DC18121A7B60}.*

[31] *WDNR, 2022,* op. cit.

[32] Ibid.

phosphorus exceeds 200 ppm, or within required setbacks to grassed waterways and surface water features.[33] Winter spreading of solid manure was permitted on four fields within the CTH O Tributary subbasin, but this spreading may not occur during a high risk runoff period. Winter spreading or spreading within surface water quality management areas needs to be injected or immediately incorporated into the soil.[34]

There are two larger animal operations within the watershed that do not yet meet the size limit for a CAFO: Sugar Creek Dairy and Sugar River Genetics (formerly Heritage Swine Genetics). Sugar River Dairy is located in the Turtle Valley Headwaters while Sugar River Genetics is within the CTH O Tributary subbasin. Sugar Creek Dairy has over 700 milking cows while Sugar River Genetics has over 1,000 mature hogs.[35] These operations warrant special notice due to the larger number of animals present but lack the permitting and monitoring that would be required if these operations met the CAFO size limit.

Best Management Practices

CAPR 341 described best management practices (BMPs) to reduce pollutant loading in agricultural areas, such as cover crops, grassed waterways, and reduced tillage, as well as in urban areas, such as rain gardens and reducing use of lawn fertilizer. The lake management plan also prioritizes agricultural parcels through their proximity to water to identify areas where BMPs would have the greatest impact on reducing pollutant loads. Additional maps identify the extent of grassed waterways and riparian buffer as identified through aerial imagery as well as areas for potential expansion of waterways and buffers within the watershed. As part of this plan development, Commission staff reexamined the potential for grassed waterways within the watershed and determined that more than 41,860 linear feet of new grassed waterways could be implemented to help control soil loss in the watershed. In preparing this 9KE plan, Commission staff received an updated map from Walworth County staff identifying BMPs within the Upper Turtle Creek watershed as of 2024 (see Map 2.11).

With the assistance of Brian Smetana, Walworth County Land Use & Resource Management, Commission staff conducted a watershed survey to verify and refine BMP estimates from aerial imagery. Commission staff joined Mr. Smetana on the afternoon of Friday, April 21st on a driving survey of the watershed to document and photograph existing BMPs as well as areas where BMPs would help to control erosion, runoff, and/or other forms of pollutant loading. The survey was conducted early in the growing season following a series of moderate rain events; ponding and erosion from recent precipitation were notable in several fields across the watershed (see Figure 2.3). Spring manure treatments had recently been applied to many of the fields. In general, many of the agricultural fields had BMPs that had been installed with collaboration from Walworth County (see Figure 2.4). Several of the areas identified for potential expansion of grassed waterways using aerial imagery in CAPR 341 exhibited minor soil erosion; these field results confirm the need for BMP installation to control soil runoff and hinder gully formation. For several existing BMPs, Mr. Smetana noted that maintenance and/or expansion could be conducted to help improve their function.

2.2 WATER POLLUTANT CAUSES AND CONCERNS

As detailed in CAPR 341, Commission staff have examined available water quality data and modeled non-point source pollutant loading in the Lake's watershed using the WiLMS and STEPL models. Turtle Creek, the CTH O Tributary, and Lake Comus exceed WDNR water quality standards for total phosphorus, resulting in their 2022 303(d) listing as impaired waters. Modeling outputs indicated that agricultural land uses, the predominant land use within the watershed, are contributing to elevated loads of phosphorus and sediment to Turtle Creek and Lake Comus. This section will describe watershed inventory work completed to better identify locations of pollutant sources within the watershed and refine the pollutant load modeling conducted for this planning effort.

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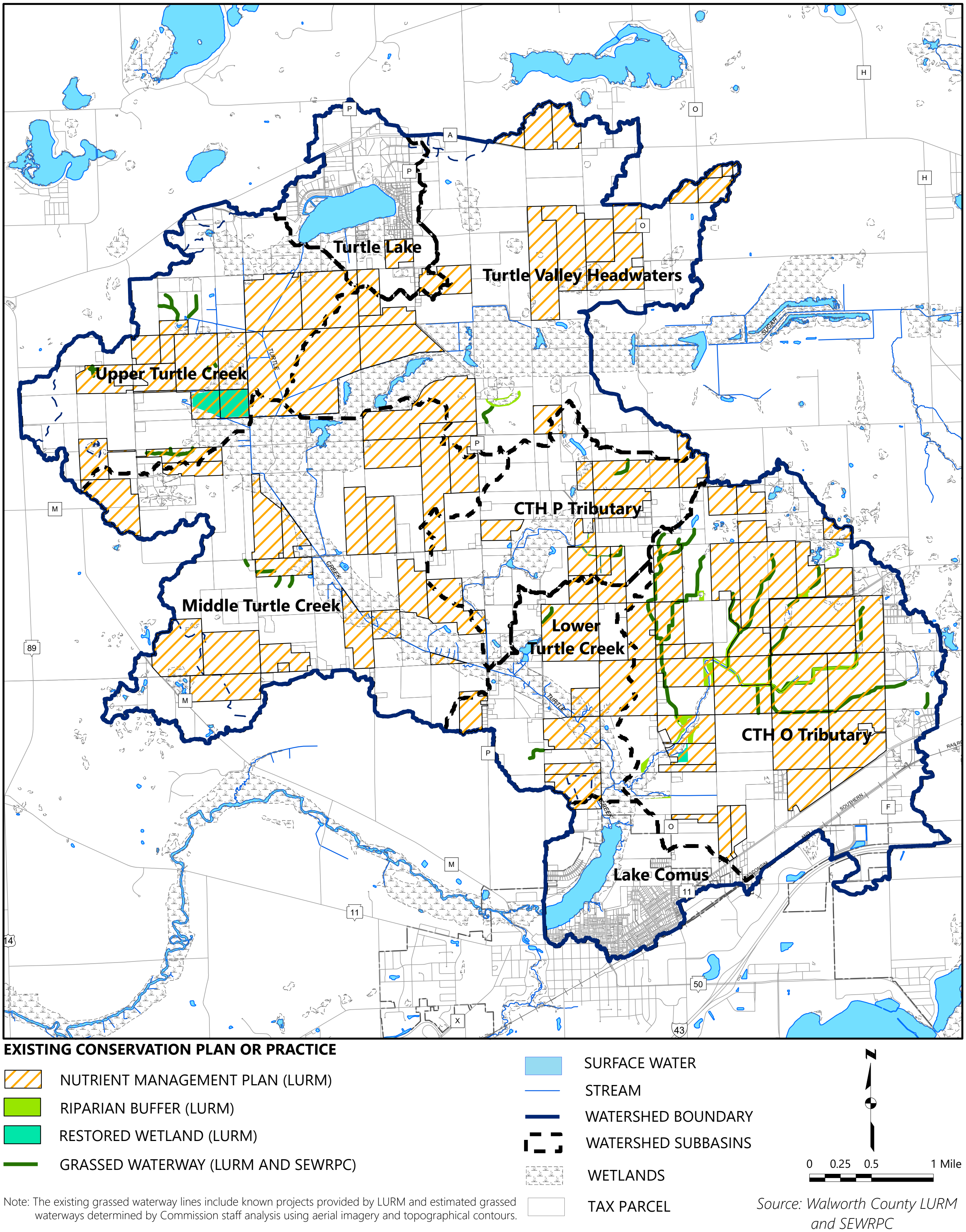
[33] *Per the permit, no applications will occur within 100 feet of a navigable water or within 25 feet of a conduit to a navigable water or wetland.*

[34] *Wisconsin Department of Natural Resources,* NR 243 – CAFO Winter Spreading Restrictions*. dnr.wisconsin.gov/sites/default/files/topic/CAFO/WinterSpreading.pdf.*

[35] *Animal numbers provided in personal communication between Commission staff and the LCPRD in August 2024.*

Map 2.11
Existing Conservation Plans and Practices Within the Upper Turtle Creek Watershed: 2024



Note: The existing grassed waterway lines include known projects provided by LURM and estimated grassed waterways determined by Commission staff analysis using aerial imagery and topographical contours.

Source: Walworth County LURM and SEWRPC

Figure 2.3
Water Quality Issues Observed During 2023 Watershed Survey

Runoff from Agricultural Fields Without Grassed Waterway

Recent Manure Applications on FieldsWaterway

Runoff and Erosion into Stream

Source: SEWRPC

Long-Term Water Quality Monitoring

As described in CAPR 341, there has been limited water quality monitoring within Turtle Creek and its tributaries outside of targeted, short-term campaigns by WDNR. As part of the data inventory for this plan and CAPR 341, volunteers have begun conducting monthly water temperature, dissolved oxygen, and total phosphorus monitoring at three stations in the watershed: two stations on Turtle Creek at the Dam Road and Island Road crossings and the final station on the CTH O tributary at the CTH O crossing. This section will describe water quality conditions within Turtle Creek and its tributaries as observed from these monitoring efforts.

Temperature and Dissolved Oxygen

Water temperature is an important element of water quality for lakes as streams because temperature influences the types of species that can live in rivers (each aquatic species has a preferred range) as well as affects dissolved oxygen concentrations in the water. Exceeding this temperature range can degrade the quality of aquatic life within the stream by limiting reproductive success, degrading habitat, and contributing to large fish-kill events. The WDNR classifies the Turtle Creek mainstem between Turtle Lake and Lake Comus as a warmwater sportfish community, which requires warm or cool waters with dissolved

Figure 2.4
Example Best Management Practices Observed During 2023 Watershed Survey

Grassed Waterways

Riparian Buffers

Land Enrolled in Conservation Reserve Program

Source: SEWRPC

oxygen concentrations that do not fall below 5.0 mg/L. The other tributaries in the watershed have been designated with attainable default Fish and Aquatic Life uses and are assumed to support either warmwater or coldwater communities depending on water temperatures and habitat in these streams.

Volunteers have monitored water temperatures monthly along the Turtle Creek mainstem at Dam Road during summer from 2019 to 2024 while volunteers and WDNR staff have monitored temperatures monthly of the CTH O tributary at CTH O during summer from 2017 to 2024. Summer temperatures at Dam Road ranged from 48 to 74°F while summer temperatures of the CTH O tributary ranged from 48 to 71°F (see Figure 2.5).

Commission staff also measured hourly temperatures in Turtle Creek upstream of the Lake at Dam Road and downstream of the Lake at Richmond Road from September 2019 to August 2021 using temperature loggers (Figure 2.6). Water temperatures of the CTH O tributary were also measured approximately 750 feet upstream of its confluence with Turtle Creek from October 2020 to August 2021. Summer Lake water temperatures were between three to six degrees Fahrenheit higher than those recorded upstream of the Lake at the Dam Road. The Lake was also between two and five degrees Fahrenheit warmer than the downstream Richmond Road site. However, the downstream site generally had slightly higher summer temperatures than the Upstream site. The CTH O tributary temperatures were generally 10°F lower than Turtle Creek upstream of the Lake, indicating that significant volumes of groundwater enter this tributary, a situation likely providing a coolwater refuge during summer. During the winter, the CTH O tributary maintained temperatures above 35°F while the sites located upstream, within, and downstream of the Lake were near or below freezing temperatures.

Temperature also governs the amount of oxygen that can be held in water (warmer water holds less oxygen than cool water).[36] The minimum DO standards for coldwater (trout) and warmwater streams, as set forth in Chapter NR 102 of the *Wisconsin Administrative Code*, are 6.0 and 5.0 mg/l, respectively. Minimum DO standards for coldwater streams are to maintain concentrations of 7.0 mg/l or greater during the trout spawning season. If the water in a stream, or other waterbody, becomes too warm, DO levels may be suboptimal (i.e., less than 5.0 mg/l) for many species of fishes and other aquatic organisms. However, streams can also become supersaturated with oxygen, generally above 15 mg/l, which can also be injurious to fish. Because the warmest water temperatures occur in the summer, this is the most important time of the year for determining physiological limitations for aquatic organisms based on DO concentrations.

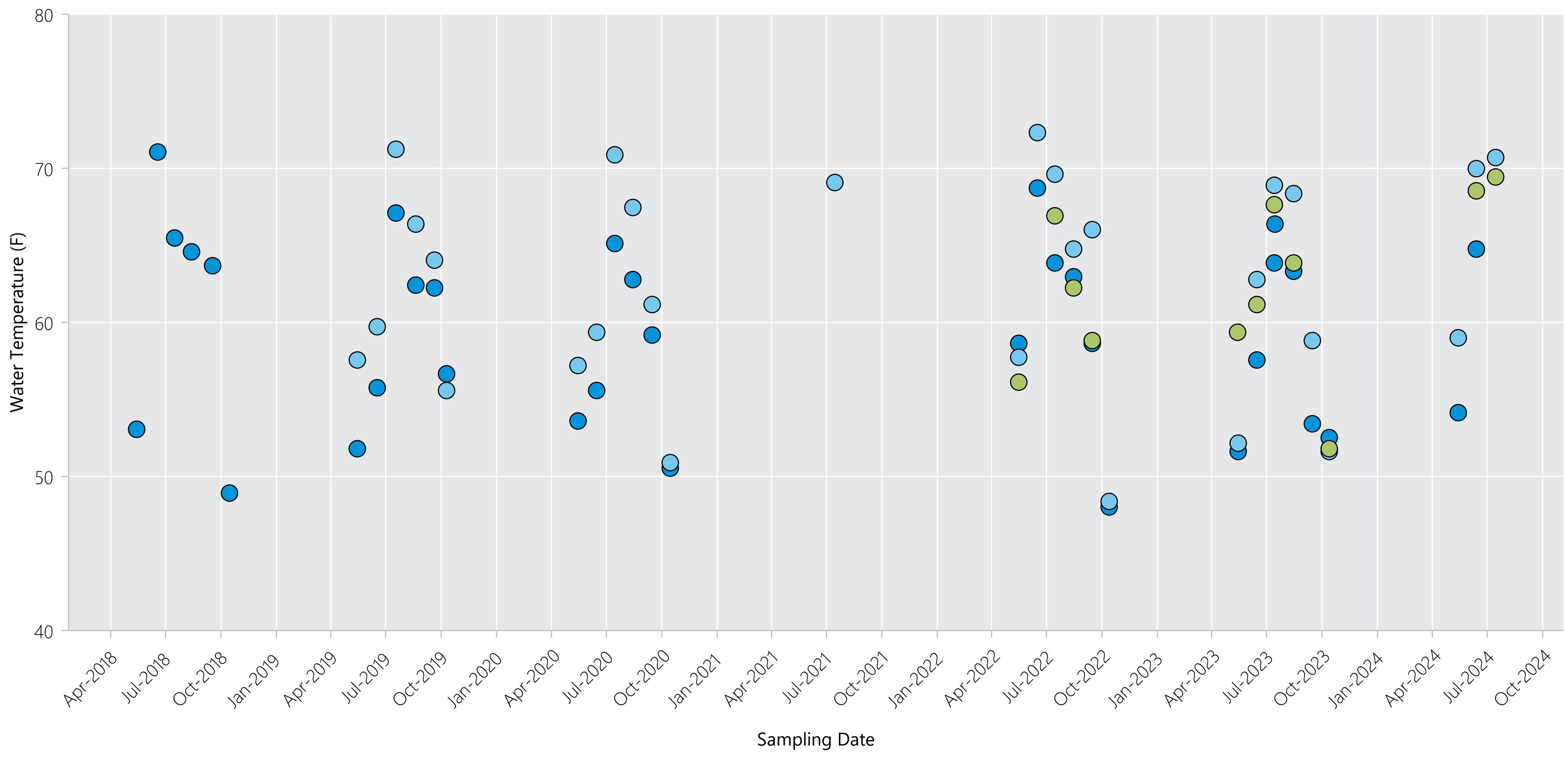
Along with water temperatures, volunteers have monitored dissolved oxygen concentrations along the Turtle Creek mainstem at Dam Road during summer from 2019 to 2024 while volunteers and WDNR staff have monitored temperatures of the CTH O tributary at CTH O during summer from 2016 to 2024. Dissolved oxygen concentrations of the CTH O tributary ranged between 3.0 to 18.9 mg/l, with a median of 8.1 mg/l, while concentrations of Turtle Creek ranged between 2.2 and 10.0 mg/l, with a median of 5.3 mg/l (see Figure 2.7). These measurements indicate that the CTH O tributary concentrations are generally supportive of a healthy fish population while concentrations for Turtle Creek at Dam Road were suboptimal (below 5.0 mg/l) in many observations.

Sediment

Volunteers from the Lake Comus Protection and Rehabilitation District (LCPRD) monitored total suspended sediment concentrations at the CTH O tributary and on Turtle Creek at Dam Road from 2019 to 2021 (see Figure 2.8). Total suspended sediment concentrations at the CTH O tributary ranged from 3 to 75 mg/l, with an average of 18.4 mg/l, while concentrations at Dam Road ranged from 2 to 197 mg/l, with an average of 28.6 mg/l. Monitoring events with high sediment concentrations also had high concentrations of total phosphorus (see below), indicating that much of the total phosphorus transported by Turtle Creek and its tributaries may be bound to organic sediment particles. Thus, intense precipitation events that drive soil runoff into surface waters may be a major contributor to sediment and total phosphorus loading in the Upper Turtle Creek watershed.

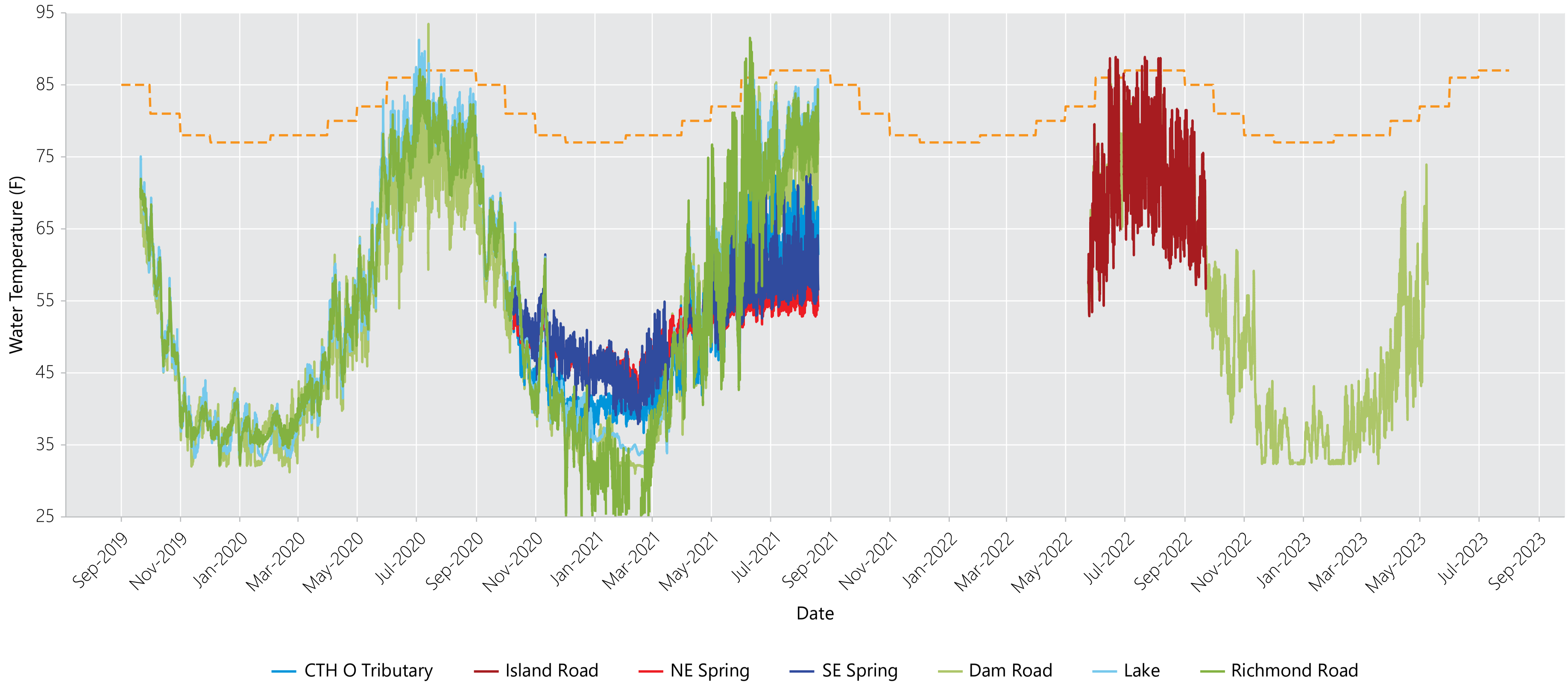
[36] *A key cause of increased stream temperatures is impervious surfaces (roadways, parking lots, buildings), which restrict infiltration of water.*

Figure 2.5
Water Temperature Monitoring on Turtle Creek and CTH O Tributary: 2018-2023



Source: LCPRD, WDNR, and SEWRPC

Figure 2.6
Water Temperatures of Lake Comus, Turtle Creek, and Groundwater Springs: 09/20/2019-05/09/2023



Note: Dashed orange line indicates acute temperature standard for inland lakes and impoundments. Upstream temperature logger may have been exposed to air on 07/14/2020, resulting in anomalously high temperatures.

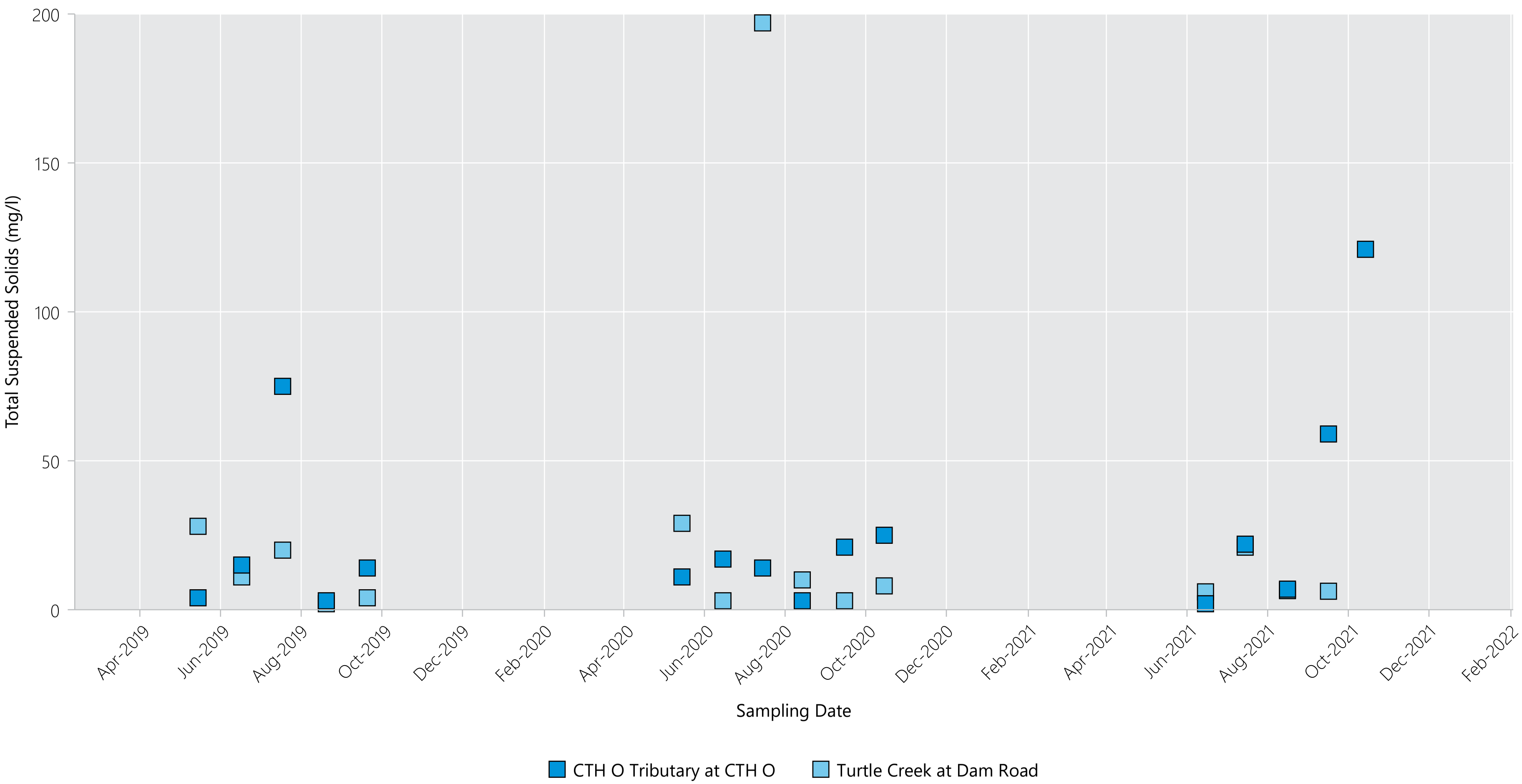
Source: SEWRPC

Figure 2.7
Dissolved Oxygen Monitoring on Turtle Creek and CTH O Tributary: 2018-2023

Note: The dashed red line indicates 5 mg/l, below which dissolved oxygen concentrations are generally unhealthy for aquatic life.

Source: LCPRD, WDNR, and SEWRPC

Figure 2.8
Total Suspended Solids Monitoring on Turtle Creek and CTH O Tributary: 2019-2021



Source: LCPRD, WalCoMet, and SEWRPC

Phosphorus

Phosphorus is a key nutrient for aquatic plants and algae, with the availability of phosphorus often limiting their growth and abundance. Sources of phosphorus can vary across a watershed, with agricultural fertilizers and animal manure as the predominant phosphorus sources in rural areas while stormwater discharge and onsite wastewater treatment systems contribute phosphorus in urban areas.

Total phosphorus concentrations were monitored on the CTH O tributary in 2016-2017 as part of the Targeted Watershed Assessment for Turtle Creek as well as on the CTH O tributary and on Turtle Creek at Dam Road in 2019-2023 (see Figure 2.9 and Map 2.12). Summer monthly total phosphorus measurements commenced on Turtle Creek at Island Road in 2022. Phosphorus concentrations in the CTH O tributary, Turtle Creek at Dam Road, and Turtle Creek at Island Road averaged 0.22, 0.24, and 0.19 mg/L, respectively. All three average concentrations are substantially higher than the 0.075 mg/L phosphorus limit for Turtle Creek set by the Rock River TMDL as well as the limit for streams and small rivers established in NR 102.06.[37] These concentrations generally peak in mid-summer and are lower during the May and October sampling events. This timing may reflect phosphorus loading sources but are likely also related to dilution effects from higher streamflow in spring and fall than mid-summer. Continued summer monthly water quality monitoring at these stations are necessary to monitor progress towards meeting TMDL goals. Chapter 3 provides recommendations regarding continuing and expanding water quality monitoring efforts within the Upper Turtle Creek watershed.

In the summers of 2020 and 2021, LCPRD volunteers collected and analyzed water samples for phosphorus from the upstream portions of the watershed. All these samples, aside from a 0.06 mg/l sample collected on June 30th, 2020 at the culvert under Turtle Lake Road, contained total phosphorus concentrations far exceeding the 0.075 mg/L phosphorus limit. Turtle Lake, the source of Turtle Creek, has averaged total phosphorus concentrations of 0.020 mg/L in its surface waters at its "deep hole" site from monitoring conducted between 1996 and 2024, with a slight decline in concentrations since 2010.[38] This indicates that Turtle Lake is not a major source of total phosphorus to the Creek, as this concentration is far lower than the total phosphorus concentrations measured further downstream.

Total phosphorus concentrations have also been measured in agricultural drain tile effluent in the Upper Turtle Creek watershed.[39] Drain tiles have been shown to export multiple forms of phosphorus and can be a substantial portion of total phosphorus loss from agricultural systems.[40] Drain tile effluent total phosphorus concentrations ranged from non-detectable to 0.63 mg/l in 2020 and 2021. Of the six drain tile samples collected, four were higher than the 0.075 mg/l total phosphorus standard for streams and small rivers. Several of these samples were collected after heavy rainfall and thus may not represent average phosphorus concentrations of the drain tile effluent. Furthermore, some drain tiles are also used to convey surface runoff and may not be completely representative of tile infiltrate after storms. Additionally, flow measurements were not collected for the drain tile effluent and thus a measure of the total phosphorus load from these tiles could not be calculated. However, these observations demonstrate that drain tiles are contributing water exceeding total phosphorus standards and thus further study into their total phosphorus loading to Turtle Creek and its tributaries is warranted.

Peaks in total phosphorus concentrations at the Dam Road and CTH O tributary sites were associated with periods of elevated rainfall, indicating that Turtle Creek becomes a more significant source of phosphorus and sediment to Lake Comus during periods of heavy precipitation and runoff. Phosphorus is tightly bound to soil particles, so as the soil is eroded during heavy precipitation events, the Creek becomes turbid and phosphorus transport rates greatly increase. This phenomenon has been studied by the US Geological Survey in the Bark River in Waukesha County, where half of the total phosphorus load of the Bark River was transported on about 10 percent of the days during their monitoring period. Total annual precipitation has

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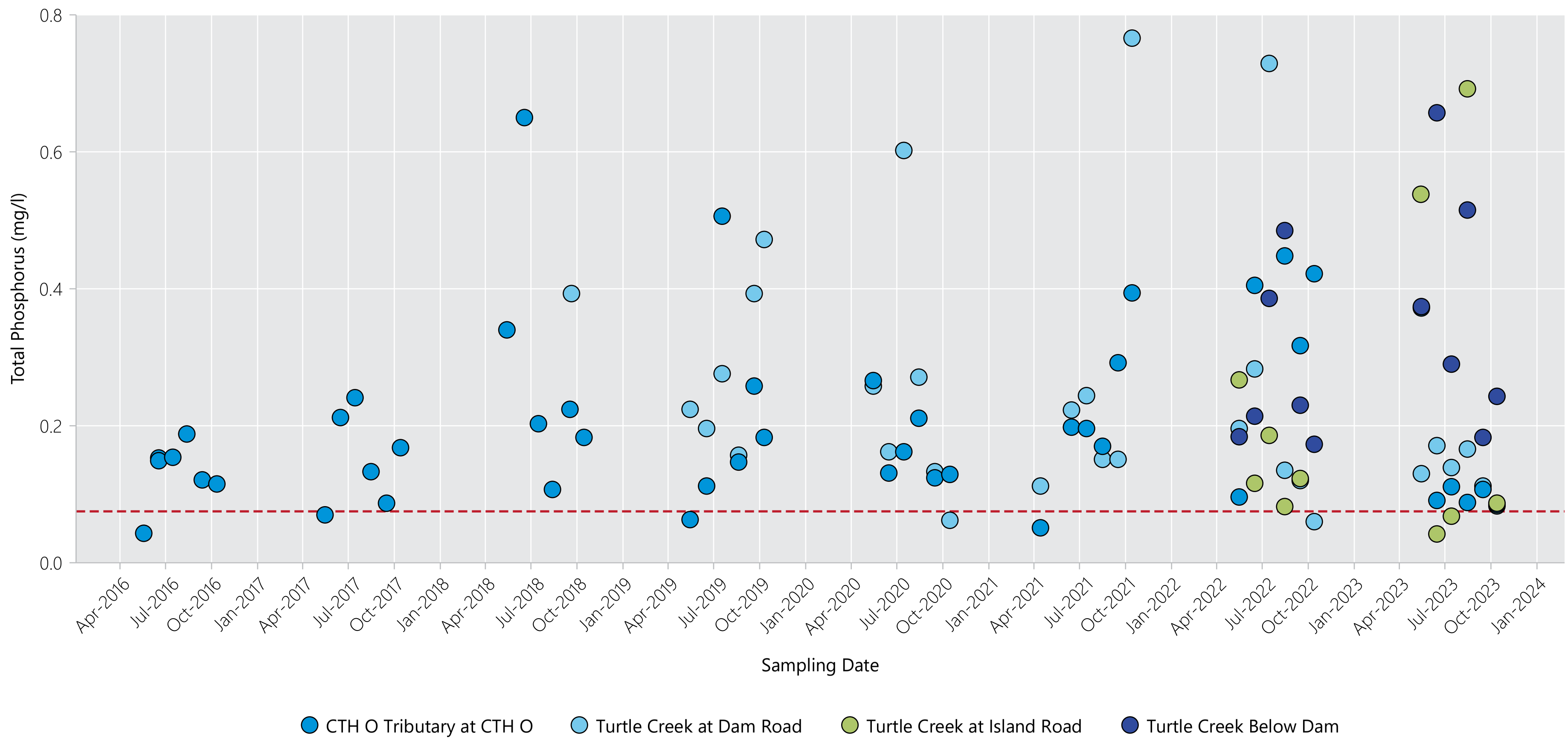
[37] *USEPA and WDNR, July 2011,* op. cit.

[38] *dnrx.wisconsin.gov/swims/viewStationResults.do?id=12406*.

[39] *Agricultural drain tiles are perforated conduits buried to more rapidly drain water and lower high water table elevations. Drain tiles are intended to increase agricultural productivity in soils that are excessively wet during potions of the year.*

[40] *For a thorough literature review on phosphorus dynamics with drain tiles, see J. Moore,* Literature Review: Tile Drainage and Phosphorus Losses from Agricultural Land, Lake Champlain Basin Program*, 2016*.

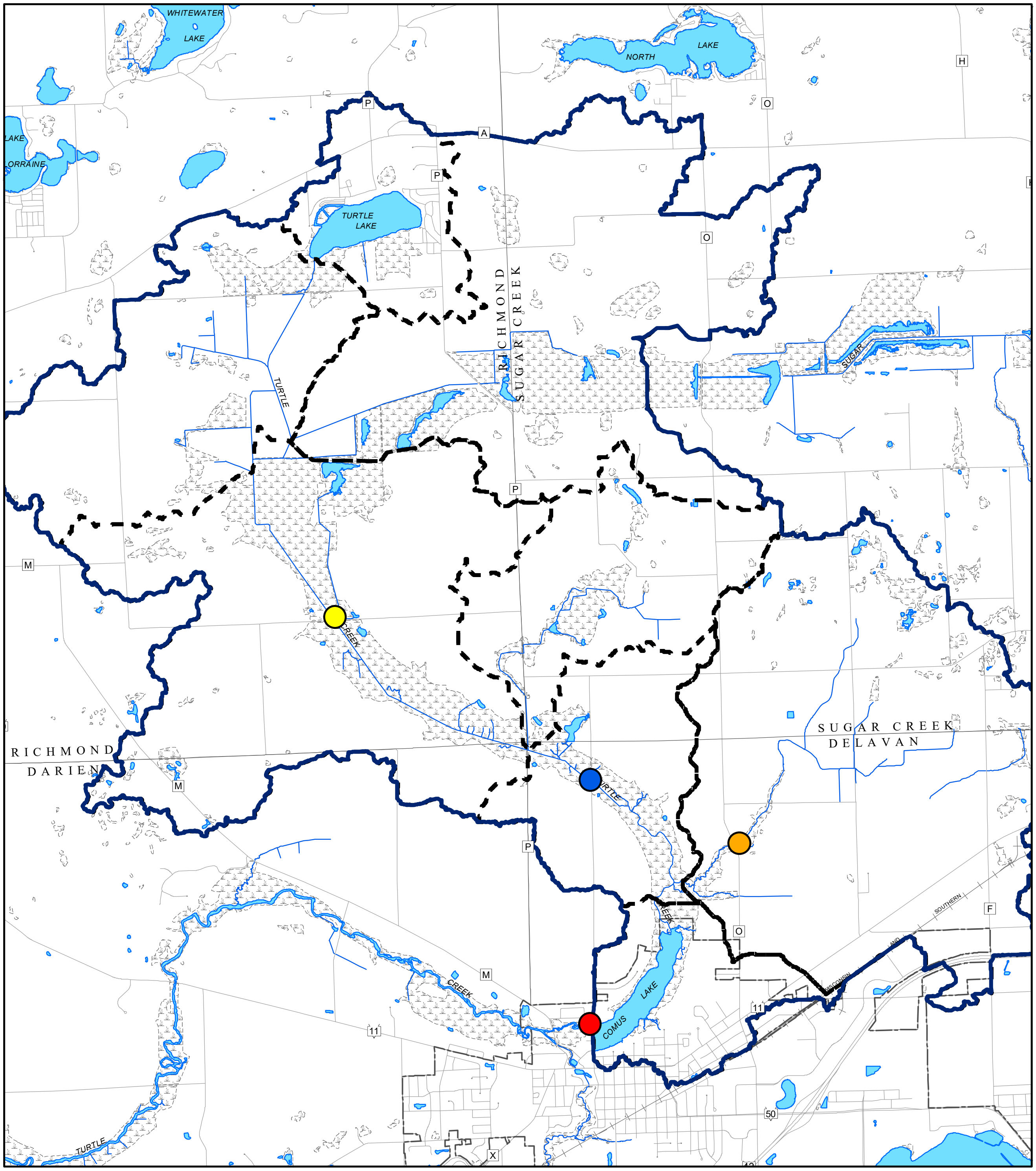
Figure 2.9
Total Phosphorus Monitoring on Turtle Creek and CTH O Tributary: 2016-2023



Note: The dashed red line indicates the 0.075 mg/l total phosphorus impairment threshold for Wisconsin streams.

Source: LCPRD, WalCoMet, and SEWRPC

Map 2.12
Mean Total Phosphorus Concentrations for Sites with Six Monthly Summer Samples



Station ID, Mean Total Phosphorus Concentration, and Years Active

- STATION 10044913: 0.22 mg/l (2019 - 2024)
- STATION 10052470: 0.24 mg/l (2016 - 2024)
- STATION 653018: 0.19 mg/l (2022 - 2024)
- STATION 10056091: 0.33 mg/l (2022 - 2024)

SURFACE WATER
STREAM
WATERSHED BOUNDARY
WATERSHED SUBBASINS

N

0 2,400 4,800 Feet

Source: SEWRPC

been increasing over the past century as have the number and intensity of large rainfall events occurring each year.[41] Thus, we can expect that runoff events have and will continue to affect phosphorus and sediment loading to Turtle Creek and Lake Comus.

Impairment Listings

As of the 2024 listing cycle, the Turtle Creek mainstem between Turtle Lake and Lake Comus is classified as Not Supporting its Aquatic Life designated use. Based on the monitoring described above, the WDNR listed Turtle Creek, the CTH O tributary, and Lake Comus as impaired on the 303(d) list with total phosphorus from non-point sources as the contributing pollutant. These listings were made because the total phosphorus concentrations in the streams consistently exceed the stream and small river standard of 0.075 mg/l while the concentrations in Lake Comus exceed the impoundment standard of 0.040 mg/l. All other tributaries to Turtle Creek within the watershed were not assessed regarding their support of their default Aquatic Life designated use.

2023 Turtle Creek Survey

A survey of Turtle Creek and its major tributaries provided an opportunity to collect valuable information related to water quality concerns that was not inventoried for CAPR 341. With assistance from a volunteer from the LCPRD, Commission staff surveyed an approximately seven-mile reach of Turtle Creek from near its headwaters at Turtle Lake to its outlet at Lake Comus on June 21st, July 7th, August 3rd, August 28th, and October 30th. The summer of 2023 was marked by a persistent drought, so water levels in the Creek were likely below normal during the stream survey. The lack of water within the stream limited the utility of continuing the survey north of Turtle Lake Road as there was little to no flowing water within the stream in this northernmost reach. Consequently, Commission staff decided to focus survey efforts on other parts of the watershed, including the CTH O tributary.

Throughout the survey, staff recorded potential pollutant loading sources such as drain tiles and streambank erosion as well as habitat features such as groundwater springs, aquatic plant beds, and overhanging woody habitat when encountered. Additionally, Commission staff measured the following stream morphological and water quality measurements: stream water depth and width; sediment depth and characteristics; water turbidity; water temperature, dissolved oxygen; and specific conductance. Water depth, sediment depth, wetted width, and bank height measurements were taken across the Creek at 28 cross-sections established by Commission staff (see Map 2.13). These cross-sections were located irregularly throughout the Creek as they were placed when Commission staff determined that the Creek's character had substantially changed since the previous reach. Water quality measurements were taken at these cross-section locations as well as sporadically throughout the survey when groundwater springs or other features were observed. The following subsections will describe these survey observations in greater detail.

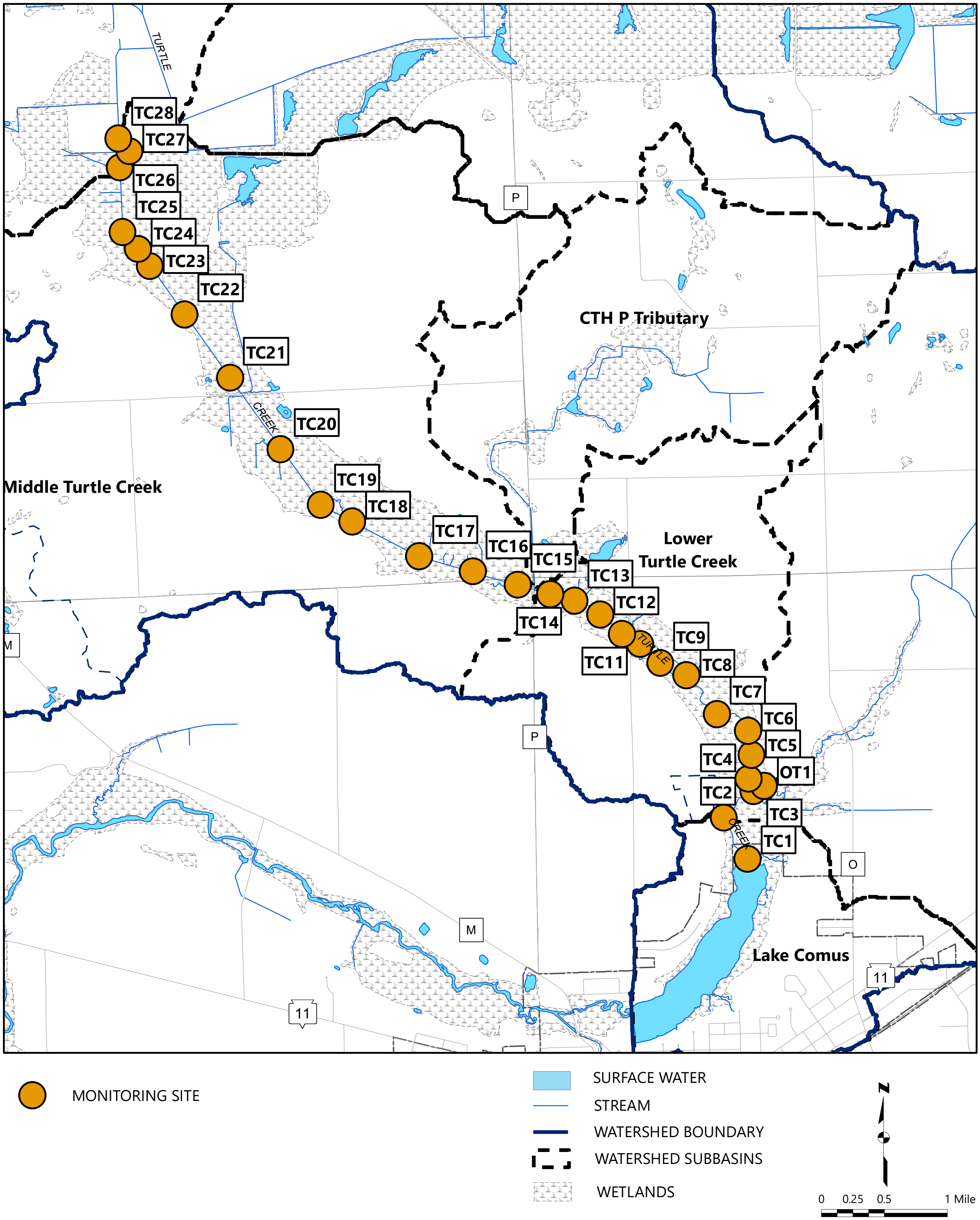
Hydrologic Modifications

Turtle Creek from Turtle Lake to Lake Comus is a low-gradient stream system, characterized by a gradient of about 0.005 feet/foot or lower (see Figure 2.10). High-quality low-gradient streams tend to lack riffles and have relatively slow currents, small substrate particle sizes, and well-developed meandering (i.e., high sinuosity) channel morphology. Such systems often flow through wetlands and may have very soft, unconsolidated (i.e., organic) substrates and poorly defined channels in some cases. All these characteristics were observed by Commission staff during the Creek survey and were particularly notable on the mainstem upstream of Dam Road. The low gradient of the stream limits its ability to restore natural meanders; human intervention will likely be required to reestablish the natural sinuosity of this stream and restore the functioning of a healthy stream system.

Straightening meandering stream channels (sometimes labelled ditching or channelization) was once a widely practiced technique thought to speed runoff. To facilitate drainage, many channelized stream reaches were commonly dredged much deeper and wider than the pre-existing stream channel provide a discharge point for drainage ditches and tiles. As described in CAPR 341, Turtle Creek has been channelized and straightened to improve drainage for agricultural production in the watershed. Plat maps produced in 1837 show an approximate streamline of Turtle Creek that was narrower and with many more meanders than the current streamline (see Figure 2.1). Between Turtle Lake Road and Dam Road, Turtle Creek is extremely

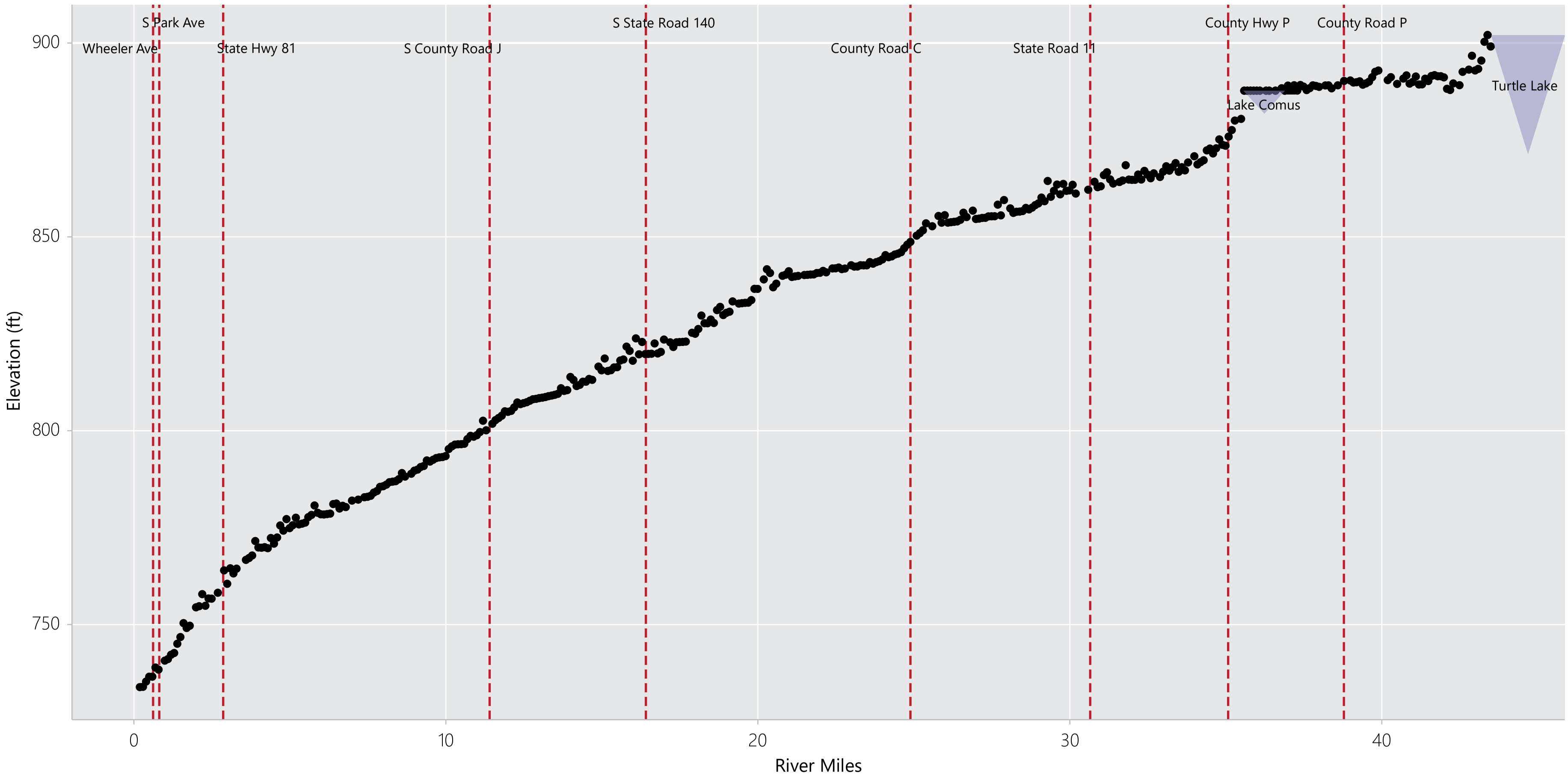
[41] *wicci.wisc.edu/2021-assessment-report/full-report.*

Map 2.13
Survey Sites for Turtle Creek Survey: 2023



Source: SEWRPC

Figure 2.10
Stream Elevation Profile for WBIC 790300: Turtle Creek



Note: Elevation data from the USGS 3D Elevation Program.

Source: USGS and SEWRPC

straight with no natural meanders, incised banks that are disconnected from the surrounding floodplains, and little variation in stream features that could provide habitat for a greater diversity of organisms (see Figure 2.11). These modifications are contributing to water quality problems as channelization facilitates sediment delivered by agricultural runoff downstream to lower portions of the Creek and to Lake Comus. Channelization compromises the stream's ability to access floodplain areas during high runoff periods, which reduces the capacity of the stream and riparian area to filter pollutants, reduces floodwater storage area, increases the stream erosive power, and destabilizes the stream banks.

Commission staff observed many hydrologic modifications along the Turtle Creek mainstem, including numerous tiles draining agricultural fields, several infilled culverts impeding water flow downstream, and pumping operations that appear to block and alter the flow direction of the water by withdrawing water from the Creek and its tributaries to provide irrigation on agricultural fields. These changes alter the natural stream flow regime, which can have detrimental effects such as decreasing water infiltration by soil and vegetation, reducing clean and cold groundwater discharge, and diminishing stream baseflow. During the stream survey, Commission staff documented and mapped the locations of hydrologic modifications, such as drain tiles, culverts, and pumps (see Map 2.7, Figure 2.12 and Figure 2.13).

Aside from the channelized and incised stream morphology, no hydrological modifications in the form of drain tiles, culverts, or pumping were observed on Turtle Creek south of Island Road. The road crossings under Dam Road, CTH P, and Island Road are all bridges that likely constrain flow during high water conditions while the roads themselves may constrain shallow groundwater flow. As the survey was conducted in summer with abundant riparian vegetation on each bank, it's possible that drain tiles are directly contributing to the stream that were not observed by Commission staff. However, given the extensive wetlands flanking the Creek, it seems likely that tiles draining adjoining agricultural fields would discharge into these wetlands first.

The most intensive and extensive hydrologic modifications are located between Turtle Lake Road and Island Road along properties owned by the DeBuck's sod farm and WDNR. Almost one mile upstream of Island Road, the Creek takes a sharp bend and flows under a small bridge that may constrain water flow. The Creek then sharply bends again and is straight for a quarter-mile until a large, potentially infilled culvert topped by an earthen berm impedes flow from the north. From this point northward, Turtle Creek becomes highly modified as the channel is split into two segments, both of which are impeded by culverts with earthen berms, and meets with the Turtle Valley Tributary, which is also split into two segments that are impeded by culverts and berms. As Commission staff approached the confluence of both segments of Turtle Creek, the flow appeared to change direction from southward to eastward where a weir and pump redirected water from the confluence of the eastern segment Turtle Creek and the Turtle Valley Tributary northward (see Map 2.14). At the northern end of this segment, another pump was withdrawing water from the Creek to presumably supply agricultural fields (see Figure 2.12). Upstream of this pump, the Creek flows southward from a perched culvert under Turtle Lake Road where the stream was rerouted to bypass a former dam (see Figure 2.13). Water levels in the Creek were too low in 2023 to continue the stream survey upstream of Turtle Lake Road; however, available aerial imagery suggests that the stream is in a somewhat more natural state with some meandering as it flows through a wetland south of its headwaters at the Turtle Lake outlet.

Drain tiles and drain tiles markers were recorded by Commission staff when observed throughout the survey (see Figure 2.13). While a few drain tiles were observed along the Turtle Creek mainstem immediately north of the partially impounded culvert, the vast majority of the observed drain tiles were near the confluence of Turtle Creek and the Turtle Valley Tributary. Within this area, Commission staff noted over one hundred markers indicating tiles that were draining nearby agricultural fields in the Creek and its tributaries.

The entire stream reach south of Turtle Lake Road and north of the partially impounded culvert is worth specific discussion. As described above, this area has the most significant hydrologic modifications, not only to the Turtle Creek mainstem but also to its tributaries. These streams are split into separate branches, impounded, pumped, and have numerous drain tiles contributing to them within this stream complex. Several stream segments in this complex exhibited little to no flow and appeared to be acting more like linear ponds from which water could be withdrawn and drained into. All of these stream segments exhibited symptoms of nutrient enrichment, such as an abundance of duckweed (*Lemna* spp.), watermeal (*Wolffia* spp.), and algal scums (see "Water Quality" subsection for further discussion). As indicated in Map 2.14, the combination of culverts, pumping, and drain tiles created a cycling of water that appeared to limit flow downstream and instead redirected water from the Creek, onto the fields, and through the tiles back into the Creek to be withdrawn again for irrigation. It is important to note that this survey occurred during drought conditions and presumably during high flow conditions the water would naturally flow and potentially be pumped downstream to alleviate flooding concerns on the adjoining farm fields in this area. During drought conditions, this complex may largely recycle its water and become mostly disconnected from the rest of the Turtle Creek mainstem downstream.

Figure 2.11
Channelized Reaches of Turtle Creek: 2023

Source: SEWRPC

Water Depth and Sediment Depth and Composition

Commission staff measured water depth, sediment depth, sediment composition, and stream morphological characteristics, such as wetted width and incised depth, in cross-sections across the Creek. A range pole was used to estimate flocculent sediment depths to the nearest tenth of a foot and water widths to nearest one-half foot at five points (at left bank, halfway between left bank and thalweg, thalweg, halfway between thalweg and right bank, and right bank) at each cross-section.

Most recorded water depths in the 2023 survey were quite shallow with a mean water depth of 1.3 feet across all observations.[42] Across all cross-sections, the thalweg had the highest average water depth while Site TC4 had the greatest average water depth at 2.3 feet across its cross-section. Across the entire Creek survey, the average water depth was higher at the most upstream and downstream portions while the water depth was lower in the middle reaches, with an average depth of only 0.3 feet deep across its cross-section at Site TC20 (see Map 2.15 and Figure 2.14). As previously mentioned, the stream survey was conducted during a moderate drought extending throughout much of the summer and early fall, so recorded water levels are likely lower than typical for this time of year. The low water levels likely contributed to water warming due to solar radiation, although this warming may have been offset by the contribution of colder groundwater that comprises much of the stream baseflow.

The wetted width is a of the stream width from where the water's edge meets the bank at the time of survey completion. Consequently, the wetted width can vary with water levels and will not represent bankfull widths during dry conditions as experienced in summer 2023. The widest portions of the Creek were near the outlet to Lake Comus, where backwatering effects are likely increasing its width (see Map 2.16). The stream generally narrowed moving upstream until just upstream of Dam Road, where the Creek briefly widened potentially from constrained flow by the Dam Road culvert. From Dam Road, the Creek gradually narrowed to a width of 21.3 feet just upstream of Island Road. The Creek gradually widened moving upstream until the impounded segments from which it then narrowed to Turtle Lake Road. There was so little water in the stream north of Turtle Lake Road that Commission staff did not take a wetted width measurement.

[42] *A pool located at the weir and pump north of Island Road had the greatest water depth observed during the survey at 6.1 feet, but this pool was not part of a stream cross-section.*

Figure 2.12
Culverts and Drain Tiles Observed During 2023 Turtle Creek Survey

Source: SEWRPC

Figure 2.13
Examples of Surface Water Pumping and Irrigation Observed in Upper Turtle Creek Watershed

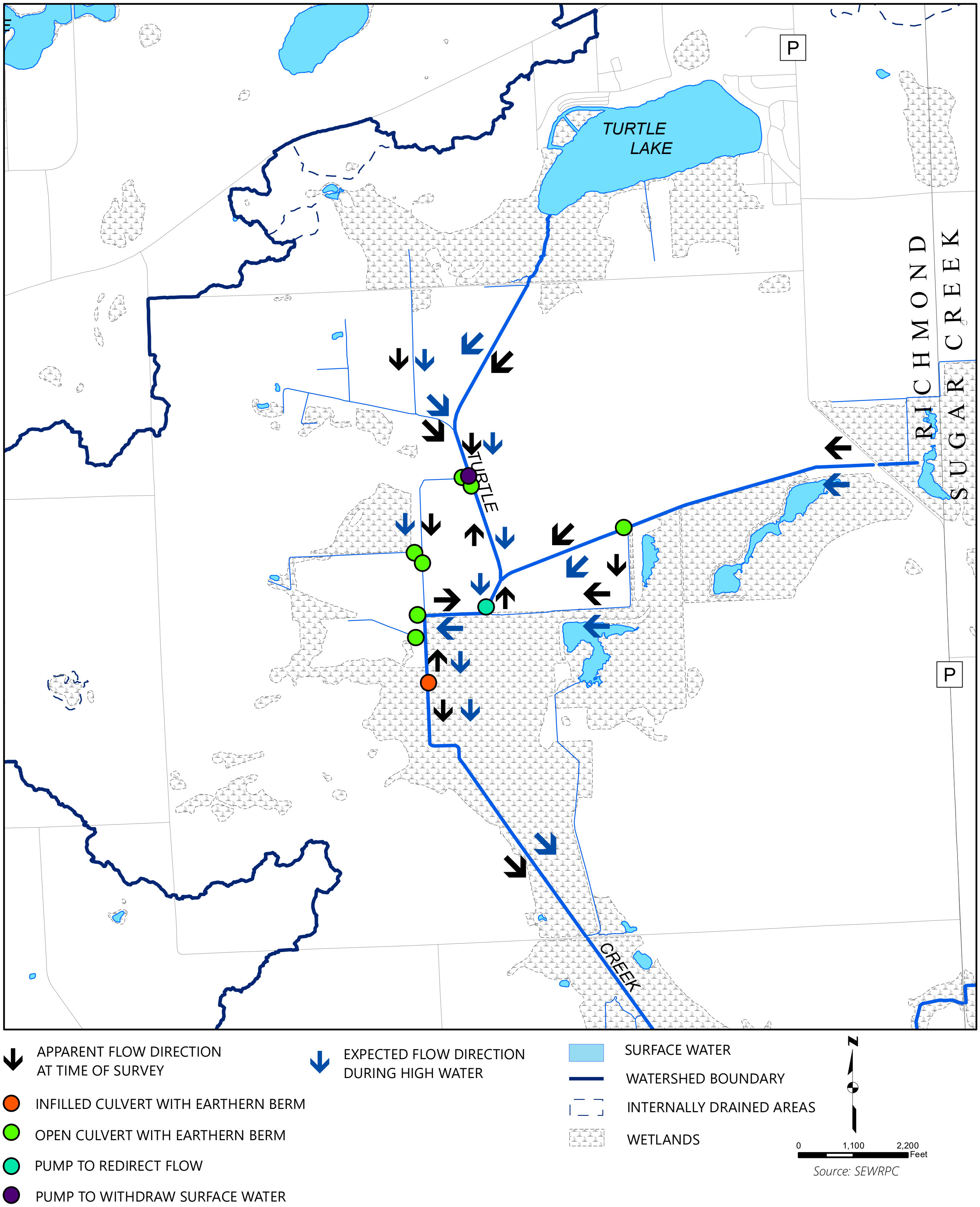
Drainage Pump at Southern End of Sod Farm

Pumps Withdrawing Turtle Creek Water

Line Irrigation in Northern Area of Watershed

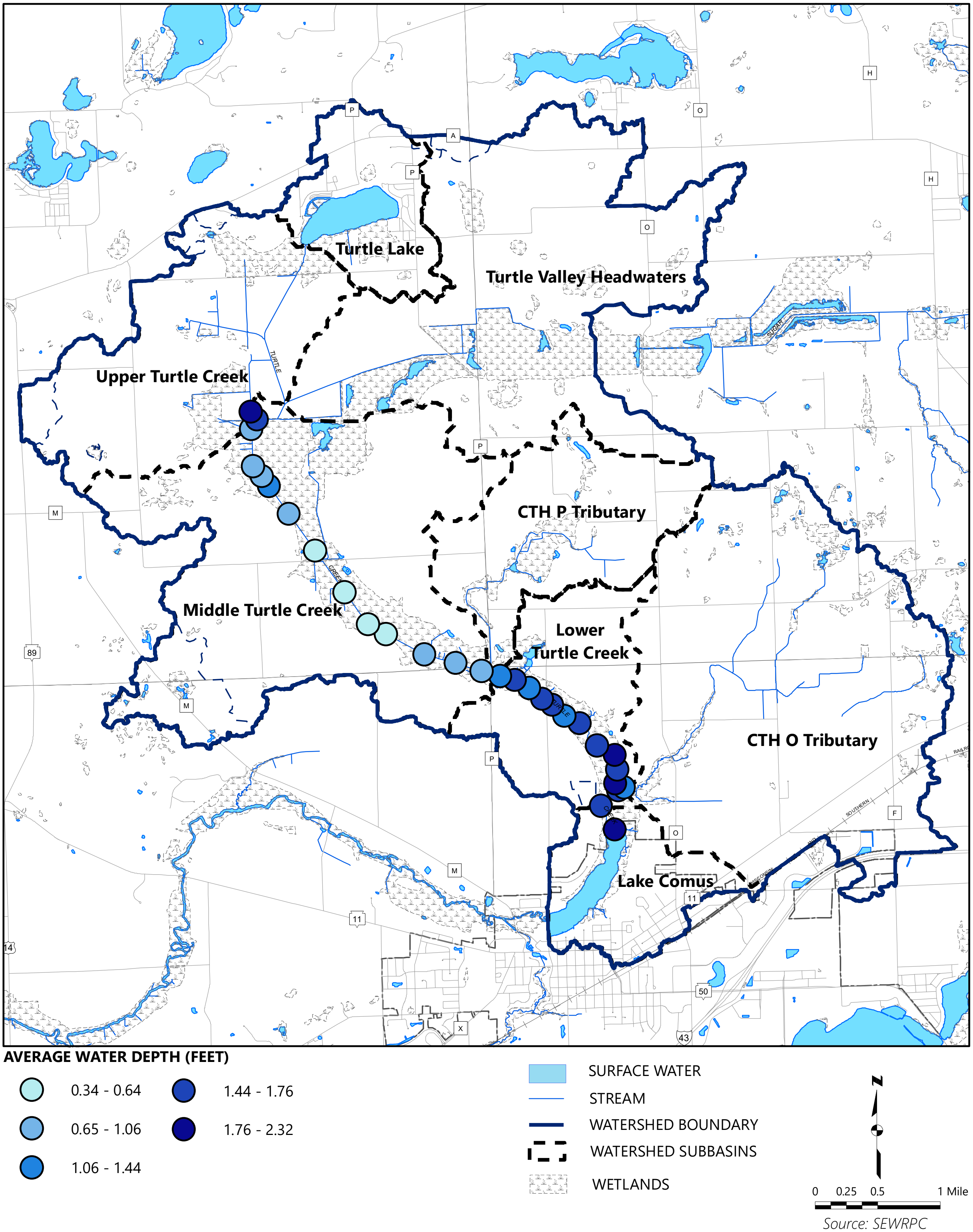
Source: SEWRPC

Map 2.14
Apparent and Expected Flow Directions on Turtle Creek



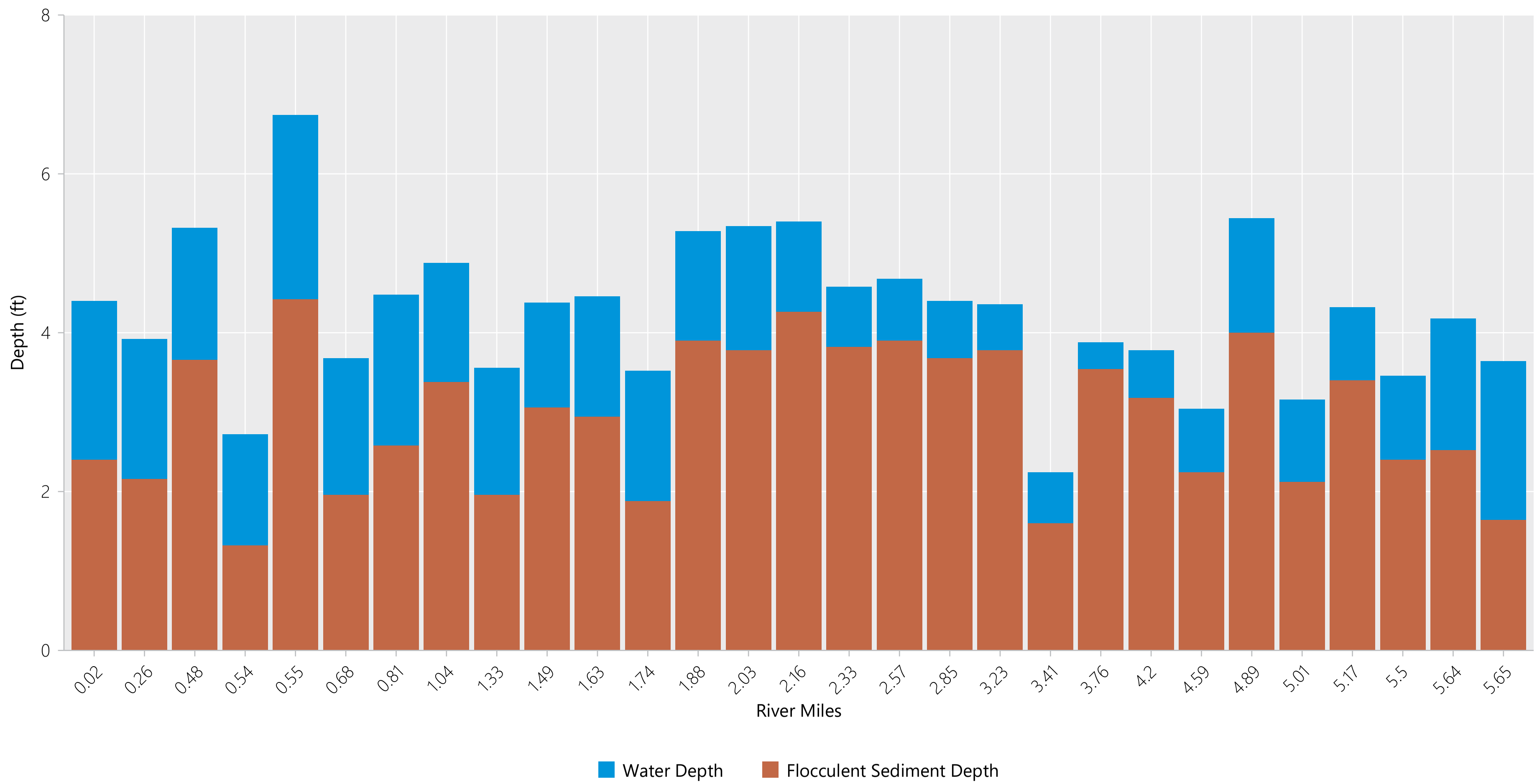
Source: SEWRPC

Map 2.15
Water Depth Observed During Turtle Creek Survey: 2023



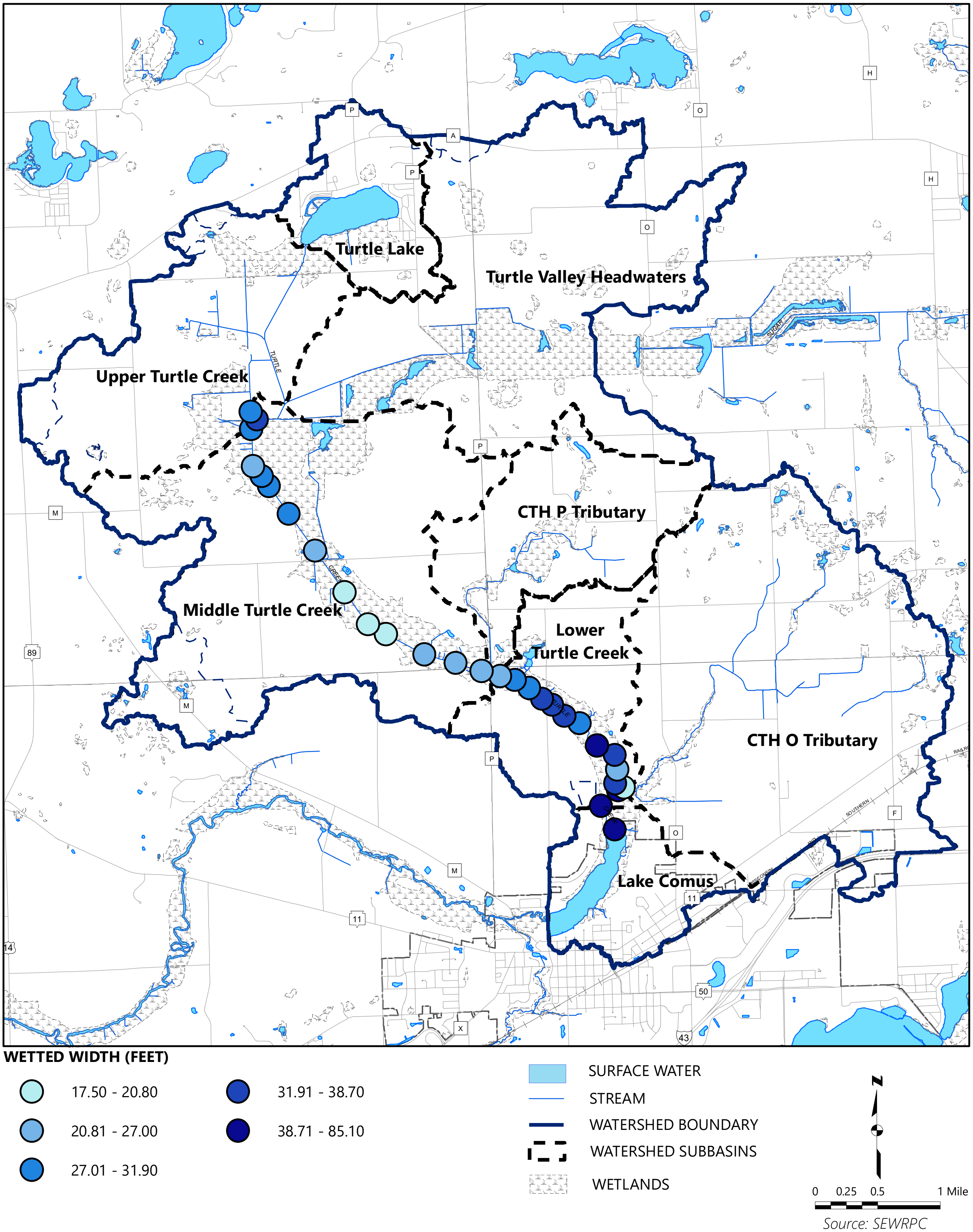
Source: SEWRPC

Figure 2.14
Turtle Creek Water and Sediment Depth: 2023



Source: SEWRPC

Map 2.16
Stream Wetted Width Observed During Turtle Creek Survey: 2023



Source: SEWRPC

Flocculent sediment depths ranged from 0 to 5.9 feet, with a mean sediment depth of 2.9 feet across all measurements. As with water depth, the deepest flocculent sediment accumulations were in the stream thalweg where sediment averaged 3.7 feet deep. In several locations, Commission staff were unable to determine the flocculent sediment depth as the combined water and flocculent sediment depth was greater than the Commission's measuring staff; these locations are marked as a combined water and sediment depth of "7+" on Map 2.17. The highest average sediment depth of 4.4 feet was observed immediately upstream of the confluence with the CTH O Tributary, but other sites like immediately downstream of the CTH P crossing and immediately downstream of the wooded bend also had deep sediment deposits at 4.3 and 4.0 feet, respectively (see Figure 2.14). As a rough approximation, Commission staff estimated the total cubic yards of flocculent sediment in the Creek to be 108,866 yd^3 by multiplying the average sediment depth by the wetted width at each cross section and then calculating the area under the curve of that flocculent sediment across the Creek profile.

Sediment composition observed throughout the survey was generally "silt", "muck", or silt/muck with a clay bottom (see Figure 2.15). The flocculent stream bed reflects that current channel was dug through organic wetland soils and does not follow the historical streambed which likely would have had substantial sand or gravel deposits. Additional sloughing of the organic material of the current streambed may also be contributing to large flocculent sediment accumulations. Limited areas with gravel, cobble, or sand substrates were found throughout the survey; these areas may have been sections of the historical Turtle Creek streambed, which is suspected to cross the current stream at several locations between Turtle Lake and Lake Comus, or deposits of material used to create fords of the Creek. Organic peat was also observed in limited occasions along the Creek banks and was typically associated with native sedge vegetation (see Figure 2.15).

Deep accumulations of flocculent sediment are common in heavily modified wetland streams, such as Turtle Creek, and likely reflect a history of agricultural land use and waterway modification within the watershed.[43] While Commission staff did not measure sediment organic content or total phosphorus concentrations, it is likely that these accumulations are nutrient-laden and are contributing to chronic water quality issues within Turtle Creek and Lake Comus. Sediment total phosphorus concentrations in similar streams draining agricultural lands in southern Wisconsin can range widely.

Water Quality

At each of the stream cross-sections, Commission staff and the LCPRD volunteer measured water temperature, dissolved oxygen concentrations, specific conductance, and turbidity using a transparency tube. These measurements are illustrated on Maps 2.18, 2.19, and 2.20 with summary statistics presented in Table 2.2. Commission staff also noted any other observations of poor water quality, such as the presence of an abundance of floating aquatic plants, scums, or unsightly smells and odors throughout the survey.

Water clarity, as measured using a transparency tube, ranged from moderately clear to poor through the surveyed length of Turtle Creek (see Map 2.18). With a transparency of 34.4 cm, the lowest clarity was observed near the Lake Comus outlet while the highest clarity, with a transparency of 84.0 cm, was observed just downstream of the weir and pump by the confluence of Turtle Creek and the Turtle Valley Tributary. Stream water clarity was potentially higher than normal as the survey was conducted during drought conditions and clarity is often lower due to soil runoff associated with precipitation events. The abundance of flocculent sediment throughout the Creek indicates that poor water clarity from excessive soil runoff is likely a persistent water quality concern.

Temperatures in the Turtle Creek mainstem ranged from warm to excessively hot, with a maximum recorded temperature of 86.8°F at Site TC19 (see Map 2.19) This temperature exceeds the acute temperature criteria for warm small streams in July of 86°F in *Wisconsin Administrative Code* NR 102.25. Exceeding the acute temperature criteria can lead to degraded health for aquatic organisms and can cause fish kills if prolonged. In contrast, the numerous groundwater springs contributing to the mainstem were much cooler with recorded temperatures between 51 and 59°F. As recognized in CAPR 341, these springs are important for the overall health of Turtle Creek and likely act as critical refugia during dry, hot conditions as experienced in the summer of 2023.

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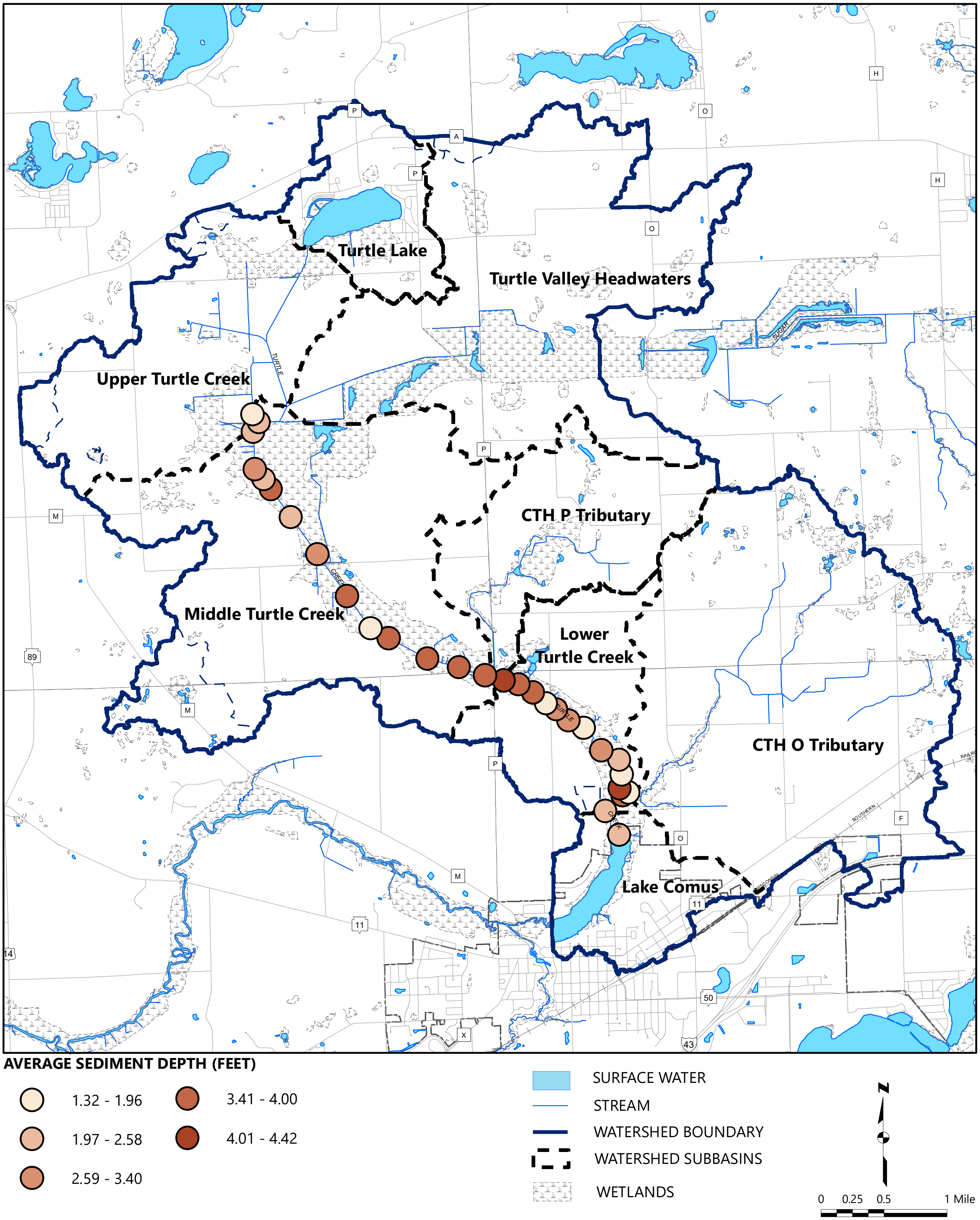
[43] *Phosphorus stored within flocculent sediment in Creek beds are one component of "legacy phosphorus," which is a term denoting buildup of phosphorus from natural soil stores or historical fertilizer applications. This legacy phosphorus can contribute to phosphorus loading and associated water quality issues long after phosphorus applications have diminished or stopped.*

Map 2.17
Flocculent Sediment Depth Observed During Turtle Creek Survey: 2023



Source: SEWRPC

Dissolved oxygen concentrations ranged from conditions that are supportive of aquatic life to conditions that may indicate oxygen supersaturation and can be harmful to aquatic life (see Map 2.20). Fish, macroinvertebrates, and many other forms of aquatic life need oxygen to survive with concentrations between 5 and 15 mg/l considered to be generally supportive. All sites with data along the Creek, aside from TC 28, had concentrations falling within this range.[44] However, dissolved oxygen saturation measurements, which are the amount of oxygen dissolved in water compared to the total amount of oxygen that is possible to be held in that water at a given temperature and pressure, indicate that conditions throughout much of the Creek may be harmful. Oxygen saturation between 90 and 110 percent saturation are generally considered desirable for aquatic life; however, supersaturation levels above 115 percent can be detrimental by, for example, causing fish to develop bubbles in their tissues. Eight of the eighteen sites (44 percent) for which the Commission recorded dissolved oxygen saturation measurements exceeded 115 percent.

Figure 2.15
Examples of Sediment Observed During 2023 Turtle Creek Survey

Flocculent Sediment on Streambed

Peat Sediment Along Streambank

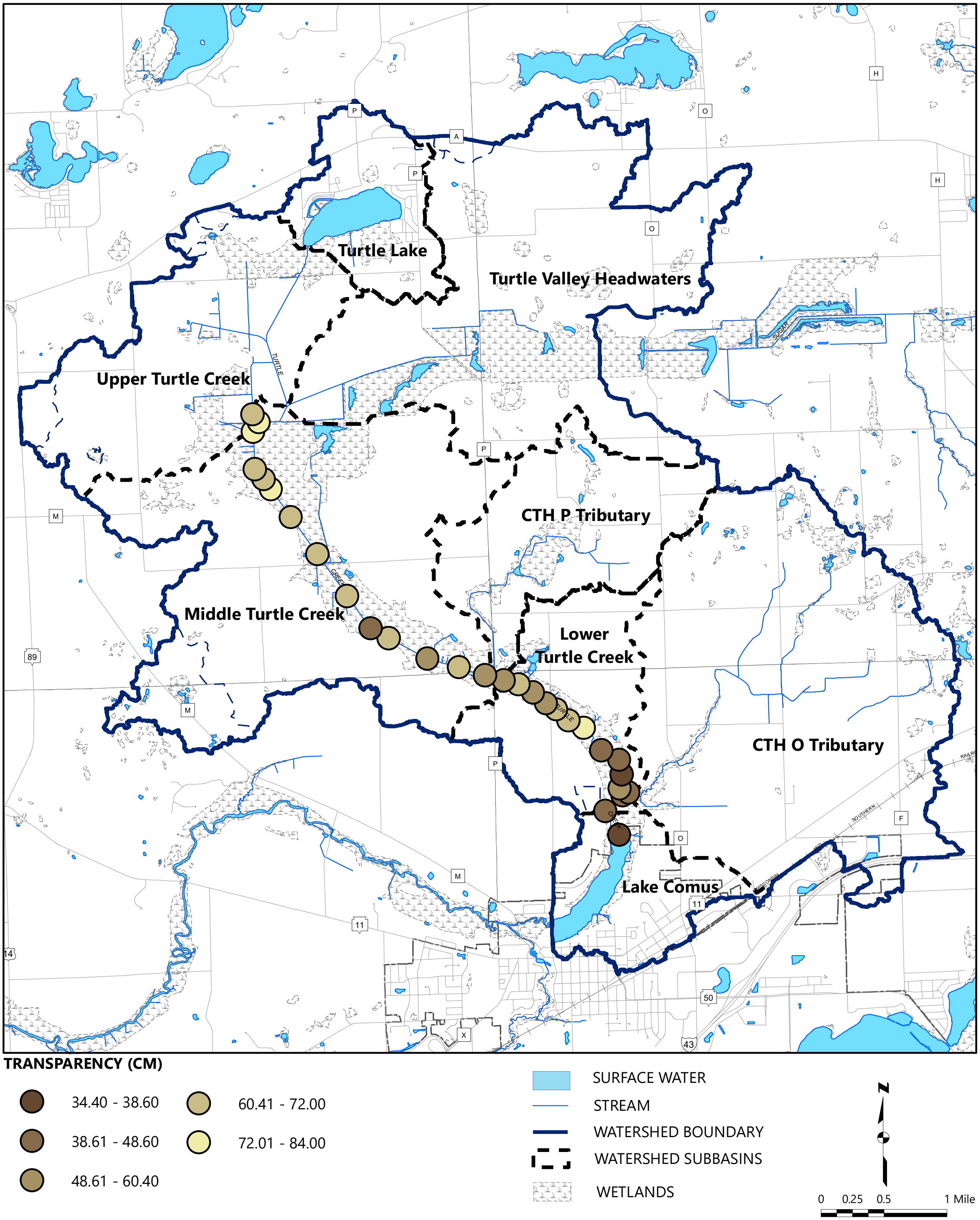
Source: SEWRPC

Specific conductance is a measure of the ability of a liquid, such as lake water, to conduct electricity, standardized at a specific temperature (25°C). This ability is greatly dependent on the water's dissolved solids concentration: as the amount of dissolved solids increases, the specific conductance increases. While many of these dissolved solids, such as magnesium, are minerals leaching from soil and bedrock, salts containing as chloride and sodium can contribute to higher specific conductance values as well. Throughout the stream survey, the specific conductance did not vary much with measurements ranging from 723 to 794.6 µS/cm @ 25°C. These results did not vary much with position in the watershed, indicating that the dissolved solid concentrations within the surveyed areas of the Creek were similar. These specific conductance values are not indicative of an overabundance of chloride, particularly as there is a low proportion of impervious surfaces within the watershed.

Throughout the survey, Commission staff also noted the presence of algal scums where thick mats of algae covered the surface of the Creek. These scums were particularly concentrated and extensive whenever there was an impediment to flow within the Creek, such as a partially impounded culvert or a log-jam (see Figure 2.16). The largest algal scum observed by Commission staff was immediately north of the impounded culvert and the scum appeared to have built up in the impeded flow. Algal scums are a symptom of the high nutrient concentrations within the Creek and, aside from their displeasing sight and smell, can contribute to lower dissolved oxygen levels and poor water quality conditions. Algal mats, duckweed, and watermeal (*Wolffia* spp.) were also observed in abundance in the stagnant steam surrounding the farms north of the Turtle Valley Wildlife Area. As these organisms can readily uptake available nutrients in the water column, their presence within this area is an indicator of high nutrient concentrations that may be contributed from

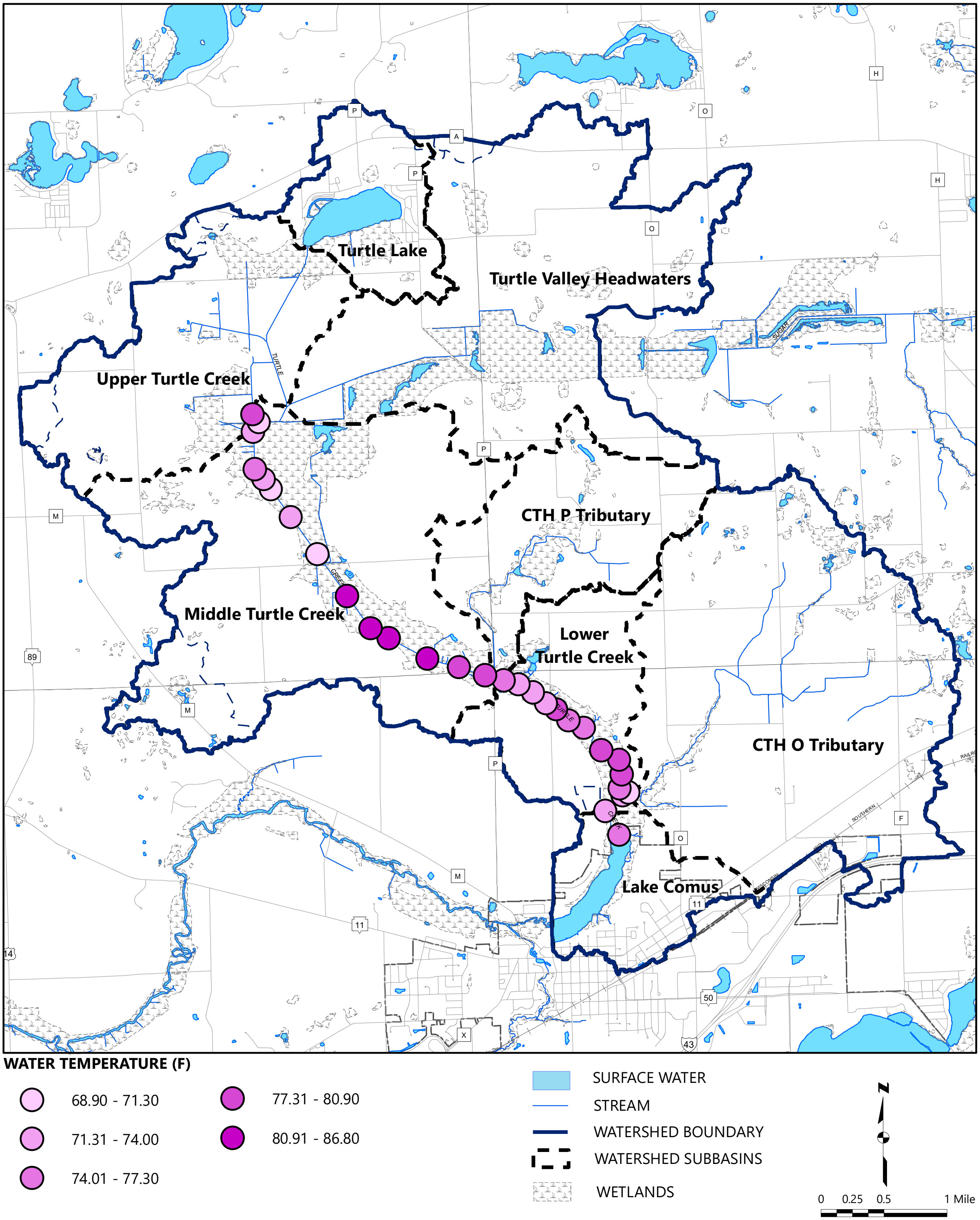
[44] *The Commission's equipment was not properly calibrated for the first few sites near the outlet to Lake Comus, so no dissolved oxygen concentrations were recorded for these sites.*

Map 2.18
Water Clarity Observed During Turtle Creek Survey: 2023



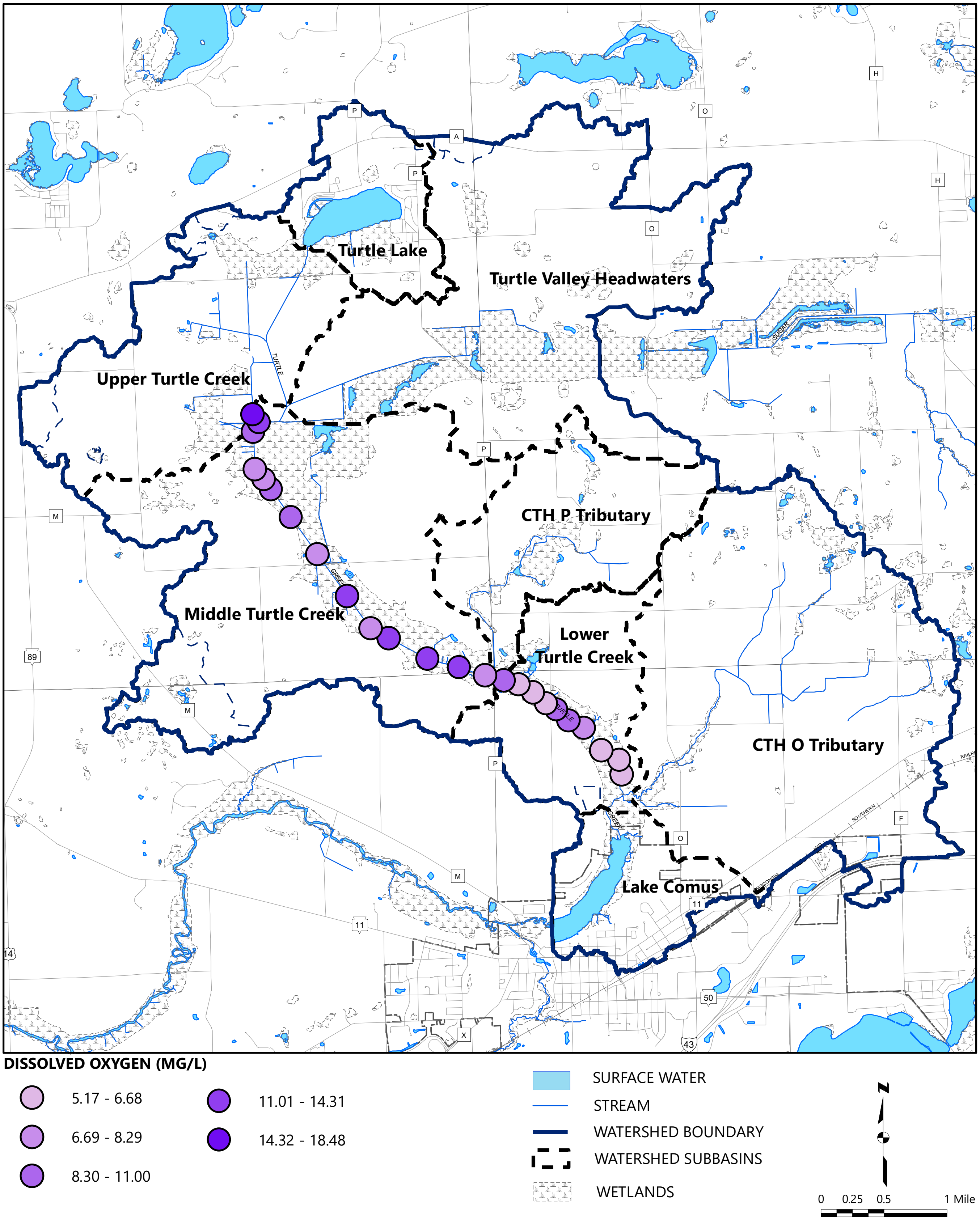
Source: SEWRPC

Map 2.19
Water Temperatures Observed During Turtle Creek Survey: 2023



Source: SEWRPC

Map 2.20
Dissolved Oxygen Concentrations Observed During Turtle Creek Survey: 2023



Source: SEWRPC

Table 2.2
Statistics for Turtle Creek 2023 Survey Measurements

Parameter	Number of Observations	Mean	Maximum	Minimum
Water clarity (cm)	28	61.4	84.0	34.4
Water temperature (°F)	28	76.7	86.8	69
Dissolved oxygen (mg/L)	24	9.4	18.5	5.2
Dissolved oxygen saturation (%)	18	126.5	200	59.7
Specific conductance (µS/cm @ 25°C)	18	761.0	794.6	723.0
Stream wetted width (feet)	28	34.7	85.1	17.5
Water depth (feet)	140	1.3	3.1	0.1
Sediment depth (feet)	140	2.9	5.9	0.0

Source: SEWRPC

the adjoining agricultural fields via surface runoff and drain tiles. The poor water quality exhibited in this area likely negatively affects Turtle Creek during high flow conditions when water is allowed to flow and/or pumped downstream from this complex.

Potential Pollutant Sources

Commission staff noted observations of potential pollutant loading sources, such as streambank erosion, drain tiles, the proximity of agricultural fields and livestock, as well as other water quality impediments throughout the survey. These observations were utilized to inform the pollutant load modeling presented in Section 2.3 as well as the recommendations provided in Chapter 3 to address poor water quality and excessive pollutant loads to Turtle Creek.

Few instances of streambank erosion were observed along the Turtle Creek mainstem as there are few bends in the Creek and most of the streambank was well-vegetated, which helps to maintain bank stability and mitigate erosion. The most significant streambank erosion was along the southern bank of the Creek where it bends near Site TC25 (see Figure 2.17). Commission staff estimated the dimensions of this erosion as 2.5 feet high, 65 feet wide, and 0.5 feet deep for a total volume of 81.25 cubic feet; at these dimensions, this erosion may marginally contribute to the Creek's sediment and nutrient issues. Other limited instances of erosion were noted but were not deemed substantial enough to contribute pollutant loads to the Creek. Overall, streambank erosion does not appear to be a significant source of nutrient or sediment pollution to Turtle Creek.

As described in CAPR 341 and Section 2.3, "Watershed Pollutant Loading and Sources," agricultural land uses are a main source of nutrient and sediment pollution to Turtle Creek. Runoff from the farm fields and livestock operations can contribute sediment, nutrients, salts, pesticides, and herbicides if there is inadequate buffering along surface waters. While much of the lower reaches of the Creek is buffered by extensive wetlands, there are still substantial segments in upstream reaches of the Creek and its tributaries that lack adequate buffers to help mitigate surface runoff (see Map 2.21). Much of the stream complex north of the Turtle Valley Wildlife Area, most of the northern bank of the Turtle Valley Tributary, and sections of the CTH P Tributary and the CTH O Tributary lack adequate buffers to mitigate surface runoff from agricultural fields. Walworth County staff have already been actively working to implement riparian buffers, grassed waterways, and other BMPs in many of these areas. Livestock were generally not observed near the Creek or its tributaries except in one instance where cattle were standing in a pasture near stream rivulets that drained into Turtle Creek.[45]

Tiles that drain agricultural fields can also be a pollutant source to surface water, particularly for water-soluble orthophosphate, nitrogen compounds, pesticides, and herbicides. Because they provide a direct pathway from fields to surface waterbodies, drain tiles can allow water and pollutants to bypass agricultural BMPs, especially riparian buffers, reducing their effectiveness. In fields with intact drain tile, between 15 to 34 percent of the total phosphorus, 78 to 87 percent of the nitrogen, and about 25 percent of the

[45] *The pasture in question is not marked as a Surface Water Quality Management Area as it located greater than 1,000 feet from Turtle Creek and stream rivulets are likely unmapped intermittent streams.*

sediment leaving the field moved through the drain tile system.[46] In fields with damaged drain tile (i.e., tile blow outs), about 65 percent of the total phosphorus and most sediment leaving the fields traveled through drain tile. Commission staff recorded drain tiles and drain tile markers throughout the stream survey; most of these tile observations were draining fields into the stream complex north of the Turtle Valley Wildlife Area (see Figure 2.12 and Map 2.7). There are likely other drain tiles located along the Creek mainstem that were not observed by Commission staff as they were covered by vegetation; recent aerial imagery appears to have captured some of these tiles (see Figure 2.18).

Figure 2.16
Algal Scums on Turtle Creek: 2023

Source: SEWRPC

Habitat Features

Commission staff encountered various springs, overhanging woody habitat, and aquatic plant beds during the stream survey. Numerous springs provide cold groundwater contributions that sustain baseflow and potential refugia from high water temperatures for fish and aquatic life in Turtle Creek and Lake Comus (see Figure 2.19). Overhanging woody vegetation was prevalent in some reaches of the Creek, particularly between Dam Road and CTH Hwy P as well as along a sharp bend north of Island Road near the WDNR property. Aquatic plant beds were located intermittently throughout much of the stream, with locally high abundance of the invasive species Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) as well as the native species coontail (*Ceratophyllum demersum*), sago pondweed (*Stuckenia pectinata*), and white water crowfoot (*Ranunculus aquatilis*). Commission staff also observed wetland vegetation buffering the stream throughout nearly the entire survey until the stream's confluence with the Turtle Valley Tributary.

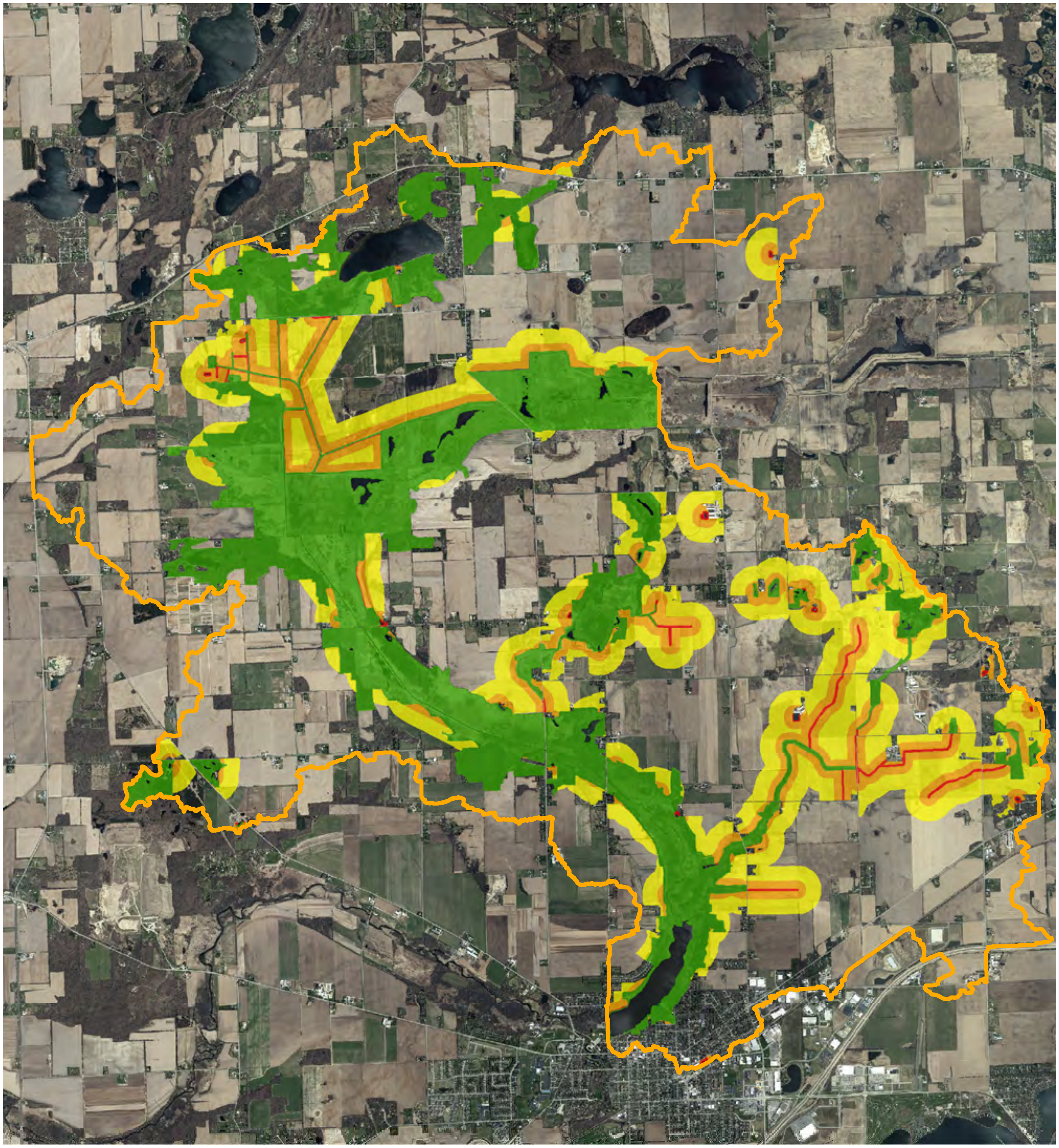
Figure 2.17
Streambank Erosion Observed During 2023 Turtle Creek Survey

Source: SEWRPC

Commission staff noted deeper pools located sporadically between Island Road and the confluence with the Turtle Valley Tributary and the mainstem. These deeper pools occasionally had sand bottoms and were often inhabited by fish and crayfish. These pools were some of the only areas in which Commission staff observed fish during the survey, implying that these may be important habitat refugia during hot and dry conditions such as summer 2023. One particularly deep pool located just south of a retaining wall and pump for a sod farm on the Turtle Valley tributary was inhabited by large fish; this pool, measured as 6.1 feet deep with a sand bottom, was likely created by either dredging or pumping activity as it was substantially deeper than any other pool on the Creek. Freshwater mussels were also observed at several locations between Dam Road and the confluence of the mainstem with the Turtle Valley tributary; several of these observations occurred at or near road crossings where the sediment was gravel fill instead of the typical flocculent muck (see Figure 2.20).

[46] *Eric Cooley,* "Nutrients Discharging from Drain Tiles in Eastern Wisconsin," *Presentation at the Eighth Annual Clean Rivers, Clean Lake Conference, Milwaukee, Wisconsin, April 30, 2012.*

Map 2.21
Existing and Potential Riparian Buffer Within the Upper Turtle Creek Watershed



RIPARIAN BUFFER

EXISTING

75 FOOT POTENTIAL BUFFER

400 FOOT POTENTIAL BUFFER

1000 FOOT POTENTIAL BUFFER

SURFACE WATER

STREAM

WATERSHED BOUNDARY

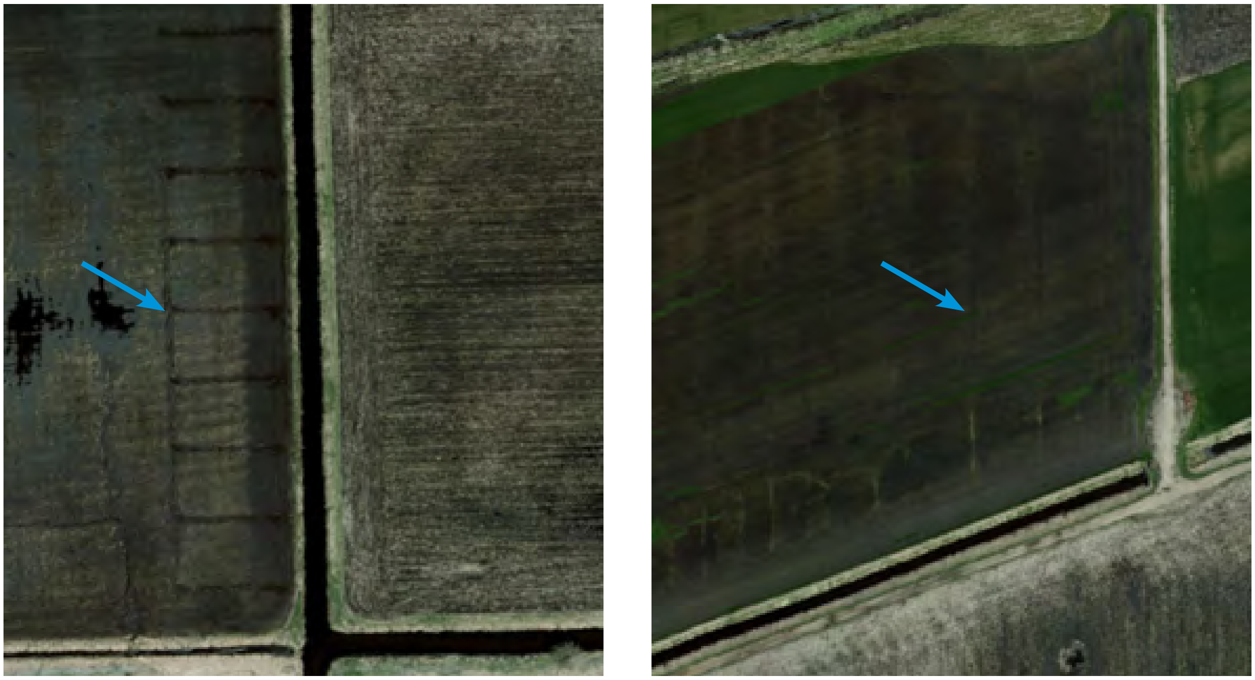
INTERNALLY DRAINED AREAS

N

0 0.25 0.5 1 Mile

Source: SEWRPC

Figure 2.18
Drain Tiles Observed in Recent Aerial Imagery of the Upper Turtle Creek Watershed



Source: ESRI and SEWRPC

CTH O Tributary Survey

Commission staff surveyed most of the CTH O tributary from its confluence with Turtle Creek to Cobblestone Road on June 21st and October 30th; the downstream portion by the Turtle Creek confluence was surveyed by boat while the remainder was surveyed on foot.[47] As with the main Creek survey, there was little water in upstream reaches of the CTH O tributary which limited the utility of continuing the survey beyond Cobblestone Road, at which point the tributary diverges into several grassed waterways draining agricultural fields.

Unlike Turtle Creek, the CTH O tributary likely still follows much of its original streambed based on historic mapping as well as stream characteristics. For example, the bottom sediments of the tributary are largely composed of sand, gravel, and cobble and the stream is fairly sinuous in its lower reaches (see Figure 2.21). The tributary also has a steeper gradient than Turtle Creek as it drops approximately 26 feet in elevation within the approximately 2.25 miles between Cobblestone Road and the confluence with Turtle Creek. Consequently, the stream has several riffle habitats over gravel and cobbles while no such features were observed on Turtle Creek. These features, along with the extensive coarse woody habitat within and overlaying the Creek, likely contribute to improved habitat for fish and other aquatic organisms in the CTH O tributary. Aside from one small stretch where residential lawn extends to the stream edge, most of the stream also appears to be well-protected by riparian buffers from the surrounding residential and agricultural land uses.

The upper reaches of the stream have also experienced similar modifications as exhibited on Turtle Creek, including channelization, incising, impoundments from culverts, and contributions from drain tiles. Some of the meanders present in 1940 aerial imagery in the upper reaches have been straightened although it is unclear whether this straightening is due to direct human modification or due to the stream bypassing these meanders during flood flows.[48] Watershed residents have noted recent major flash flooding events in the CTH O tributary with at least two locations where flood waters created a straightened ditch that

[47] *Commission staff did not survey a small section of the CTH O tributary where it passes through a culvert under a private driveway southwest of CTH O.*

[48] *Personal communication between Commission staff and the LCPRD in September 2024.*

Figure 2.19
Examples of Habitat Features Observed During 2023 Turtle Creek Survey

Groundwater Springs

Aquatic Vegetation

Coarse Woody Habitat

Overhanging Vegetation

Source: SEWRPC

bypassed stream meanders; such events were not noted to previously occur and may reflect more intense precipitation events occurring within southeastern Wisconsin. Upstream of Goose Pond Road, the stream becomes heavily incised and can be up to fifteen feet lower than the surrounding farmlands. The stream passes through culverts at CTH O, Goose Pond Road, and Cobblestone Road; these culverts appear to be appropriately sized although there was a significant impoundment with flocculent sediment and extensive coverage by duckweed and watermeal immediately upstream of Goose Pond Road (see Figure 2.22). A few drain tiles were observed in the upper reaches of the stream although it's likely that more tiles exist that were not observed due to extensive vegetation coverage along the stream banks. Fallen trees and other woody debris also caused smaller impoundments in several areas in both the lower and upper reaches of the stream. A few instances of streambank erosion were noted throughout the survey; this erosion is unlikely to be a major source of phosphorus and sediment loading but may be more substantial for the smaller CTH O tributary than the similarly sized erosion on the larger Turtle Creek.

2.3 WATERSHED POLLUTANT LOADING AND LOAD REDUCTIONS

The most prevalent pollutants to lakes include sediment and nutrients, both of which have natural sources and sources that are attributable to human activity. Sediment and nutrients contribute to lake aging. Sediment and nutrient loads can greatly increase when humans disturb land cover and runoff patterns through activities such as tilling and construction, both of which typically loosen soil, increase runoff and in turn allow soil to more easily erode and eventually enter streams and lakes.

Prior Modeling Efforts for Turtle Creek Watershed

Using the Universal Soil Loss Equation (USLE), the WNDR estimated 18,319 tons of soil erosion per year within the Turtle Creek watershed as part of the 1984 Turtle Creek Priority Watershed Plan.[49] Approximately 98 percent of this soil erosion was estimated to come from cropland, while pasture and woodlands made up the balance. Croplands were estimated to lose 6.7 tons of soil per acre per year. It is important to note that the USLE does not estimate soil loss from commercial, residential, or wetland land uses, so the estimated soil loss does not include these acreages. Muck farming, which was a common practice within the upper reaches of the watershed, is particularly susceptible to wind erosion if the fine organic soils dry out. The priority plan indicated that wind erosion control practices should be installed within the watershed, as it is particularly susceptible to wind erosion problems. There has been some woodland regrowth in the upper reaches of the watershed and lines of trees acting as windbreaks appear more commonly now than at the time the plan was written.

Figure 2.20
Macroinvertebrates Observed During 2023 Turtle Creek Survey

Monarch Caterpillar in Riparian Buffer

Freshwater Mussel

Crayfish

Source: SEWRPC

Phosphorus and total suspended sediment loading for Reach 80 of the Rock River watershed were estimated using the Soil & Water Assessment Tool for the Rock River TMDL established in 2011. As part of the TMDL, nonpoint source phosphorus and sediment loads from agricultural and natural areas were modeled. The Reach 80 basin, which includes the Upper Turtle Creek watershed as well as lands tributary to Swan Creek and Turtle Creek downstream to the Rock-Walworth County border, has an estimated baseline total phosphorus loading of between 2,000 to 4,000 pounds per year and a total suspended sediment loading of between 300 to 600 tons per year. On a per-acre basis, the estimates were between 0.03 to 0.10 pounds of total phosphorus per acre per year and between 0 to 0.02 tons of total suspended sediment per acre per year. If these per-acre estimates are extrapolated to the Upper Turtle Creek watershed, the total loading would be between 630 and 2,101 pounds of total phosphorus per year and between 21 and 420 tons of total suspended sediment per year.

[49] *Turtle Creek Priority Watershed Plan, 1984,* op. cit.

Pollutant Load Modeling

Commission staff modeled pollutant loading and load reductions from current conditions using the USEPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) model.[50] STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. During the preparation of CAPR 341, WDNR staff provided guidance on how to enhance the Commission's modeling effort to better represent baseline load conditions in 2011 when the Rock River TMDL was completed, and to represent load reductions efforts that make progress toward meeting the TMDL load reductions goals for the watershed.[51] Additionally, Walworth County staff have provided invaluable information on livestock counts, soils, and use of agricultural BMPs within the watershed. Results from the STEPL modeling efforts detailed below are presented in Appendix A.

Model Parameterization

Commission staff parameterized the 2011 pollutant load model using the Commission's 2010 land use for the watershed, which was mapped to STEPL land use categories.[52] The number of agricultural animals in 2011 were slightly decreased from the numbers presented in CAPR 341, which were provided by Walworth County staff, under the assumption that dairy farms within the watershed have been increasing their livestock count over time.[53] The number of septic systems were divided amongst the subbasins in a pro-rated fashion using the rural residential land use in each subbasin as a percent of the entire watershed. Universal Soil Loss Equation parameters for cropland and soil phosphorus concentrations were modified following discussions with WDNR and Walworth County staff. The instance of streambank erosion noted during the 2023 Turtle Creek survey was also included in the model.

Commission staff consulted with Walworth County Land Use & Resource Management staff to estimate the acreages of BMPs established at the time of the Rock River TMDL as follows:

- Conservative tillage at 50 percent of cropland (7,445 acres)
- No-till at 10 percent of cropland (1,490 acres)

Figure 2.21
Habitat Features Observed During 2023 CTH O Tributary Survey

Riffle Habitat

Coarse Wood

Streambed Cobbles

Source: SEWRPC

[50] *For more information on STEPL, see www.epa.gov/nps/spreadsheet-tool-estimating-pollutant-loads-stepl.*

[51] *Virtual meeting between WDNR, Walworth County, and Commission staff on March 15th, 2022.*

[52] *Lands identified by the Commission as wetlands were categorized as "User Defined" in STEPL with corresponding soil loss equation, runoff nutrient concentrations, and nutrient concentrations in shallow groundwater.*

[53] *This assumption was supported by noting expansions to farm buildings when comparing 2010 and 2024 aerial imagery.*

Figure 2.22
Hydrological and Water Quality Concerns Observed During 2023 CTH O Tributary Survey

Culvert Under CTH O | Streambank Erosion | Drain Tile | Duckweed Covering Impoundment

Source: SEWRPC

- Cover crops at 0 to 1 percent of cropland (150 acres)
- Nutrient management plans at 9.7 percent of cropland (1,450 acres)

The conservative tillage and nutrient management plans were applied across each subbasin in a pro-rated fashion by the number of agricultural acres in each subbasin as a percent of the watershed. The no-till practices were implemented in the Turtle Valley Headwaters, Middle Turtle Creek, and CTH O Tributary subbasin as these subbasins had the highest number of agricultural acres. Any acres with nutrient management plans were assumed to also be utilizing either reduced or no-till practices, which was modeled using the "Combined BMP" tool in STEPL. The 150 acres of cover crops were modeled as occurring in the CTH O Tributary.

Pollutant Loads and Load Reductions

Without any BMPs modeled, Commission staff estimated an annual load of 43,468 pounds of phosphorus, 137,049 pounds of nitrogen, and 8,861 tons of sediment in the Upper Turtle Creek watershed in 2011. Under the 2011 estimated BMP coverage, the model outputs an estimated annual load of 35,221 pounds of phosphorus, 122,774 pounds of nitrogen, and 7,074 tons of sediment (see Map 2.22). The BMPs already implemented in 2011 were reducing nonpoint source pollutant loads by 19.0 percent for phosphorus, 10.5 percent for nitrogen, and 20.2 percent for sediment compared to modeled conditions without any BMPs implemented. The highest estimated total phosphorus, nitrogen, and sediment loads were from the CTH O Tributary subbasin closely followed by the Middle Turtle Creek and Turtle Valley Headwaters subbasins. The Turtle Lake and Lake Comus subbasins had the lowest pollutant loads. Croplands were the predominant source of phosphorus, nitrogen, and sediment at 87.6, 82.0 percent, and 97.2 percent of the total loads, respectively. Achieving the targeted instream concentrations in Turtle Creek set by the Rock River TMDL requires reducing annual total phosphorus loads by 49 percent and sediment loads by 25 percent from non-point sources. When applied to the 2011 STEPL output, these goals correspond to reducing phosphorus loads by 17,258 pounds and sediment loads by 1,769 tons to attain loading of 17,963 pounds of phosphorus per year and 5,305 tons of sediment per year.

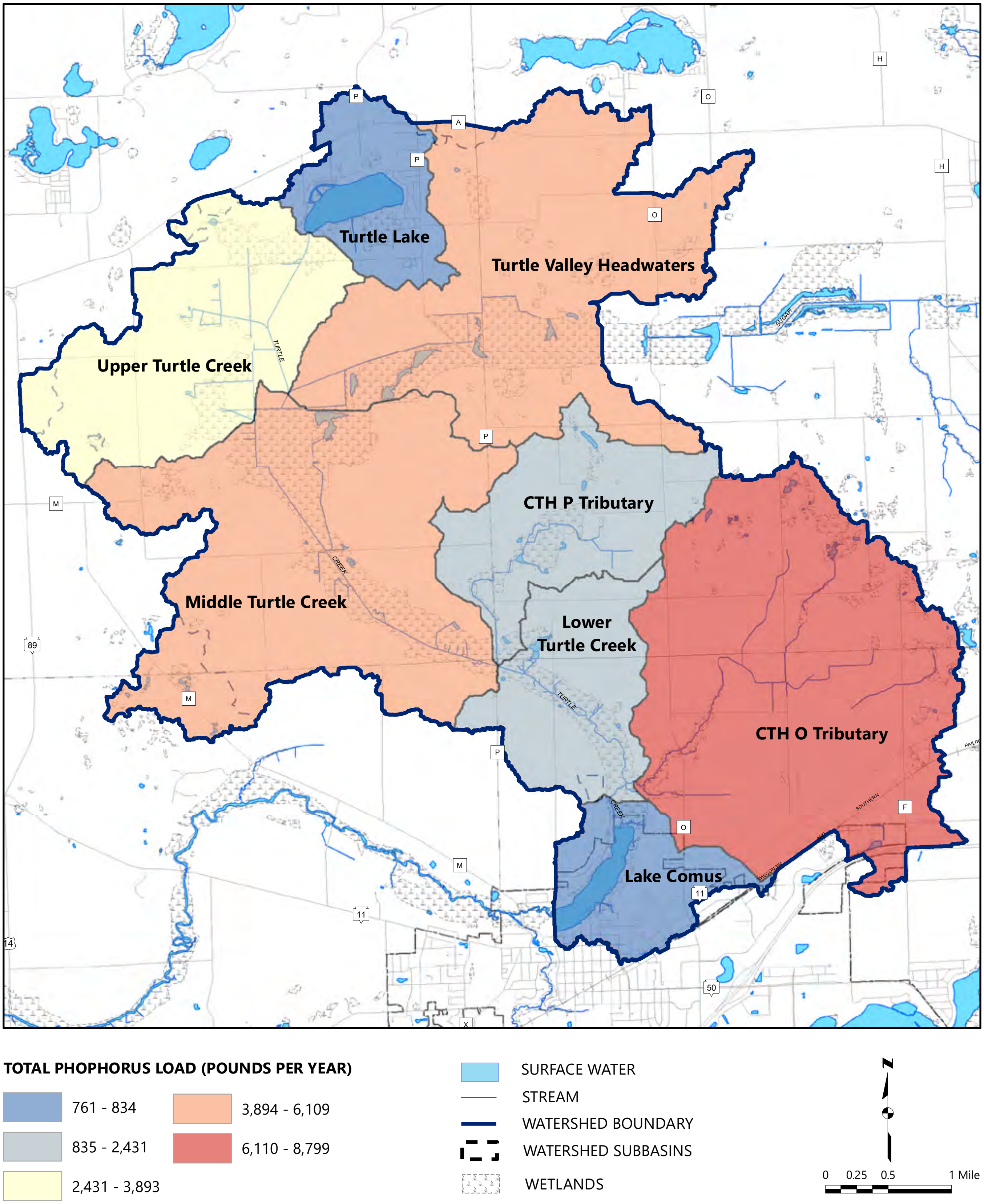
As described in CAPR 341, many agricultural BMPs have already been implemented within the watershed since 2011 to make progress toward achieving these goals. Between 2011 and 2022, the use of nutrient management plans increased from 1,450 to 6,162 acres, the use of cover crops has increased from an estimated 1 percent to 5 percent, 1.5 acres of barnyards have been enhanced, and approximately 9,905 linear feet of gullies have been addressed through grassed waterways and other BMPs. Commission staff used the updated cover crop and nutrient management numbers along with 2020 land use to model 2024 pollutant loads in the watershed in order to gauge how much progress had already been made and to set a baseline for further pollutant load reductions in this 9KE plan. These BMPs were modeled in a pro-rated fashion as was conducted for the 2011 model; all 700 acres of cover crops were presumed to be within the CTH O Tributary subbasin. With these updated model parameters, the model outputs an estimated annual load of 31,076 pounds of phosphorus, 112,021 pounds of nitrogen, and 6,631 tons of sediment. These practices and land use changes resulted in a reduction of 4,145 pounds of phosphorus (24 percent of TMDL goal), 10,753 pounds of nitrogen, and 1,043 tons of sediment (20 percent of TMDL goal). Croplands are still the predominant source of the remaining modeled pollutants, constituting 85.3 percent, 78.4 percent, and 96.9 percent of the phosphorus, nitrogen, and sediment loads, respectively.

Walworth County has worked to mitigate phosphorus loading in the watershed by implementing barnyard runoff controls and installing grassed waterways in gullies, among other practices. The modeled load reductions described above do not account for the pollutants mitigated from these efforts in the watershed since 2011. Walworth County staff used the BARNY model to estimate a 554.1 pound phosphorus reduction from their barnyard runoff control efforts.[54] Additionally, Walworth County has installed 9,905 linear feet of grassed waterways along gullies within the watershed. Commission staff estimated this phosphorus reduction at 413.3 pounds using STEPL model using an average gully dimension of 1 foot x 1 foot x 1 foot, a soil class of sandy loam, and an efficiency of 0.85. These efforts total an additional 967.4 pounds of phosphorus reduction that were not accounted for in the STEPL watershed modeling effort.

Additional BMPs need to be implemented to meet the 49 percent total phosphorus reduction and 25 percent sediment reduction goals from the Rock River TMDL. Using the STEPL model described above, Commission staff simulated scenarios in which conservation practices that further reduce pollutant loading were implemented in the Upper Turtle Creek watershed. Combining multiple BMPs on cultivated fields throughout the watershed is the most effective strategy for reducing total phosphorus loads to the Creek. Commission staff based the modeled BMP practices on current practice use and adoption trajectories within the watershed, envisioned changes based on increased priority and funding for the watershed, and the current cost-share rates available to help implement these practices. With an increase in 2,185 acres of cover crops, 3,696 acres of reduced tillage, 1,680 acres of no-tillage, 4,793 acres of nutrient management plans, and 154.5 acres of farmland conversion to wetland, the Upper Turtle Creek watershed is modeled to load 18,180 pounds of total phosphorus, 85,080 pounds of nitrogen, and 4,802 tons of sediment (see Table 2.3 and Map 2.23). These efforts would meet the sediment load reduction goal set by the Rock River TMDL and are just below the total phosphorus goal (17,041 pounds reduced compared to goal of 17,258 pounds from 2011 conditions). Combining these modeled phosphorus reductions with the 967.4 pounds reduced using barnyard runoff controls and grassed waterways since 2011 would total 18,008.4 pounds of phosphorus reduced from the watershed, which exceeds the Rock River TMDL goal of 17,258 pounds (49 percent of 2011 loading).

[54] *Personal communication between Commission staff and Walworth County staff.*

Map 2.22
Modeled Total Phosphorus Loading by Subbasin Under 2024 Conditions



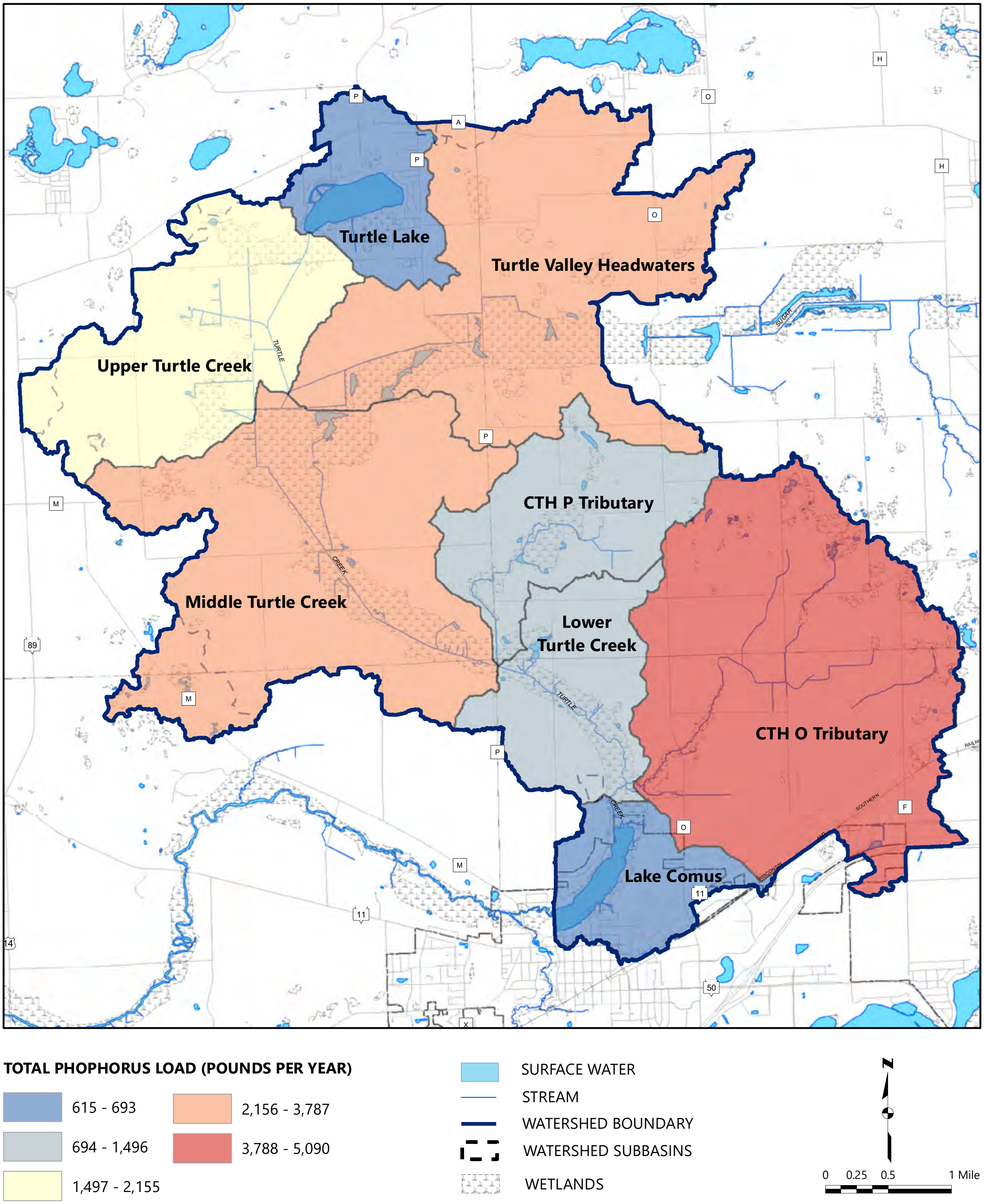
Source: Walworth County LURM and SEWRPC

Table 2.3
Modeled Best Management Practices for Upper Turtle Creek Watershed: 2022 and Future Conditions

	Cover Crops (acres)		Reduced Tillage (acres)		No Tillage (acres)		Nutrient Management Planning (acres)		Potential Restorable Wetland Conversion (acres)	
Subbasin	2022	Future	2022	Future	2022	Future	2022	Future	2022	Future
Turtle Lake Subbasin	0	0	164.7	264.7	0.0	0.0	145.2	195.2	0	0.0
Turtle Valley Headwaters	0	660	1,418.9	2378.9	41.9	342.0	1,287.5	2,547.5	0	0.4
Northern Turtle Creek	0	0	866.5	1216.5	0.0	50.0	763.7	863.7	0	135.7
CTH P Trib Subbasin	0	250	599.2	949.2	0.0	150.0	528.1	1,028.1	0	0.0
Middle Turtle Creek	0	575	1,280.0	1,630.0	28.0	628.0	1,124.9	2,127.9	0	18.3
CTH O Trib Subbasin	700	1,400	1,941.2	3111.2	69.9	599.5	1,772.6	3,602.2	0	0.0
Southern Turtle Creek	0	0	464.6	764.6	0.0	50.0	409.5	459.5	0	0.0
Lake Comus Subbasin	0	0	116.3	232.6	0.0	0.0	102.5	102.5	0	0.0
Total	700	2,885	6,851.4	10,547.7	139.8	1,819.5	6,134.0	10,926.6	0	154.4

Source: SEWRPC

Map 2.23
Modeled Total Phosphorus Loading by Subbasin with Recommended Practices to Meet TMDL Goals



Source: Walworth County LURM and SEWRPC

The modeling described above presents one of many potential scenarios to achieve the Rock River TMDL phosphorus and sediment reductions goals. Different combinations of reduced or no-tillage, nutrient management plans, cover crops, and land retirement may also achieve these goals. As described in Section 2.1, Commission staff estimate an additional 41,860 linear feet of potential grassed waterways in the watershed; implementing these grassed waterways could reduce phosphorus by 1,746 pounds. Several other practices and projects, such as remeandering sections of the Creek and reconnecting the floodplain, are not readily modeled in STEPL but would still provide phosphorus and sediment reductions. Attaining reductions by implementing these practices could offset shortcomings from modeled practices that do not reach the estimated acreages. Chapter 3 of this plan will describe these BMPs in greater detail, illustrate where these practices could be applied in the watershed, and detail the costs, technical assistance, potential funding sources, and timelines to implement these practices.

Credit: Commission Staff

PLAN RECOMMENDATIONS 3

3.1 WATERSHED GOALS, MANAGEMENT OBJECTIVES, AND IMPLEMENTATION

This nine key element (9KE) plan is designed to serve as a guide for the management of water quality within the Upper Turtle Creek watershed and for the management of the land surfaces that drain directly and indirectly to the waterways and, consequently, to downstream waterbodies, including Lake Comus (Lake), Turtle Creek (Creek), and ultimately the Rock River. Hence, developing an approach for working towards meeting the pollution load limits established under the Rock River Total Maximum Daily Load (TMDL) study was a major focus of this watershed plan. However, that focus was only one component of the overall watershed goals and management objectives that were established to address critical issues in the watershed based on watershed inventory results.

This watershed plan was prepared in the context of the Southeastern Wisconsin Regional Planning Commission's (SEWRPC or Commission) regional water quality management plan,[55] the Turtle Creek Priority Watershed Plan,[56] the Multi-Jurisdictional Comprehensive Plan for Walworth County,[57] the Walworth County Land and Water Resources Management Plan,[58] the Lake Comus Management Plan,[59] and the Rock River Recovery.[60] In particular, the Walworth County Land and Water Resources Management Plan (LWRMP) priority issues, goals, objectives, and implementation work plan elements formed the basis of the recommendations

[55] *SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan For Southeastern Wisconsin: 2000, Volumes One through Three*, 1978. SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan For Southeastern Wisconsin: An Update and Status Report*, March 1995.*

[56] *Rock County Department of Land Conservation,* Turtle Creek Priority Watershed Plan*, April 1984.*

[57] *SEWRPC Community Assistance Planning Report No. 288 (2nd edition),* A Multi-Jurisdictional Comprehensive Plan Update for Walworth County*, June 2019.*

[58] *Walworth County Land Use and Resource Management,* Walworth County Land and Water Resource Management Plan: 2021 - 2030*, 2020.*

[59] *SEWRPC Community Assistance Planning Report No. 341,* A Lake Management Plan for Lake Comus, Walworth County, Wisconsin*, December 2022.*

[60] *www.dnr.wisconsin.gov/topic/TMDLs/RockRiver/index.html.*

outlined below. Hence, continued implementation and funding to support the County LWRMP work plan elements, which support recommendations of this plan for the Turtle Creek watershed, is critical to the successful implementation of this plan.

The goals of the plan and the management objectives to be achieved through the plan's implementation are described below. The management objectives related to each goal consist of broad approaches or general types of actions required to meet the goal. Specifying these objectives breaks the goals down into manageable pieces, helps determine the specific steps necessary to achieve a goal, and facilitates developing measures to track progress. In some instances, specific targets are associated with a management objective. These targets estimate the level of effort that will be required to achieve a defined amount of improvement. The management objectives and targets also provide direction for developing specific policies and projects to address problems in the Turtle Creek watershed. Section 3.2 identifies specific actions to achieve the management objectives, in the form of policies, activities, or projects. Major stakeholders for implementing the plan include, but are not limited, to the Lake Comus Protection and Rehabilitation District (LCPRD), City of Delavan, Walworth County, Wisconsin Department of Natural Resources (WDNR), the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP), the Natural Resource Conservation Service (NRCS), the Walworth County Metropolitan Sewerage District (WalCoMet), the University of Wisconsin – Extension, Rock River Coalition (RRC), Glacierland Resource Conservation & Development (Glacierland RC&D), and the recently formed producer-led group Walworth Alliance Teaching Environmental Regenerative Systems (WATERS).

This watershed plan strives to protect existing high-quality resources, prevent resource degradation, and enhance resource function by implementing measures consistent with the following goals:

1. Manage lands in a manner protecting natural resource features

2. Identify opportunities to improve the quality of land and water (including groundwater) resources within the watershed

3. Minimize further degradation of surface water features and preserve, maintain, or enhance the quality of all waterbodies within the watershed

4. Promote active stewardship among residents, farmers, landowners, businesses, community associations, as well as governmental and non-governmental organizations

Description of Problems Related to Water Quality

The existing state of water quality in the Upper Turtle Creek watershed is described in Chapter 2 of this report. That description documents several water quality problems that currently exist in the watershed and are briefly described below:

- The conversion of large wetland complexes to agricultural fields that are heavily dependent on drain tile systems has both increased the transport of sediments, nutrients, and other pollutants to local waterways and reduced the recharge of groundwater

- Channel modifications, channelization, disconnected floodplains, agricultural drain tiles, and pumping systems have altered the natural flow regime of the streams and rivers of the watershed

- Instream concentrations of total suspended solids (TSS) are often high and contribute to sedimentation in stream channels

- Chronically high concentrations of nutrients that can stimulate excessive growth of plants and algae are present in surface waters

    - Turtle Creek, CTH O Tributary, and Lake Comus exceed water quality standards for total phosphorus, resulting in their 2022 303(d) listing as impaired waters

    - While there is limited data on nitrogen concentrations within the surface waters of the watershed, high instream concentrations are suspected

- Periods of summer water temperatures in Turtle Creek are sometimes above optimal levels contributing to suboptimal dissolved oxygen (DO) concentrations

- Instances of low DO concentrations as well as supersaturation conditions have been observed in several monitored surface waters of the watershed

Management Objectives for Water Quality

Based on the statement of water quality problems above and the analysis in Chapter 2, there are seven management objectives for the Upper Turtle Creek watershed:

1. Use existing Rock River TMDL guidance for phosphorus and sediment load reduction goals

2. Prioritize implementing regenerative agricultural practices to improve soil health and reduce phosphorus and sediment loading to Turtle Creek, its tributaries, and Lake Comus

3. Enhance and restore form and function of Turtle Creek and its tributaries and restore former wetland areas

4. Reduce impacts of legacy phosphorus found in channelized streams throughout the watershed

5. Continue water quality monitoring to track progress toward meeting nonpoint source load reductions and improving water quality

6. Preserve or enhance groundwater recharge to improve water quality and protect habitat for coolwater species

7. Establish partnerships between municipalities, associations, producers, and permitted entities to collaborate on water quality goals, pursue funding and incentivize practices

Linking the TMDL to Implementation of Water Quality Improvements

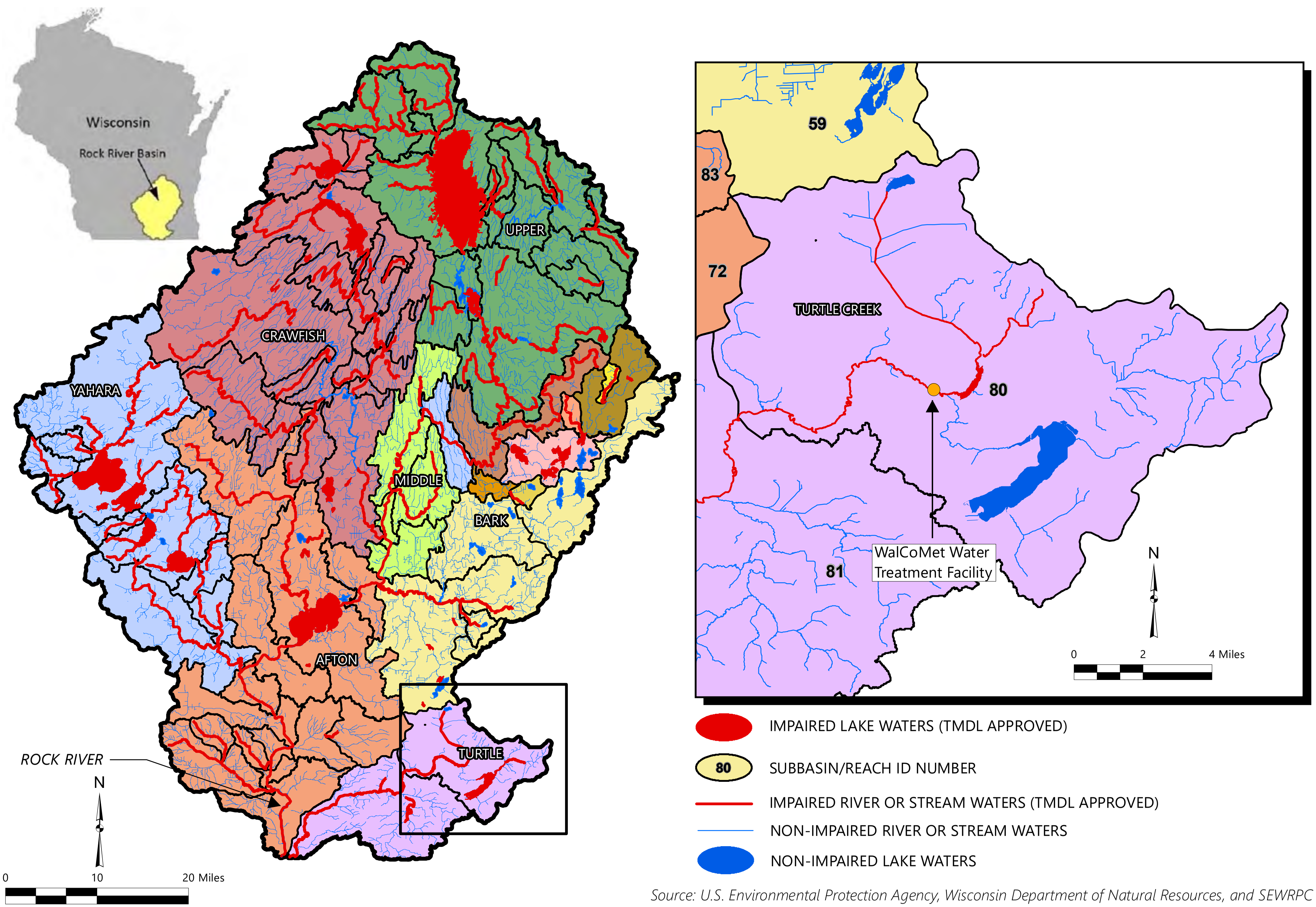
The Rock River TMDL was approved by the U.S. Environmental Protection Agency (USEPA) and the WDNR in 2011,[61] and relied largely on modelled data to quantify pollutant loads (un-permitted nonpoint source) and wasteload (permitted point source) allocations. The TMDL study established phosphorus and sediment load reduction goals for the Upper Turtle Creek watershed as a reach of the larger Rock River basin (see Map 3.1). This watershed, as defined in the Rock River TMDL, comprises all lands contributing to Turtle Creek upstream of State Highway C, an area including the Delavan Lake and the Jackson Creek watersheds as well as Lake Comus and its watershed. Achieving the targeted instream concentrations in Turtle Creek will require annual total phosphorus reductions from baseline loads of 75 percent for wastewater treatment facilities (WWTFs) and 49 percent for non-point sources. It will also require baseline sediment loads reductions of 1 percent from WWTFs and 25 percent from non-point sources. Of these nonpoint source loads, non-permitted urban sources contributed 19 percent of the total phosphorus and 15 percent of the sediment.

It is important to consider both the TMDL and additional information obtained since its completion when developing the implementation actions that may improve water quality within the portion of the Turtle Creek watershed that this 9KE watershed plan is focusing on. It should be noted that due to the nature of modeling uncertainty and the fact that agricultural nonpoint source loads are not regulated under the Federal Clean Water Act (CWA), achieving the wasteload allocations contained in the TMDL study would be expected to improve water quality conditions, but would not necessarily result in attainment of the phosphorus and sediment standards in Turtle Creek. Although TMDL load and wasteload allocations were used to establish the benchmark goals, the success of the management actions proposed under this watershed plan will be improvements in measured ambient or instream water quality rather than attainment of load and wasteload allocations.

This watershed plan envisions that restoration techniques be applied as a management action within the context of the Rock River TMDL pollutant reduction goals. The recommended management strategy would

[61] *USEPA and WDNR, July 2011,* op. cit.

Map 3.1
Subbasins and Impaired Reaches of Wisconsin's Rock River Watershed: 2021



Source: U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, and SEWRPC be to combine point and nonpoint source load reductions and instream ecological restoration techniques. It is important to note that stream restoration is a vital pollution reduction strategy to meet TMDL goals for phosphorus and sediment, but stream restoration should not be implemented for the sole purpose of nutrient or sediment reduction in this watershed.

The management actions discussed in detail in subsequent sections were chosen because it is anticipated that they will have the greatest effect on improving water quality within the Upper Turtle Creek watershed. As actions are implemented, water quality data are collected, and new information and technology become available, the LCPRD, in consultation with the Federal, State, and local municipalities and partners, will discontinue actions that are deemed ineffective and add actions that may not be included in this report.

3.2 MANAGEMENT RECOMMENDATIONS

Consistent with the Federal CWA, the Upper Turtle Creek watershed plan is designed to address the physical, chemical, and biological functions of this system. The watershed plan presents recommendations intended to provide guidance for improving water quality in the watershed over a ten-year period. However, because of the long-time scales needed for reductions in pollutant loads to be measurable in a complex natural system and limitations on the financial resources available for plan implementation, the plan will realistically be implemented over a time period longer than ten years. The plan recommendations include specifically identified management measures to advance the achievement of the overall plan objectives in the near term and somewhat more broadly targeted measures that would be implemented as opportunities arise over a longer time frame. For these reasons, the effects of various plan recommendations on reducing pollutant loads to the waterbodies in the watershed are addressed in several ways:

- Certain general recommendations to improve water quality may be applicable to the entire watershed while others may apply to targeted stream reaches or areas of the watershed. These general recommendations do not have the information necessary for load reduction estimates to be practically quantified individually.

- For specific recommended management measures the total phosphorus and TSS load reductions are estimated where feasible, enabling those reductions to be compared to the existing pollutant loads presented in Chapter 2 as well as the targeted loads provided in the Rock River TMDL report.

Turtle Creek's low water clarity, high nutrient concentrations, and significant amounts of nonpoint pollutant loading stem predominantly from rural land uses across the watershed. As rural nonpoint runoff is the greatest source of pollutant loads, and potential load reductions within the watershed, many of the targeted management measures are focused on cropland best management practices (BMPs). Specifically, targeted cropland BMPs recommended in this watershed include the use of cover crops and no-till practices, increased implementation of nutrient management plans, and restoration of potentially restorable wetlands and expansion of riparian buffers. The most effective approach for implementing BMPs across the watershed will likely require outreach about the need for, and benefits of, such practices, cost-sharing or financial incentives to reduce risk to agricultural producers, as well as meeting and exceeding existing agricultural performance standards.

Prioritizing Parcels to Reduce Nonpoint Source Pollutant Loads

Reducing nonpoint sources of phosphorus and sediment from agricultural land uses in the Upper Turtle Creek watershed is a major priority for the LCPRD, the City of Delavan, Walworth County, and other organizations committed to improving water quality in the watershed. Understanding where BMPs should be applied within a watershed is critical to ensure that land, financial, and time resources are effectively spent on projects with the greatest potential pollutant load reduction. To that end, Commission staff prioritized parcels for effectiveness of implemented conservation practices within the watershed using 2020 land use, soil, and floodplain information. Generally, the effectiveness of agricultural BMPs to improve water quality decreases with distance from a waterbody. Therefore, parcels adjacent to Turtle Creek, its tributaries, and Lake Comus would receive high priority. Based upon this principle, a general parcel level agricultural priority map for BMP implementation was developed. Implementation priority for each parcel was assigned to one of the following three categories:

- **High priority** – Parcels with over 50 percent of land devoted to agricultural that abut or are intersected by waterways including Lake Comus, the mainstem of Turtle Creek, drainage ditches and tributaries, and/or floodways designated by the Federal Emergency Management Agency (FEMA)

- **Moderate priority** – Parcels with less than 50 percent of land devoted to agricultural that intersect waterways as well as parcels with any agricultural lands intersected by FEMA-designated floodplains

- **Low priority** – Agricultural lands that are not directly connected to a waterway and are outside of FEMA-designated floodplains

This strategy prioritizes where pollutant loads are most easily delivered to water bodies and where pollutant loads can be most cost-effectively reduced. Based upon this analysis, approximately 5,622 acres of high priority, 2,000 acres of moderate priority, and 12,389 acres of low priority agricultural lands are found within the watershed (see Map 3.2).

Recommended Nonpoint Source Reduction Practices for the Upper Turtle Creek Watershed

Implementing BMPs that reduce nonpoint source pollutant loading throughout the watershed, educational programming, and broadening/deepening public support have the greatest potential for improving the health of the Upper Turtle Creek watershed. Reducing pollutant loads will take coordination at Regional, County, municipality, and local scales. Strong partnerships that adopt programmatic approaches, such as County land and water conservation plans, meaningfully contribute to long-lasting pollutant reduction. However, it is also essential to promote education and outreach programs regarding pollutant loading, particularly nonpoint source loading. The recommendations in this section are intended to improve soil health, enhance water quality, and support biological diversity.

Table 3.1 provides a summary of the management recommendations most focused on nonpoint source pollutant load reduction. When enough information is available to do so, this summary includes performance indicators, quantities of recommended areas to implement these measures, their estimated costs, modeled total phosphorus and sediment reductions, as well as the funding programs and entities responsible for their implementation. These recommendations provide guidance for the management of the land and water resources within the watershed with respect to a variety of general and specific factors and issues that contribute to the problems related to impairing the hydrologic, hydraulic, geomorphologic, physiochemical, and biological functions of Turtle Creek as detailed in Chapter 2.

This plan will also provide a timeline for when specific practices and projects should be completed and general management measures to meet the goals and management objectives of this plan. This chapter also includes an information and education component to incorporate recent and ongoing watershed management programs and initiatives, information on potential funding sources, and recommendations for measuring and assessing implementation success.

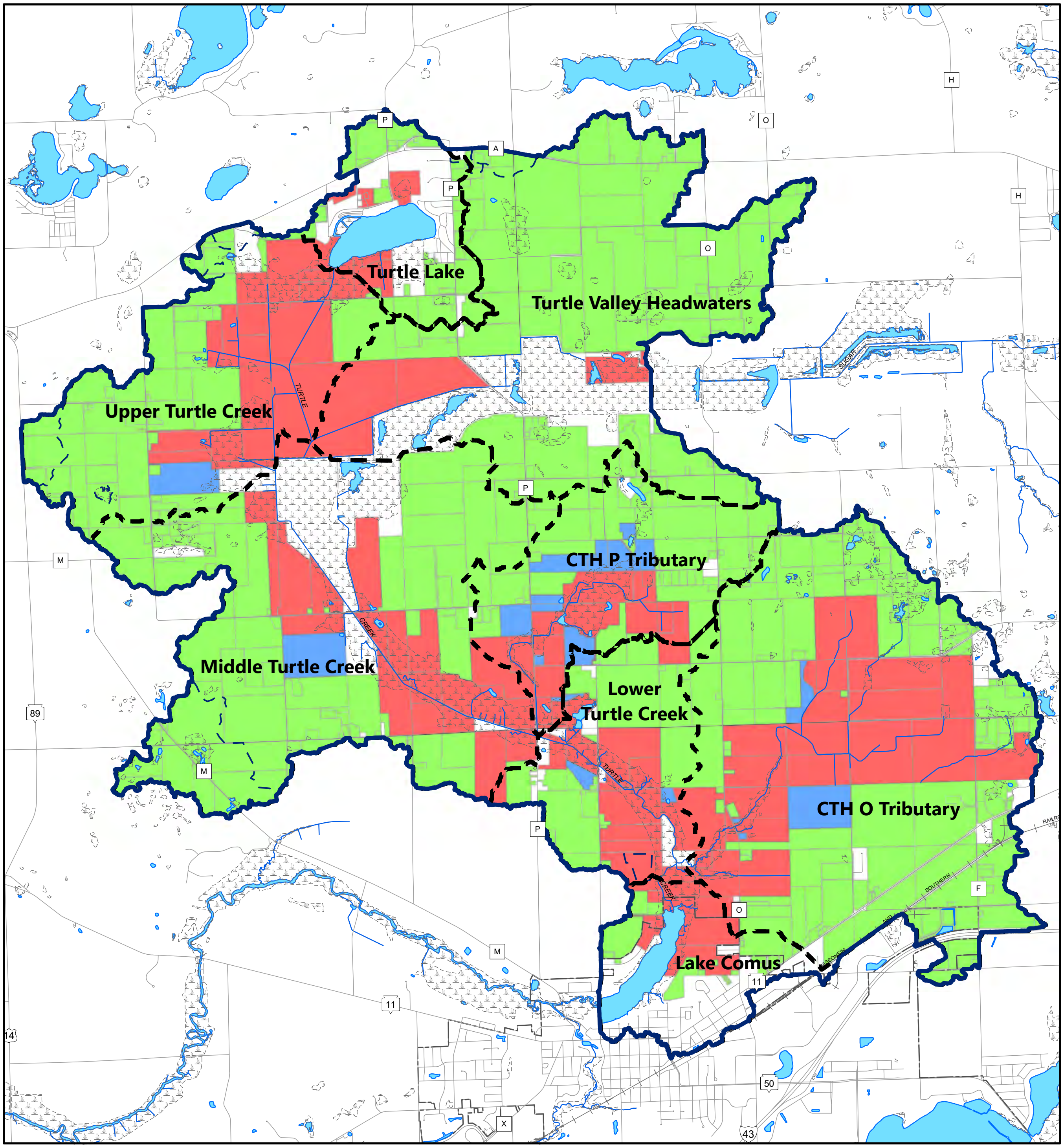
Estimating Pollutant Load Reductions

To better refine estimates of pollutant load reductions for the Upper Turtle Creek watershed, the USEPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) model was applied to some specific project recommendations under this study.[62] STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. The tool is able to compute estimates of watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biochemical oxygen demand (BOD_5); and sediment delivery based on various land uses and management practices. For each of the areas examined in the watershed using STEPL, the annual nutrient loading was calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation and the sediment delivery ratio. Estimates of annual sediment and pollutant loads based on year 2020 land use and existing loads and implemented BMPs are provided in Chapter 2 of this Report.[63]

[62] *Tetra Tech, Inc.,* User's Guide: Spreadsheet Tool for the Estimation of Pollution Load, Version 4.4, *March 2018; more information on the STEPL model can be found at www.epa.gov/sites/default/files/2021-01/documents/steplguide404.pdf.*

[63] *The estimated potential pollutant load reductions from the implementation of BMPs are computed using generalized BMP efficiencies.*

Map 3.2
Prioritization Among Parcels for Implementation of Agricultural BMPs



Priority Agricultural BMP Parcels (Urban Areas not Ranked)

- HIGH
- MODERATE
- LOW
- TAX PARCEL

- SURFACE WATER
- STREAM
- WATERSHED BOUNDARY
- INTERNALLY DRAINED AREAS
- WATERSHED SUBBASINS
- WETLANDS

N

0 0.25 0.5 1 Mile

Source: SEWRPC

Table 3.1
Targeted Management Measures, Estimated Cost, and Estimated Phosphorus and Sediment Reduction for the Upper Turtle Creek Watershed: 2024

Recommendations	Indicators	Quantity	Estimated Cost ($)[a]	Phosphorus Reduction[b]	Sediment Reduction	Funding Programs[c]	Implementation
Agricultural BMPs							
Increase use of reduced tillage practices in watershed from 50 percent to at least 77 percent	Number of acres cropland with conservation practice applied	3,696 acres	10,312	4,652 lbs	1,309 tons	EQIP, TRM, SWG	NRCS, Walworth County, WDNR, Local Partners
Increase use of no-till in watershed from 10 percent to at least 22 percent	Number of acres cropland with conservation practice applied	1,680 acres	32,995	2,354 lbs	704 tons	EQIP, TRM, SWG	NRCS, Walworth County, WDNR, Local Partners
Increase use of cover crops in watershed from 5 percent to 20 percent	Number of acres cropland with conservation practice applied	2,185 acres	131,428	2,954 lbs	867 tons	EQIP, TRM, SWG	NRCS, Walworth County, WDNR, Local Partners
Increase implementation of lands under nutrient management plans from 44 percent to 78 percent	Number of acres cropland with conservation practice applied	4,793 acres	191,720	5,823 lbs	1,603 tons	EQIP, TRM, SWG	NRCS, Walworth County, WDNR, Local Partners
Install additional grassed waterways[d]	Number of linear feet of grassed waterways installed	41,860 feet	209,300	1,760 lbs	1,392 tons	EQIP, TRM, SWG	NRCS, Walworth County, WDNR, Local Partners
Ensure animal operation performance standards are met	Number of animal operators not meeting NR 151 standards and Walworth County ordinances	--	--	--	--		WDNR, DATCP, Walworth County, Local Partners
Restore Hydrologic Functions							
Restore Areas of Potentially Restorable Wetlands (PRW) *Highest Priority Areas* *High Priority Areas* *Moderate Priority Areas*	Number of acres of restored wetland	 154 acres 364 acres 1,220 acres	 616,000 1,456,000 4,800,000	 372 lbs 879 lbs 2,947 lbs	 136 tons 412 tons 1,382 tons	CREP/CRP, EQIP, TRM	NRCS, Walworth County, WDNR, Local Partners
Implement remeander projects, such as toe wood-sod mats, reconnecting the streams to historic channel, two-stage channel	Number of linear feet of stream channel with remeander projects installed	28,776 feet	2,877,600 to 48,919,200	N/A	N/A	TRM, SWG	NRCS, WDNR, Walworth County, Local Partners
Implement ditch plug and/or fill projects	Number of linear feet of drainage ditch to be impacted by ditch plug projects	30,500 feet	2,440,000[e]	N/A	N/A	TRM, SWG	NRCS, WDNR, Walworth County, Local Partners
Riparian Buffers Restoration							
Install minimum 75-foot wide riparian buffer strips	Number of acres of riparian buffer installed	179 acres	78,760	469 lbs		CREP/CRP, EQIP, TRM	NRCS, Walworth County, WDNR, Local Partners

Table continued on next page.

Table 3.1 (Continued)

Note: A combination of the listed practices will be applied to agricultural fields to get the desired reductions required by the Rock River TMDL. Not all practices listed will be applied to each field. The combinations of practices applied will vary by field. In most cases just applying one practice to a field will not get desired reductions and a combination of two to three practices will be necessary to get desired reductions.

[a] Estimated per unit costs are as follows: 2.79 for reduced tillage, 19.64 per acre for no-till, 60.15 per acre for cover crops, 40.00 per acre for nutrient management plans, 5.00 per linear foot for grassed waterways, 440 per acre for riparian buffer, 4,000 per acre for land conversion, and between 100 and 1,700 per linear foot for stream remeandering depending on practice.

[b] Estimated phosphorus reductions per acre were sourced from the STEPL pollutant loading model for each conservation practice individually applied to one acre of cultivated cropland.

[c] See Section 3.6 "Funding Opportunities" for a more detailed description of the Environmental Quality Incentives Program (EQIP), Total Runoff Management (TRM), Conservation Reserve Enhancement Program (CREP), Conservation Reserve Program (CRP), and the Surface Water Grants (SWG) programs. Also see Table 3.6 for information on additional potential funding programs.

[d] For phosphorus and sediment load reduction estimates, Commission staff assumed gully dimensions of 1 foot depth and 1 foot width. Actual load reductions will likely vary based on specific conditions of each gully.

[e] Due to the uncertainty of the number and/or size of these potential ditch plug installations, permitting issues, design costs, and willingness of landowners, this estimate of a total project cost for these project areas are likely to vary widely. For this estimation, hydrologic restoration using ditch plugs were estimated to cost approximately $8,000 per 100 foot-long embankment addressed.

Source: Walworth County, NRCS, and SEWRPC

Agricultural BMPs

Pollutant load modeling presented in this plan as well as the Turtle Creek Priority Watershed Plan and the Rock River TMDL have all identified rural nonpoint sources as major contributors to total phosphorus and sediment pollution in Turtle Creek.[64,65] Consequently, utilizing agricultural BMPs and regenerative agriculture techniques are the most effective measures to reduce nonpoint source pollutants and improve the water quality within the watershed. Walworth County Land Use & Resource Management staff supplied the estimated number of acres within the watershed where agricultural BMPs have already been applied.[66] Agricultural parcels where conservation practices and nutrient management plans have already been applied in the upper Turtle Creek watershed are shown in Map 2.11.

The Commission's STEPL modeling effort indicates the number and amount of these practices required within the watershed to meet the pollutant load reduction goals set by the Rock River TMDL. A combination of enforcement to meet existing agricultural performance standards as well as outreach and financial incentives to implement additional BMPs that exceed these standards will be required to meet these goals.

Existing runoff management standards have been established by the State of Wisconsin and are administered by the WDNR and DATCP. Chapter NR 151, "Runoff Management," of the *Wisconsin Administrative Code* provides runoff management, nutrient management, soil erosion, tillage setback, as well as implementation and enforcement procedures for the regulations. Chapter ATCP 50, "Soil and Water Resource Management Program," of the *Wisconsin Administrative Code* prescribes farm conservation practices that can be used to implement these standards.[67]

Since all cultivated land within the Upper Turtle Creek watershed is within a Farmland Preservation Zoning District, agricultural landowners may be eligible to receive a $7.50 per acre tax credit if they participate in the Farmland Preservation program and are certifiably complying with NR 151.[68] As per the aforementioned statutes and Walworth County ordinances, agricultural landowners participating in the Farmland Preservation program not in compliance will be issued a notification of non-compliance detailing the violation, a deadline to cure the violation, the process to contest the violation, and that the landowner may not claim the aforementioned tax credit until the violation is corrected.[69] Experience in the State has indicated that a combination of regulation and informed local decision making by landowners/operators is needed to achieve water quality improvements consistent with the attainment of water quality standards and criteria.[70]

Although this plan recognizes the importance of continued funding and staff to ensure adherence to State, County, and local standards, it goes beyond reliance on regulation and enforcement. This watershed plan's strategy is to rely on empowered local decision makers creating unique solutions that work for the Upper Turtle Creek watershed to ultimately exceed compliance standards. This strategy is designed to augment the work of Walworth County staff who work with landowners and operators to implement innovative and effective conservation practices continued through collaboration amongst the County, State, and Federal agencies. Glacierland RC&D and WATERS could be involved as feasible to assist with education and outreach to producers as well as cost-share agricultural BMPs.

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[64] *Rock County Department of Land Conservation,* Turtle Creek Priority Watershed Plan, *April 1984.*

[65] *USEPA and WDNR, 2011,* op. cit.

[66] *Personal communication between Brian Smetana, Senior Conservation Technician, Walworth County Land Use & Resource Management and Commission staff, July 2024.*

[67] *For more information, see docs.legis.wisconsin.gov/statutes/statutes/91/v/80.*

[68] *To view a map of lands within Farmland Preservation Zoning Districts, see datcpgis.wi.gov/maps/?viewer=fpp. For more information on Farmland Preservation Zoning, see datcp.wi.gov/Pages/Programs_Services/FPZoning.aspx.*

[69] *Walworth County Code of Ordinances Chapter 26 Article IV, "Conservation." library.municode.com/wi/walworth_county.codes/code_of_ordinances?nodeId=WACOCOOR_CH26EN_ARTIVCO_DIV2SOWACOSTFAPRPR.*

[70] *The Minnesota Pollution Control, Wisconsin Department of Natural Resources, and The St. Croix Basin Water Resources Planning Team*, Implementation Plan for the Lake St. Croix Nutrient Total Maximum Daily Load*, prepared by LimnoTech, February 2013.*

Aside from the agricultural land that they own, the LCPRD, City of Delavan, Town of Delavan, and other municipalities have little capacity to directly implement agricultural BMPs. However, these entities can play a role in encouraging, educating, and incentivizing the adoption of these practices within the watershed. The Surface Water Restoration and Management Plan Implementation subprograms of the WDNR Surface Water Grant program are two major avenues by which the LCPRD and local partners can help fund watershed BMPs that reduce nonpoint source loading. As several of these practices may require specialized equipment and training as well as a major shift in how these farms have previously been operated, the local agricultural industry, including retailers, crop advisors, cooperatives, and other local markets, should be prepared to assist farmers in changing practices. Due to the importance of reducing rural nonpoint source phosphorus and sediment pollution to the water quality and general ecosystem health of the waterways in the Upper Turtle Creek watershed, the following recommendations should be considered high priority.

- **Recommendation 1.1: Continue to assist landowners to prepare and implement conservation plans and conservation practices needed for compliance with NR 151 and the conservation compliance requirements for farmland preservation tax credits**

  The Walworth County LURM currently assists landowners reach compliance with the necessary requirement of the farmland preservation tax credits. This vital assistance should continue based on the strategy articulated in the Walworth County Land and Water Resource Management Plan. The Walworth County LWRMP prioritized implementing BMPs on farmlands participating in the farmland preservation program and farmlands identified in several completed 9KE watershed plans and the Rock River Recovery TMDL. [71] It is recommended that the LURM prioritizes farmlands identified in this Upper Turtle Creek 9KE watershed plan and indicate in the next update to the LWRMP that this watershed should be a focus area for farmland project implementation in the County.

- **Recommendation 1.2: Conduct a thorough landscape analysis to identify conservation practices appropriate for specific properties throughout the watershed.**

  An evaluation of the Upper Turtle Creek watershed could include the GIS based software Agricultural Conservation Planning Framework (ACPF) and/or the Erosion Vulnerability Assessment for Agricultural Lands (EVAAL). This work would supplement the pollutant modeling presented in this plan as well as the modeling and analysis conducted by Walworth County using SnapPlus and BARNY.

- **Recommendation 1.3: Incentivize use of no-till and conservation tillage practices and assist farmers and/or landowners in seeking funding for implementing such practices**

  Removing crop residue and disrupting soil through tillage often enables soil erosion. When soil is tilled, the soil structure resisting erosion is weakened and more soil is exposed to erosive forces, leading to nutrient and sediment laden surface runoff. No-till farming is the practice where soil is undisturbed except for where the seed is placed in the soil. No-till planters disturb less than 15 percent of the row width. The combination of minimal ground disturbance and minimal removal of crop residue contribute to a more stable soil surface that is less susceptible to erosion and the accompanying runoff of nonpoint source pollutants.

  No-till benefits are recognized in several areas. By not turning soil over to prepare a seed bed, soil structure, including pores and channels formed throughout the soil surface layers, remains intact. Furthermore, soil does not become compacted, allowing precipitation to better infiltrate. These changes result in less surface runoff and enable agricultural producers to enter fields in wetter conditions. The residue left behind after crop harvest is left to break down naturally, increasing the amount of organic matter in the soil. Decaying residue cycles nutrients back into the soil, decreasing reliance on artificial fertilizer. Soil with higher organic matter and better structure generally has more capacity to absorb and hold water, releasing it to crops during the growing season. Some soils are better suited to no-till than others. Soil warming and drying may be slower in the spring especially on poorly drained soils causing plants to germinate more slowly. Since the soil is not turned over, undesirable weeds may be harder to control and herbicide use could increase or alternative weed control practices used (e.g., cover crops coupled with mechanical termination). The benefits of no-till are not fully realized until the practice has been in place for several consecutive years.

[71] Walworth County Land and Water Resource Management Plan: 2021 - 2030*, 2020,* op. cit.

To be effective, no-till must be done as part of a system of crop rotation, nutrient management, and integrated pest management. Managing weeds and the residue resulting from no-till requires the farmer to be committed to changing additional seemingly interdependent farming practices as well as renting or purchasing new equipment or modifying existing equipment. These changes are not only a financial risk to farmers but also require that agricultural retailers, crop advisors, and local markets provide necessary training, equipment, and products to assist farmers transition to no-till.

As discussed in Chapter 2, Commission staff modeled pollutant load reduction scenarios using STEPL. In order to achieve the nonpoint source total phosphorus reduction goal of 49 percent and sediment load reduction goal of 25 percent for the Upper Turtle Creek watershed established by the Rock River TMDL, the percent of acres on which no-till agriculture is currently practiced should be increased from an estimated 10 percent to at least 22 percent within the next ten years. This increase in no-till coverage, in combination with other agricultural BMPs and restoration recommendations described below, would be necessary to meet the goals set by the TMDL.

➤ **Recommendation 1.4: Promote increased cover crop acreage and assist farmers and/or landowners in seeking funding for implementing such practices**

Establishing cover crops includes planting grasses, legumes, forbs or other herbaceous plants for seasonal cover and conservation purposes. Common cover crops used in Wisconsin include winter hardy plants such as barley, rye, and wheat as well as less common crops like oats, spring wheat, hairy vetch, red clover, turnips, canola, radishes, and triticale.[72, 73] Cover crops help reduce phosphorus and sediment loads to waterbodies by reducing erosion and improving infiltration. Cover crops grow during months when cultivated fields would otherwise be bare. This allows such fields to capture solar energy during fallow periods, a situation helping nourish soil biota, hold nutrients that otherwise would be carried away in water, and hold soil protecting it from erosion. When used properly for erosion control, cover crops produce a near continuous vegetative ground cover protecting soil against raindrop impact as well as sheet and rill erosion. Continuous plant cover increases infiltration, reduces runoff speed, promotes diffuse flow and runoff across the soil surface, causes soil particles to aggregate promoting desirable soil structure, and binds soil particles to plant roots. Decreased soil loss and runoff translates to reduced transport from farmland of nutrients, pesticides, herbicides, and harmful pathogens associated with manure that degrade the quality of surface waters and could pose a threat to human health. Over time, a cover crop regimen increases soil organic matter leading to further improvements in soil structure, stability, increased moisture and nutrient holding capacity for plant growth, and greater soil carbon storage.

Recent findings of the USDA Sustainable Agriculture Research and Education program recommend that a variety of strategies be employed to encourage agricultural producers to plant cover crops. Education, sharing new research results, appropriate technical assistance, low-cost seed, and in some cases, financial incentives will be necessary to encourage more farmers to adopt cover crops.[74] To achieve targeted total phosphorus load reduction of 49 percent and sediment load reduction goal of 25 percent, the number of acres planted to cover crops in watershed area should increase from 5 to 20 percent in combination with other agricultural BMPs as per the Commission's STEPL modeling. The LCPRD should promote activities that encourage producers to experiment with and hopefully employ cover crops in the longer term. This could include sponsoring producer-led educational events that focus on cover crop application. Furthermore, the LCPRD could consider cooperating with Walworth County, the City of Delavan, WATERS, and/or WalCoMet to make specialized equipment needed for cover crop application available to producers at low cost. Other counties have acquired such equipment and rent it to producers at a nominal cost.[75]

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[72] *USDA NRCS Wisconsin,* Cover Crops Factsheet, *2014.*

[73] *See UW-Extension website for more information at www.fyi.uwex.edu/covercrop.*

[74] *Download USDA report at website www.ctic.org/media/web/1533827451_2016_CTIC_Cover_Crop_Report.pdf.*

[75] *As an example, Ozaukee County and the Milwaukee River Clean Farm Families producer-led group offer a variety of incentives to encourage farmers to experiment with cover crops. Some of these programs are summarized at the following website: www.cleanfarmfamilies.com/cover-crop-program.*

- **Recommendation 1.5: Ensure all agricultural lands employ nutrient management plans and assist farmers in preparing and implementing these plans**

  The goal of a nutrient management plan is to avert excess nutrient applications to cropland and to thereby reduce nutrient runoff to lakes, streams, and groundwater.[76] Nutrient management plans consider the amounts, types, and timing of nutrient applications needed to obtain desired yields and minimize risk of surface water and groundwater contamination. In Wisconsin, nutrient management plans are based on the NRCS 590 standard.[77] Plans must be prepared by a qualified planner, which may be the farmer or a certified crop advisor. Soil testing is done on each field to help producers identify where nutrients are needed and where they are not and considers tillage, manure application, and residue management practices. Plans help farmers allocate nutrients economically (i.e., right source, rate, time, and place) while also helping to ensure they are not over-applying nutrients which could cause water quality impacts.[78] Ensuring that all agricultural fields in the watershed operate under a nutrient management plan would be a substantial step forward in achieving the 49 percent total phosphorus and 25 percent sediment load reduction goals. Parcels within the upper Turtle Creek watershed that have agricultural land uses and are not known to have a nutrient management plan are shown on Map 3.3.[79]

- **Recommendation 1.6: Install additional grassed waterways, maintain existing waterways, and assist farmers and/or landowners seeking funding to implement such practices**

  Grassed waterways carry runoff water off fields in a way that limits soil loss. Grassed waterways are constructed in natural drainage ways by grading a wide, shallow channel and planting the area to sod-forming grasses. When needed to help or keep vegetation established on sites having prolonged flows, high water tables or seepage problems; subsurface drains, underground outlets or other hard engineered components may be installed. Effective grassed waterways convey runoff water from fields and the sod helps capture entrained sediment and prevents runoff from eroding a channel and forming a gulley. The vegetation may also absorb some chemicals and nutrients in the runoff water and provide cover for small birds and animals. Grassed waterways fill with sediment over time and need to be rejuvenated by removing sediments, regrading, and replanting. Based on Commission staff estimates, the Upper Turtle Creek watershed already contains over 60,500 linear feet of grassed waterways, most of which are along ditches contributing water to the CTH O tributary (see Map 2.11). Some of these practices have degraded over time and could benefit from continued maintenance. Installing additional grassed waterways, particularly within steeply sloped cultivated fields where gully erosion is already evident, can further reduce phosphorus and sediment loading to surface waters. Potential areas where grass waterways may be particularly useful due to steep slopes or signs of erosion and/or moisture were identified by Commission staff using aerial imagery and are illustrated on Map 3.3. More than 41,860 linear feet of potential new grassed waterways have been identified and could be warranted in the Upper Turtle Creek watershed.

- **Recommendation 1.7: Install additional water and sediment control basins, maintain existing basins, and assist farmers and/or landowners seeking funding to implement basins**

  Water and sediment control basins are typically earthen embankments constructed across the slope of a field to arrest gully formation and soil erosion. These basins detain field runoff and allow suspended sediment within that runoff to settle out. Installing additional water and sediment control basins in combination with grassed waterways on steeply sloped fields can reduce phosphorus and sediment loading to surface waters. Potential areas where water and sediment control basins may be particularly useful are steeply sloping agricultural fields and particularly where gully erosion may already be evident. Although Commission staff did not model the phosphorus and sediment reductions from these practices

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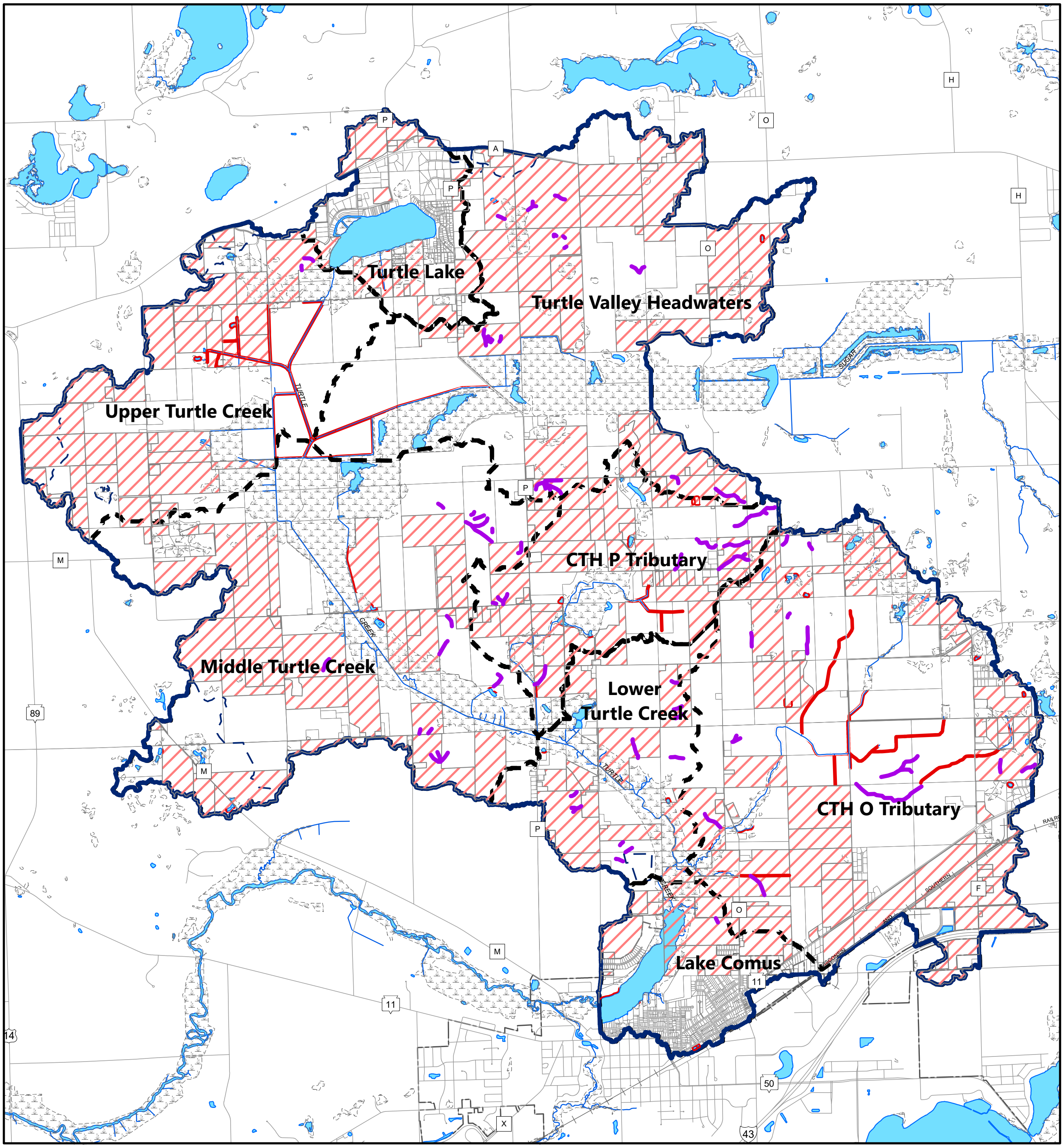
[76] *For more information on nutrient management and planning, see datcp.wi.gov/Pages/Programs_Services/NutrientManagement.aspx.*

[77] *Wisconsin Natural Resources Conservation Service,* Conservation Practice Standard: Nutrient Management Code 590, *CPS 590-1, 2015, datcp.wi.gov/Documents/NM590Standard2015.pdf.*

[78] *As an example of a tool to help farmers apply at the "right time," DATCP produced the Runoff Risk Advisory Forecast which uses soil moisture, temperature, landscape characteristic, and precipitation data to determine the risk of runoff in the present and near future. This tool can prevent inadvertent nutrient loss by warning producers of unsuitable nutrient application conditions. For more information, see .www.manureadvisorysystem.wi.gov/runoffrisk/index.*

[79] *The parcels shown as needing a nutrient management plan were identified using the SEWRPC 2020 land use inventory. These represent parcels that had at least 25 percent of their area identified to be in agricultural land use and are not known to already have a nutrient management plan.*

Map 3.3
Recommended Conservation Plans and Practices Within the Upper Turtle Creek Watershed



RECOMMENDED CONSERVATION PLAN OR PRACTICE

NUTRIENT MANAGEMENT PLAN (LURM)

POTENTIAL RIPARIAN BUFFER EXPANSION
75-FOOT MINIMUM RECOMMENDED WIDTH (SEWRPC)

POTENTIAL GRASSED WATERWAY (LURM AND SEWRPC)

SURFACE WATER

STREAM

WATERSHED BOUNDARY

WATERSHED SUBBASINS

WETLANDS

TAX PARCEL

0 0.25 0.5 1 Mile

Source: Walworth County LURM and SEWRPC

in STEPL, it is expected that implementing and maintaining these practices in the steeply sloping uplands of the Turtle Creek watershed should help meet pollutant load reduction goals.

Drain Tiles

Extensive subsurface drain tile networks have been installed over large areas of agricultural land to help lower seasonally high-water tables, allowing these areas to be more amenable to profitable agricultural use. In some situations, drain tiles include surface inlets to drain closed depressions that fill with runoff (e.g., Hickenbottom inlets). Drain tiles often discharge directly into streams or into ditches that discharge into streams. Because they provide a direct drainage pathway from fields to surface waterbodies, drain tiles can allow water and pollutants to bypass agricultural BMPs and natural features that modulate flow and remove contaminants from runoff. Research conducted at the University of Wisconsin Discovery Farms illustrates this bypass effect.[80] Drain tiles can export a substantial portion of the total phosphorus lost from agricultural systems in a variety of phosphorus forms, although dissolved phosphorus tends to be more common than particulate forms.[81] In fields with intact drain tile, between 15 to 34 percent of the total phosphorus, 78 to 87 percent of the nitrogen, and about 25 percent of the sediment leaving the field moved through the drain tile system. In fields with damaged drain tile (i.e., tile blow outs), about 65 percent of the total phosphorus and most of the sediment leaving the fields traveled through drain tile. These results show that drain tiles can constitute a major pathway through which sediment and nutrients travel from agricultural fields to surface waters.

Within the Upper Turtle Creek watershed, the LCPRD, local volunteers, and Walworth County staff have noted locations where drain tiles discharge to Turtle Creek and its tributaries, particularly in the Turtle Valley Headwaters subbasin. As discussed in Chapter 2, some drain tiles in the watershed are contributing waters with high concentrations of total phosphorus to surface waters although the total phosphorus loading by these drain tiles could not be calculated due to lack of simultaneous flow measurements. Consequently, action should be taken to reduce phosphorus export from these drain tiles to help protect surface water quality. The following recommendations are intended to mitigate the impacts of drain tile on the surface water hydrology and quality.

➤ **Recommendation 1.8: Repair, reduce, or retrofit drain tile systems and assist landowners seeking funding to implement such practices**

At a very minimum, damaged drain tile systems should be repaired to eliminate unintentional connections with surface water (e.g., blow outs, suck holes). As stated previously, these features dramatically increase the amount of soil and nutrients carried by drain tile networks to surface water. Natural surface hydrology should be restored by reducing, to the extent feasible, ineffective or unnecessary drain tile systems and/or retrofitting systems when needed. This recommendation should be considered a high priority. Specific measures that can be taken to accomplish this recommendation include:

- Encourage producers to identify and expeditiously repair drain tile network breaches. The most obvious locations are where water carried by drain tiles erupts to the surface or where surface runoff disappears into the ground at unplanned locations.

- Discourage the use of surface inlets. Consider the profitability of closed depression areas drained by surface inlets and evaluate alternative water management or land use options.

- Investigate drainage patterns and available drain tile system maps to determine whether certain operational systems are no longer necessary. Remove or disconnect unneeded tile systems. This recommendation is especially appropriate for riparian parcels owned by WDNR that were likely farmed prior to public acquisition. If drain tile network maps are not available, drain tiles may often be identified using aerial imagery or unmanned aerial vehicles looking for lines of frost heave or reduced soil moisture in spring. Additionally, visual inspection along streams and ditches, especially in early spring when vegetation is low and runoff is generally greater, can reveal the drain tile outlets.

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[80] *Eric Cooley,* Nutrients Discharging from Drain Tiles in Eastern Wisconsin, *Presentation at the Eighth Annual Clean Rivers, Clean Lake Conferences, Milwaukee, WI, April 30, 2012.*

[81] *For a thorough literature review on phosphorus dynamics with drain tiles, see J. Moore,* Literature Review: Tile Drainage and Phosphorus Losses from Agricultural Land, *Lake Champlain Basin Program, 2016.*

- Work with landowners to collect and digitize any maps or knowledge of drain tile system locations. This is especially appropriate prior to any potential sale of farmland.

- Measure drain tile effluent total phosphorus concentrations and flow using a regular monitoring schedule (e.g., monthly or biweekly) to determine average total phosphorus loading and estimate proportion of total field phosphorus export. Whenever possible, measure tile discharge rates.

- Integrate in-line water level control devices into drain tile systems. Lower water levels would be used to encourage drainage during spring and other stretches of excessively wet weather. Conversely, higher water levels can benefit crop yields during dry weather through subirrigation. These control structures can reduce phosphorus and nitrogen loads by reducing tile flow volume as well as by promoting denitrification.[82] An example of an inline water level control device installed in a field tile network is illustrated in Figure 3.1.

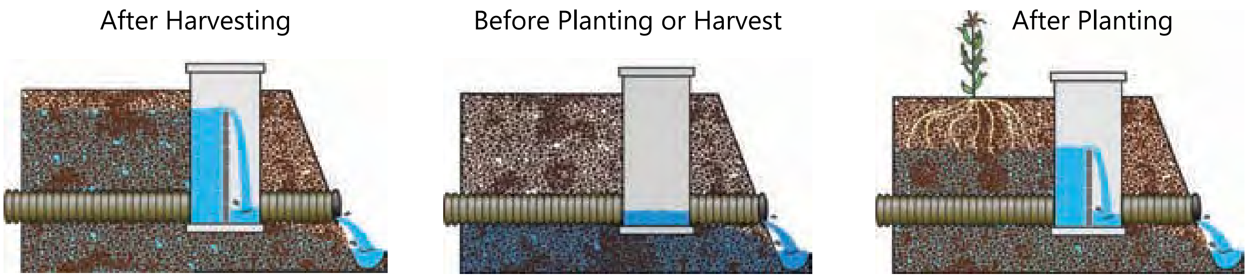
- Investigate options for drainage and pumping operations at DeBuck's Sod Farm. DeBuck's Sod Farm operates an extensive irrigation and drainage system in order to effectively cultivate sod crops in an area that was historically a large wetland complex (see Figure 2.7 and Map 2.9 in CAPR 341). The sod fields are drained through a large drain tile system that drains into the East and West Branch Turtle Creek and the North and South Branch Turtle Valley Tributary. The streams in this area are effectively deeply incised drainage ditches with large pumps installed throughout. During periods of dry weather, when the water table is lowered, the large pumps are used to draw water into the property from Turtle Creek and its tributaries that is then pumped to sprinkler systems to water the sod crop. This pumping, under certain conditions, reverses the natural flow directions of the East and West Branch of Turtle Creek (see Map 2.14 and Figure 2.13). As described in Chapter 2, these stream segments and drainage ditches act more as linear ponds from which water could be withdrawn and drained into. All of the channelized ditches in this area exhibited symptoms of nutrient enrichment. The combination of culverts, pumping, and drain tiles has created a cycling of nutrient rich water onto the fields, through the drain tiles after collecting more nutrients from the fields, and back into the Creek to be withdrawn again for irrigation.

When the water table is elevated, it is assumed that water would naturally flow downstream (west and south – see Map 3.4). Drained water from the fields containing high levels of phosphorus would be directed through drain tiles into the East and West Branch of Turtle Creek and pumped out of the farm property and flow into the mainstem of Turtle Creek. The assumed flow direction during normal- to elevated water table levels and the location of the main pump on the property are shown on Map 3.4. Directly across from the main pump outlet on East Branch Turtle Creek is a large wetland complex owned by WDNR. The complex abuts the Turtle Valley Wildlife Area that was restored to mostly shallow marsh and wet meadow.

This watershed plan recommends investigating options for reducing the hydrologic impacts and nutrient loading of Turtle Creek caused by the drainage and irrigation systems at DeBuck's Sod Farm. One aspect recommended for exploration is the feasibility of extending the main drainage pump outfall pipe located on the East Branch Turtle Creek at the southern edge of the property to drain into the adjacent wetland complex to the south that is owned by WDNR. This re-routing of the outfall would discontinue the direct pumping of large amounts of nutrient-rich runoff into Turtle Creek. In theory, the runoff would be able to slowly filter through the wetland, allowing the wetland vegetation to take up some of the nutrients and more gradually release the filtered runoff downstream into Turtle Creek (see Map 3.4). Any investigation and/or study should be done in collaboration with all adjacent landowners including DeBuck's Sod Farm and WDNR. The proposed investigation should include the feasibility of creating a shallow marsh habitat similar to that of the restored Turtle Valley Wildlife Area property.

[82] Ibid.

Figure 3.1
Inline Water Control Diagram



Source: Purdue University

➤ **Recommendation 1.9: Implement saturated buffers and/or bioreactors to treat tile drainage**

Saturated buffers, unlike ordinary riparian buffers, capture and treat water from tile drainage. A saturated buffer has a control structure that redirects flow from a main tile line through a lateral distribution line into the buffer. Once within the buffer soils, the water redirected from the tile percolates deeper into the soil or gets taken up by vegetation. In its study at Bear Creek in Iowa, the Leopold Center for Sustainable Agriculture at Iowa State University found that the use of a saturated buffer reduced annual nitrate loads by about 55 percent. However, the evidence for phosphorus removal through saturated buffers is not well established.[83]

Bioreactors are another method for capturing and treating tile drainage water. Unlike saturated buffers, which redirect nutrients deeper into soil or into vegetation, bioreactors remove nitrates by promoting a process called denitrification, by which nitrate is predominantly converted to inert nitrogen gas. Bioreactors provide a carbon source, such as wood chips, for the bacteria to fuel this conversion. As with saturated buffers, there is less consensus that bioreactors are effective for reducing phosphorus loads.[84] Implementing saturated buffers and bioreactors to reduce nitrogen from tile drainage water should be considered a medium priority.

➤ **Recommendation 1.10: Manage fertilizer application to minimize losses via drain tile**

Applying fertilizer and manure at the appropriate rates and timing has been shown to minimize phosphorus export from farm fields to drain tiles.[85] Over-application of fertilizer and manure results in excess nitrogen and phosphorus quantities in the soil that are not utilized by crops and subsequently can be exported via drain tiles to waterways. UW-Extension fertilizer application guidance suggests appropriate phosphorus and nitrogen application rates for crops and conducting soil tests for nitrogen and phosphorus to avoid over-application.[86] Avoiding application when soils are saturated can help to reduce transport of fertilizer and manure through the soil profile and into the drain tile. Furthermore, since the excess nutrients are not needed by crops, excessive application diminishes producer profitability. The LCPRD, Walworth County, DATCP, and NRCS should continue to work with agricultural producers in the watershed to manage fertilizer applications and reduce nutrient loading into waterways. This recommendation should be considered a high priority.

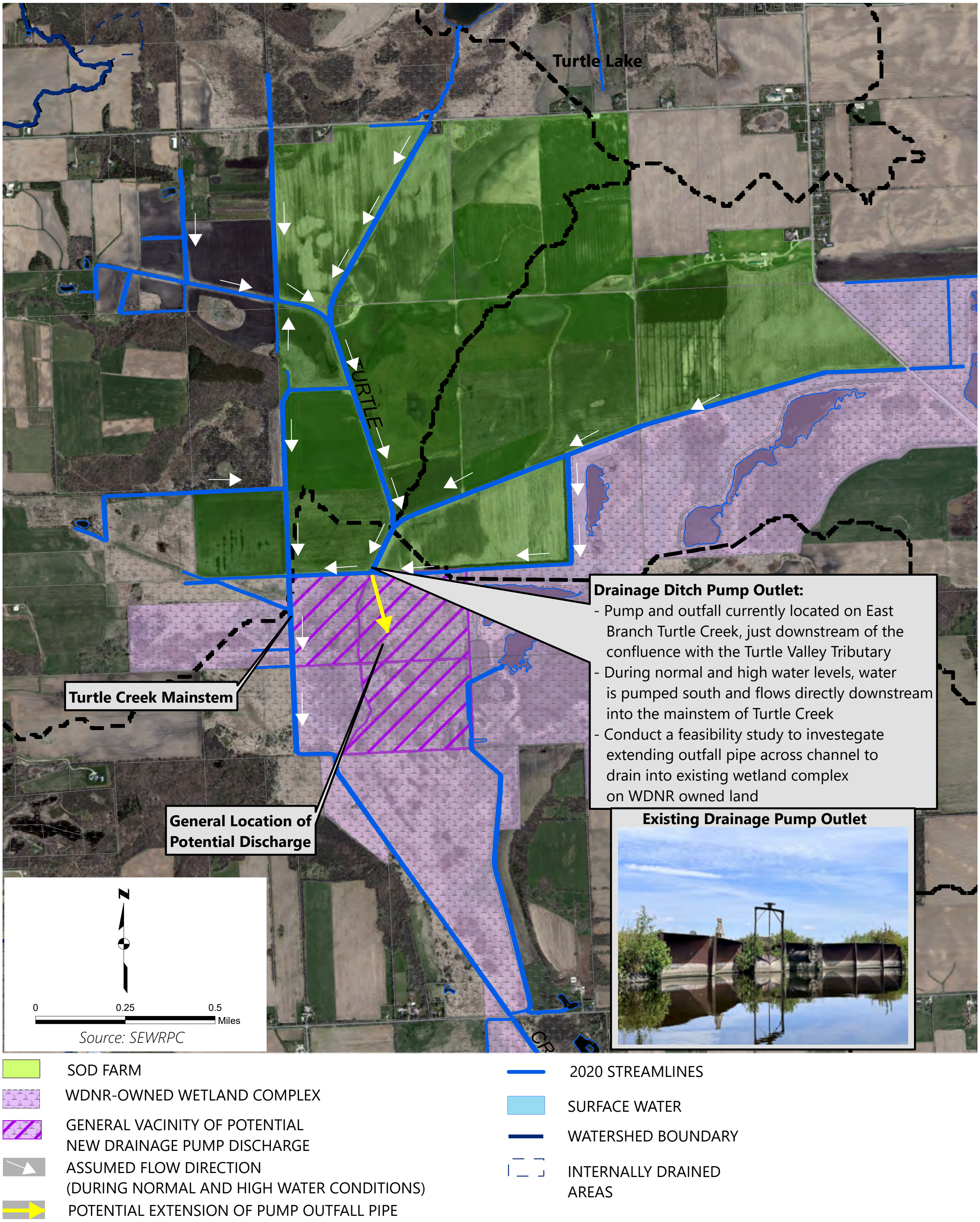
[83] Ibid.

[84] Ibid.

[85] Ibid.

[86] *C.A.M. Laboski and J.B. Peters,* Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin, *University of Wisconsin Cooperative Extension A2809, 2018. See walworth.extension.wisc.edu/files/2018/11/Nutrient-Application-Guidelines-for-Field-Vegetable-Fruit-Crops-in-WI-A2809.pdf.*

Map 3.4
Area for Investigating Extension of Pumped Drainage System From Sod Farm



Note: Further study would be required before designing, permitting, and implementing any specific practice.

Animal Operations

In Wisconsin, an animal feeding operation with 1,000 or more animal units is defined as a Concentrated Animal Feeding Operation (CAFO).[87] Under State and Federal law, CAFOs must have a WDNR-issued Wisconsin Pollutant Discharge Elimination System (WPDES) permit to protect surface and ground waters from excessive runoff and animal waste. Consequently, CAFOs are more stringently monitored and regulated than smaller animal feeding operations. Among the requirements are that CAFOs have a nutrient management plan developed as part of the permit process; that response plans are developed for manure and non-manure spills; that manure spreading limits and setbacks are specified; and that additional inspection, monitoring, and reporting requirements are adhered to.[88] There is one CAFO located within the upper Turtle Creek watershed at the time of this writing.[89] In addition to this operation, there are multiple other animal operations within the watershed that do not meet the number of animal units to be defined as a CAFO (see Map 2.10). The LCPRD, Walworth County staff, and local residents should continue to work with the WDNR to address any concerns about water quality impacts from animal operations in the watershed.

➤ **Recommendation 1.11: Ensure that animal operation performance standards are met**

The provision for barnyard runoff control systems and six months of manure storage are recommended for all livestock operations in the watershed as well as maintaining exclusion of livestock from waterbodies and adjacent riparian areas. Animal waste storage, management, and utilization must comply with Walworth County ordinances.[90] To assist with enforcement, citizens and volunteers can report suspected violations to County or State authorities. Furthermore, it is recommended that WDNR and DATCP consider increasing levels of cost-share funding to enable a higher level of BMP implementation needed to meet the NR 151 performance standards. This recommendation should be considered a high priority.

Hydrologic Restoration

Ditching or channelizing streams can have important implications for acute and chronic sediment source and transport within a watershed. For example, ditching reaches through wetland organic soils and/or converting highly meandering stream channels into straight line ditches can create an almost limitless source of highly erodible sediments and associated nutrient loads with a great capacity to convey sediment and nutrient loads downstream. Most notably, ditching increases channel slope and confines floodwater to small channel areas by disconnecting the stream from wetlands that help to absorb runoff. These factors work together to increase the ability of a stream to transport sediment. However, ditches are usually dug too deep and/or wide to provide reasonable flow velocities during fair and dry weather. Therefore, sediment accumulates along the ditch during lower flows and fills the channel with soft sediment. These accumulated sediments are readily transported downstream during the next high flow event. Ditching usually disconnects the stream from its functional floodplain.[91] This results in increased downstream flooding, channel incision, and bank erosion because high flows are not allowed to spill out over the floodplain. Lastly, ditching also causes significant damage to instream habitats and has many negative consequences on both water quality and associated fish and wildlife communities.

The extensive ditching and channelization of Turtle Creek and its tributaries upstream of Lake Comus has impaired desirable hydrologic and ecologic functions of Turtle Creek. A potential solution is to restore the Creek's mainstem back to its original path and profile to the extent practicable as shown in Figure 3.2.

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[87] Wisconsin Administrative Code *NR 243 Animal Feeding Operations relates an animal unit to the impact of one beef steer or cow. Therefore, 1000 beef cattle are equivalent to 1000 animal units. Other animals have differing ratios. For example, the following numbers of animals are equivalent to 1000 animal units: 500 horses, 715 dairy cattle, 5,000 calves, 5,500 turkeys, 10,000 sheep.*

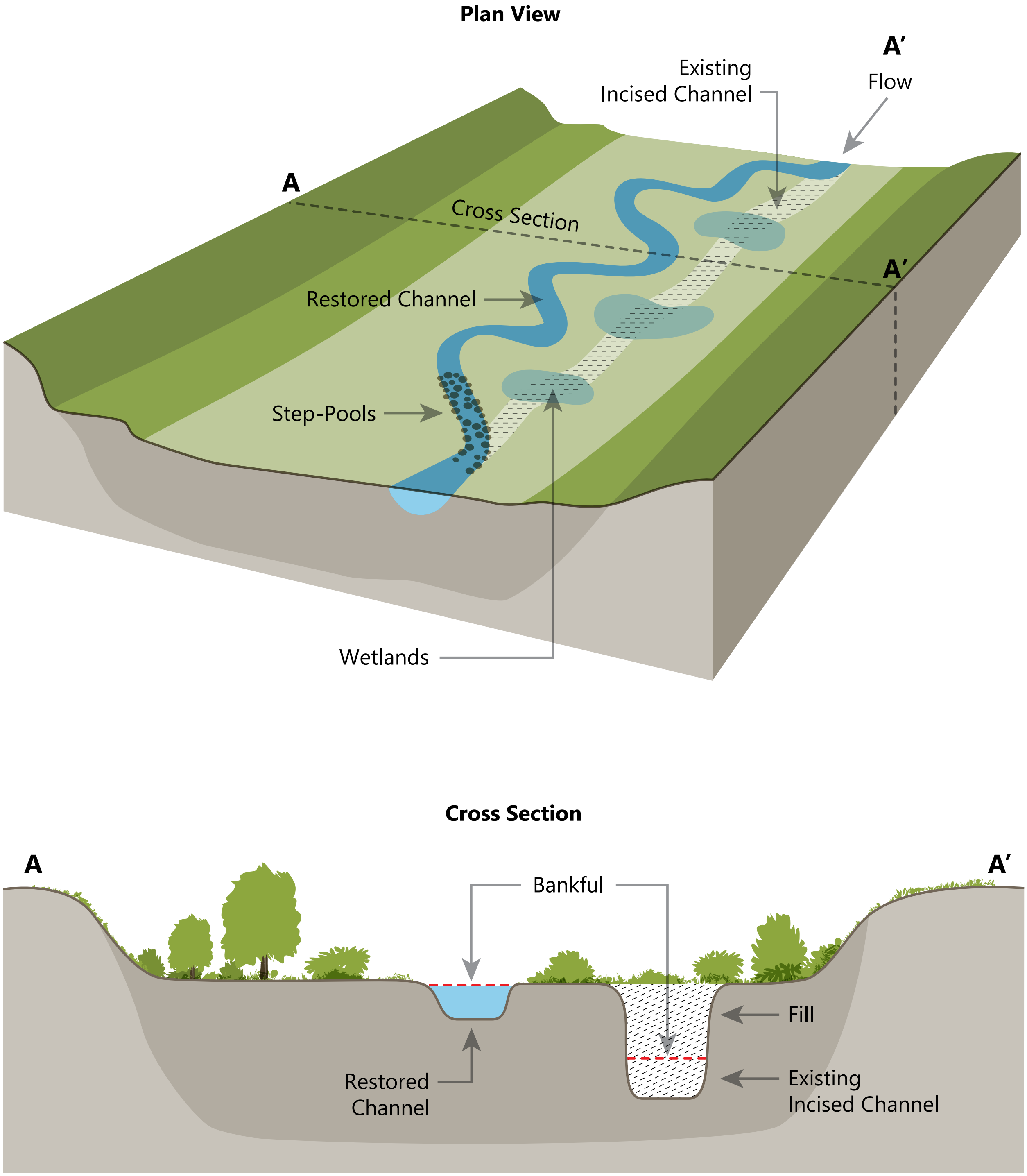
[88] *For more information, see dnr.wisconsin.gov/topic/CAFO/WPDESNR243.html.*

[89] *While there is only one CAFO within the boundaries of the Upper Turtle Creek watershed, there are other CAFOs near the watershed that do land spreading of manure within the watershed.*

[90] *Walworth County Code of Ordinances Chapter 6 Article IV, "Animal Waste Storage." For more information see library.municode.com/wi/walworth_county/codes/code_of_ordinances?nodeId=WACOCOOR_CH6AN_ARTIVANWAST.*

[91] *It should be noted that "functional floodplain," as referred to in the recommendations to improve water quality and habitat in this Chapter, is defined as a relatively flat valley floor or bench that can carry and/or retain some volume of flood water that has overtopped the banks of a stream. The use of the term in this Chapter is not necessarily referencing the regulatory 1-percent-annual-probability (100-year recurrence interval) floodplain.*

Figure 3.2
Potential Stream Restoration Design Elements to Improve Sinuosity and Stream Function



Note: The example shown in this schematic includes a raised elevation for the restored channel bed when compared to the existing channel. Any changes to channel bed elevation would need to consider upstream and downstream channel elevation profiles and elevations of road culverts and other fixed structures.

Source: Modified from W. Harman, R. Starr, M. Carter, et al., A Function-Based Framework for Stream Assessments and Restoration Projects, *US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC, EPA 843-K-12-006, p. 36, 2012 and SEWRPC*

This would decrease slope, improve floodplain connection and function, and mitigate streambank erosion. Map 3.5 indicates areas for potential projects to restore hydrologic function in the Upper Turtle Creek watershed through the recommendations below. Further study beyond the scope of this plan would be required to determine appropriate exact reaches for installation of such features.[92]

- **Recommendation 2.1: Enhance or restore natural landscape elements to restore connections between streams and their functional floodplains including re-establishing the periodic hydrologic connection of streams and adjacent existing and potential wetlands during high flow periods, where applicable**

  Natural landscape elements should be restored to detain stormwater and reduce the speed that runoff leaves the landscape, contributes to stream flashiness, and its negative effects on water quality and aquatic habitat quality. This recommendation should be considered a high priority. Specific measures that can be taken to accomplish this recommendation include the following examples (see Map 3.5 for potential locations for these types of restorations).

  - Where land use, land ownership, topography and channel conditions, and soil types are conducive to periodic inundation, it is recommended that actions be taken to restore or improve connections between streams and their functional floodplains by adjusting morphology channel profiles. This strategy intends to re-establish the periodic hydrologic connection of streams to adjacent wetlands during high flow periods. This goal is integral with all stream realignment, remeandering, or restoration projects undertaken within this watershed. Stream morphology and profile can be adjusted to better resemble natural systems in many ways, including the following examples:

    - Relocate spoil piles that were deposited adjacent to ditched stream sections. Often these spoil piles have disconnected the stream from a floodplain that still exists just beyond the berm. Complete removal of the berms is ideal; however, where flooding concerns may prevent complete removal, strategic breaks in the spoil berms may provide connections to floodplain areas where it is appropriate to allow for some floodplain functions.

    - Lessen stream slope by lengthening channel length as part of stream meandering (see Figure 3.2). An ideal location to restore stream function is where pre-existing channel segments or stream traces remain visible (see Figure 2.1 and Map 3.5). Due to high potential cost, remeandering streams should be considered a medium priority.

    - Modify the stream bed or bed material to increase flood elevations (e.g., install riffles, ditch plugs, stream roughness enhancing features and/or vegetation).[93]

    - Lower floodplain elevations in areas parallel to the streams. One approach for this strategy could be a multi-stage channel design, excavating one or more flat benches adjacent to the stream at bankfull elevation and installing associated meanders and/or other habitat features designed to accommodate a range of flows while maintaining sediment transport capacity. Multi-stage channel design includes a channel to accommodate and sustain low flow habitat features, bankfull floodplain benches, and sometimes an inner berm below a bankfull bench. The most common form of multi-stage channel is the two-stage channel (see Figure 3.3), though three- and four-stage channels are options for larger streams and areas where the necessary space is available.

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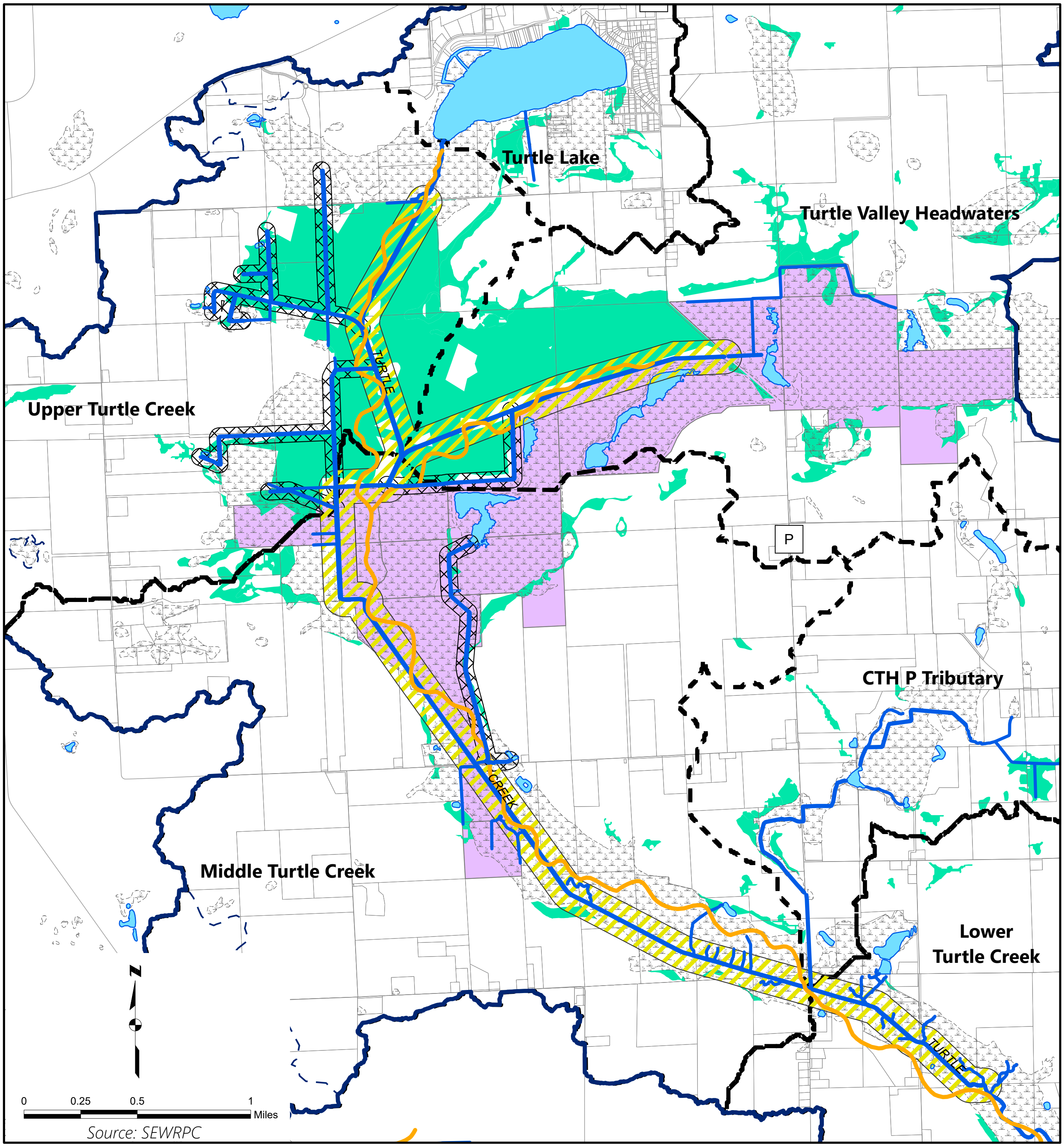
[92] *The commission has completed plans focusing on watershed protection. An example is Mason Creek, a tributary of North Lake in Waukesha County. This plan, entitled* Mason Creek Watershed Protection Plan, *is SEWRPC's Community Assistance Planning Report Number 321 and was published in 2018. The reader may find this report useful to envision future work benefitting the project. See www.sewrpc.org/SEWRPCFiles/Publications/CAPR/capr-321-mason-creek-protection-plan.pdf.*

[93] *With careful planning, opportunities commonly exist to increase floodplain connectivity without expanding the extent of the modeled 100-year flood elevation.*

Map 3.5
Potential Areas for Hydrologic Restoration Projects in the Upper Turtle Creek Watershed



AREAS TO CONSIDER PROJECTS THAT RE-ESTABLISH FLOODPLAIN CONNECTION, IMPLEMENT SATURATED BUFFERS, AND REALIGN STREAM TO HISTORIC CHANNEL

AREAS TO CONSIDER PROJECTS THAT RESTORE HYDROLOGIC FUNCTION SUCH AS DITCH PLUGS AND FILLS

POTENTIALLY RESTORABLE WETLANDS

WDNR-OWNED PARCELS

2020 STREAMLINES

1837 STREAMLINES

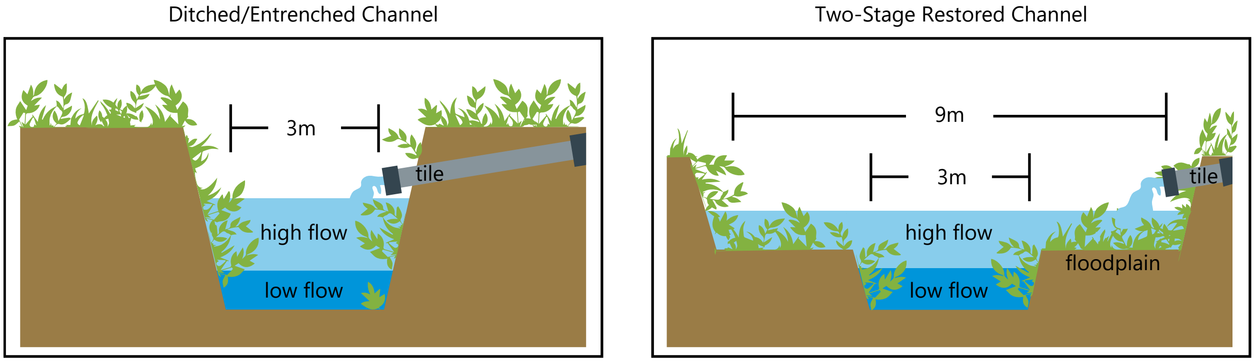
SURFACE WATER

WATERSHED BOUNDARY

INTERNALLY DRAINED AREAS

Note: This figure includes several potential areas for hydrologic restoration. Further study would be required before designing and implementing any specific practice.

Figure 3.3
Cross-Section Schematic of a Two-Stage Channel Design



Note: The two-stage ditch design: a) Trapezoidal channel, with steep slopes, lack of floodplain connectivity, and drain tile, prior to floodplain restoration; b) restored two-stage ditch, with drain tiles cut back. The dark gray represents water levels during base flow and the light gray represents water levels during stormflow.

Source: Modified from S.S. Roley, J.L. Tank, and M.A. Williams, "Hydrologic Connectivity Increases Denitrification in the Hyporheic Zone and Restored Floodplains of an Agricultural Stream," Journal of Geophysical Research, *117(G3), p. 2, 2012 and SEWRPC*

  - Implement sod toe restoration in straightened reaches of Turtle Creek to facilitate stream remeandering. Sod toe restoration could be used as a lower-cost alternative for facilitating remeandering, narrow over-widened stream reaches, and create a low-flow channel alongside the current stream to reduce pollutant loading and enhance habitat.[94] Sod-toe restoration shares many of the benefits of stream remeandering at a significantly lower cost per lineal foot. These projects could be particularly effective to restore conditions in areas where a historic stream channel is not apparent in arial imagery or field surveys.

- Divert intense runoff from impermeable surfaces away from direct discharge to surface water. Install check dams and ditch turnouts along roadside ditches to detain stormwater, encourage diffuse overland flow, encourage infiltration, and capture sediment and nutrients.

- Consider installing saturated buffers and/or utilizing water control structures in tile-drained agricultural areas of the watershed. Alternatively, drain tile outlets could be modified to discharge water into constructed wetlands rather than directly into surface waters.

- When drained land no longer produces commodities at a profit, or when drained land is abandoned and left fallow, or when the landowner simply desires to introduce restoration practices, restore wetland hydrology and naturalize vegetation. These types of projects are particularly important in riparian areas. Implementing such projects commonly involves employing drain tile removal, ditch plugs, and ditch fills.[95]

➤ **Recommendation 2.2 Restore marginal crop and pasture lands, farmed wetlands, and potentially restorable wetlands**

Agricultural lands are prime candidates for wetland restoration because they are in undeveloped, open space uses, and because there are Federal and State programs available to support conversion of specific agricultural lands to wetlands. Agricultural lands that are within the regulatory floodplain are likely to flood more often, leading to damaged crops, diminished production, and extensive pollutant loading to nearby waterways. Conversion of agricultural lands could be undertaken through land purchases, donation, or easements. Some programs provide a percentage of the restoration costs as well as an

[94] *Minnesota Department of Natural Resources, 2010,* op. cit. *files.dnr.state.mn.us/publications/waters/toe_woodsod_mat_dec2010.pdf.*

[95] *For more information on installing ditch plugs and ditch fills., see Chapter 4 of A.L. Thompson and C.S. Luthin,* Wetland Restoration Handbook for Wisconsin Landowners, *Wisconsin Department of Natural Resources Bureau of Science Services SS-989, 204: dnr.wisconsin.gov/topic/Wetlands/handbook.html.*

annual rental rate. In other instances, land may be purchased or permanently placed into conservation easement by willing landowners, restricting development and eliminating the chance that these open areas may be placed into more impervious urban land uses in the future. This recommendation would be implemented as a voluntary program, considered at the discretion of each individual property owner. Specific measures that can be taken to accomplish this recommendation include the following examples.

- Work with property owners to consider discontinuing the cultivation of existing farmed wetlands[96] and areas considered by WDNR to be potentially restorable wetlands (PRW)[97] and restore these areas to their natural wetland conditions. Map 3.6 provides levels of priority for lands within the Upper Turtle Creek watershed that should be considered for restoration to wetlands. It should be noted that any PRW areas of which landowners are interested and willing to restore to wetlands should be considered as the highest priority no matter the location. The priority levels provided by Map 3.6 are simply a first level assessment of the lands that would be most likely to improve water quality within the Upper Turtle Creek watershed. The categories of potentially restorable areas shown on Map 3.6 include the following.

    - PRWs (shown in green) – all areas considered by WDNR to have preliminary characteristics necessary to be restored to wetlands. These areas are a moderate priority for restoration to wetland

    - PRWs that are in agricultural land uses and are within the 1-percent-annual-probability floodplain (shown in orange hatch). These areas are a high priority for restoration to wetland.

    - PRWs that are in agricultural land uses and are within the regulatory floodway (shown in pink hatch). These areas are the highest priority for restoration to wetland.

    - Farmed wetlands – areas that possess characteristics necessary to support a wetland habitat but are currently cultivated according to the SEWRPC 2020 land use inventory. These areas are a moderate priority for restoration.

    - In addition, according to the Nature Conservancy's Wetlands by Design GIS tool,[98,99] the large PRW areas located south of Turtle Lake as well as the PRW areas located near the intersection of Cobblestone Road and Goose Pond Road have been identified as particularly suitable for flood abatement (shown in purple rectangles). These areas are the highest priority for restoration to wetland.

As many of these specific recommendations are intended to impact the hydrology of the streams, care should be taken to site these projects appropriately to avoid undesired effects on neighboring properties. The least controversial projects are likely to occur on publicly owned lands, such as the parcels owned by WDNR (see Map 3.5). Owners of neighboring property parcels should be informed of any potential restoration work and should ideally be asked to collaborate on any proposed projects to expand the scope of restoration and promote active stewardship among residents, farmers, landowners, and governmental and non-governmental organizations. Any wetland conservation or stream realignment work will likely

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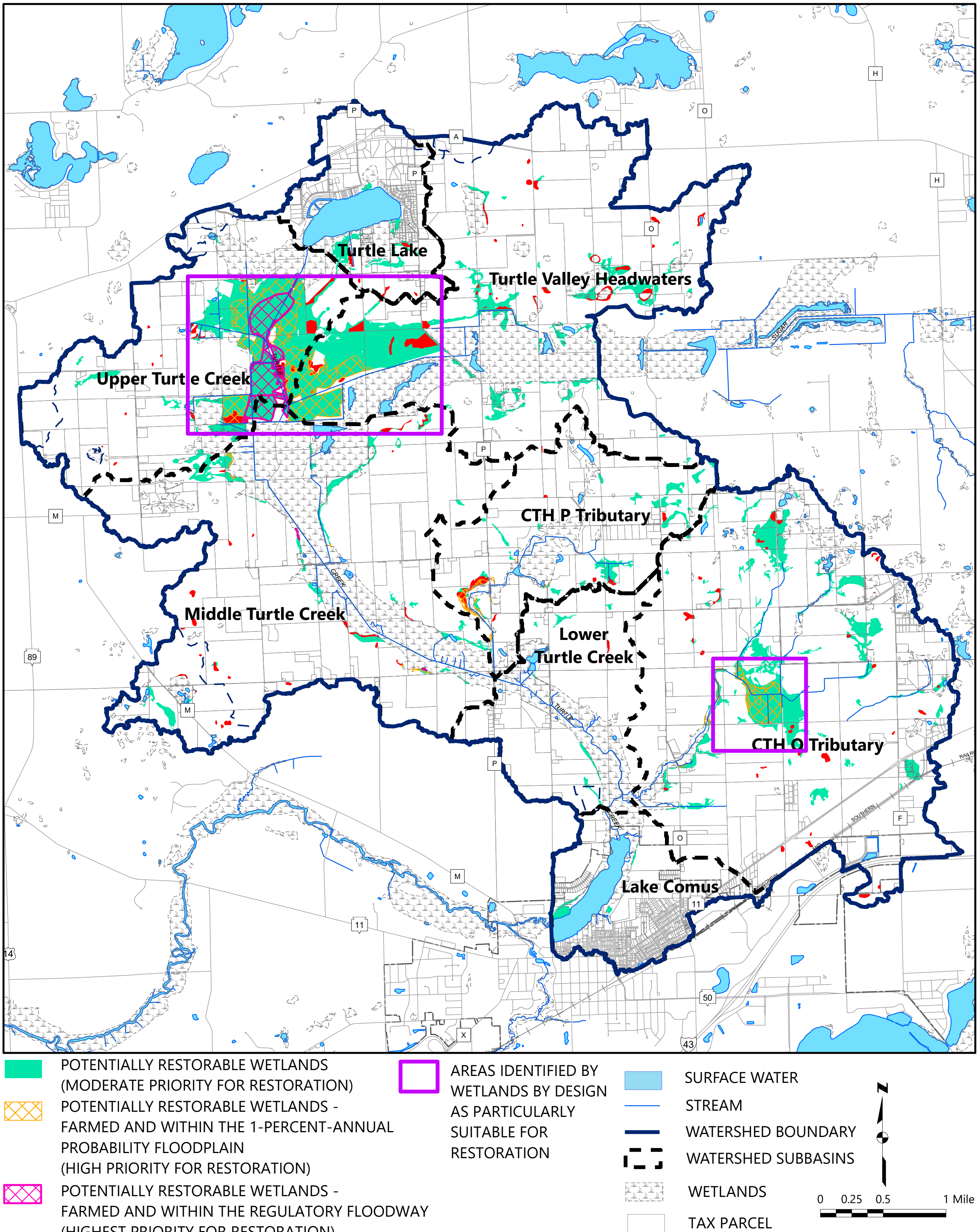
[96] *Farmed wetland designations are included as part of the Southeastern Wisconsin Regional Planning Commission's 2020 land use inventory.*

[97] *The WDNR has developed a digital dataset to identify areas of former wetlands that were drained and converted to agricultural uses. To be potentially restorable wetland, an area must have hydric soils, must not be currently mapped as a wetland, and have a land use compatible with restoration techniques.*

[98] *Miller, N., J. Kline, T. Bernthal, J. Wagner, C. Smith, M. Axler, M. Matrise, M. Kille, M. Silveira, P. Moran, S. Gallagher Jarosz, and J. Brown,* Wetlands by Design: A Watershed Approach for Wisconsin, *Wisconsin Department of Natural Resources and The Nature Conservancy, 2017.*

[99] *Wetlands by Design is a planning tool designed collaboratively by the WDNR and The Nature Conservancy that can be used to help prioritize decisions regarding wetland conservation and restoration. Individual wetland areas and potentially restorable wetland areas are ranked according to their capacity to provide flood abatement, fish and aquatic habitat, phosphorus and sediment retention, nitrogen reduction, surface water supply, shoreline protection, carbon storage, and floristic integrity.*

Map 3.6
Potentially Restorable Wetland Areas to Consider for Restoration



Source: Walworth County LURM and SEWRPC

require permitting from the WDNR and floodplain modeling.[100] Projects that raise the regulatory 100-year flood elevations require additional steps to execute. However, hydrologic restoration opportunities typically exist that do not raise the 100-year flood elevations. For example, ditch-fill projects that fill a ditch crossing a broad floodplain oftentimes have negligible effect on 100-year flood elevations.

Riparian Buffer Protection and Prioritization Strategies

Riparian buffers provide multiple benefits including mitigating pollutant runoff into surface waters, improving streambank stability, and providing habitat for wildlife and aquatic organisms (see Figure 3.4). All riparian buffers provide some level of protection; however, wider buffers provide more benefits (infiltration, temperature moderation, and species diversity) than narrower buffers. Therefore, it is important that existing buffers be protected and expanded where possible. The riparian buffer network to the 75-foot, 400-foot, and 1,000-foot widths as summarized in Section 2.3, "Water Quality and Pollutant Loading" of CAPR 341 provides the framework upon which to protect and improve water quality and wildlife within the Upper Turtle Creek watershed. This framework can be achieved by combining strategies such as land acquisition, conservation easement acquisition, regulation, and BMPs, as discussed in the following subsection.

<u>Regulatory and Other Opportunities</u>

Chapter NR 115, "Wisconsin's Shoreland Protection Program," of the *Wisconsin Administrative Code* establishes a minimum 75-foot development setback from the ordinary high-water mark of navigable lakes, streams, and rivers.[101] A minimum tillage setback standard of five feet from surface water channels is also called for under Section NR 151.03 of the *Wisconsin Administrative Code*. Insufficient buffer between a field and a waterway can contribute to significant sediment and phosphorus loading to the waterway and can significantly limit wildlife habitat. In addition, based upon the water quality and wildlife goals for this watershed, neither the 5-foot tillage setback nor the 75-foot buffer requirement are adequate to achieve pollutant load reduction goals and resource protection concerns.

Crop yield losses have been found to be greatest near drainage ditches that flood. Therefore, adding buffer to areas prone to flooding would not displace agriculture from prime production areas. Fields with high slopes (see Map 2.4) and high soil erodibility, fields where the minimum riparian buffer width of 75 feet is not being met (see Map 2.20) and/or crop land is located within the 1-percent-annual-probability floodplain, and fields containing potentially restorable wetlands within 1,000 feet of a waterway could be considered priority fields for riparian buffer installation. In addition, the 75-foot-wide buffers adjacent to waterways are envisioned to be harvestable buffers, enabling periodic livestock fodder harvest or pasturing. Expanding riparian buffers to the 400- and 1,000-foot widths, or greater to the extent practicable, is not likely to be achievable until such time that the agricultural land is converted to urban uses. At that time, it may be possible to design portions of the development to accommodate such buffer widths. From a practicality standpoint, this may be the last chance to establish critical protective boundaries and/or open space and habitat connections around waterways.

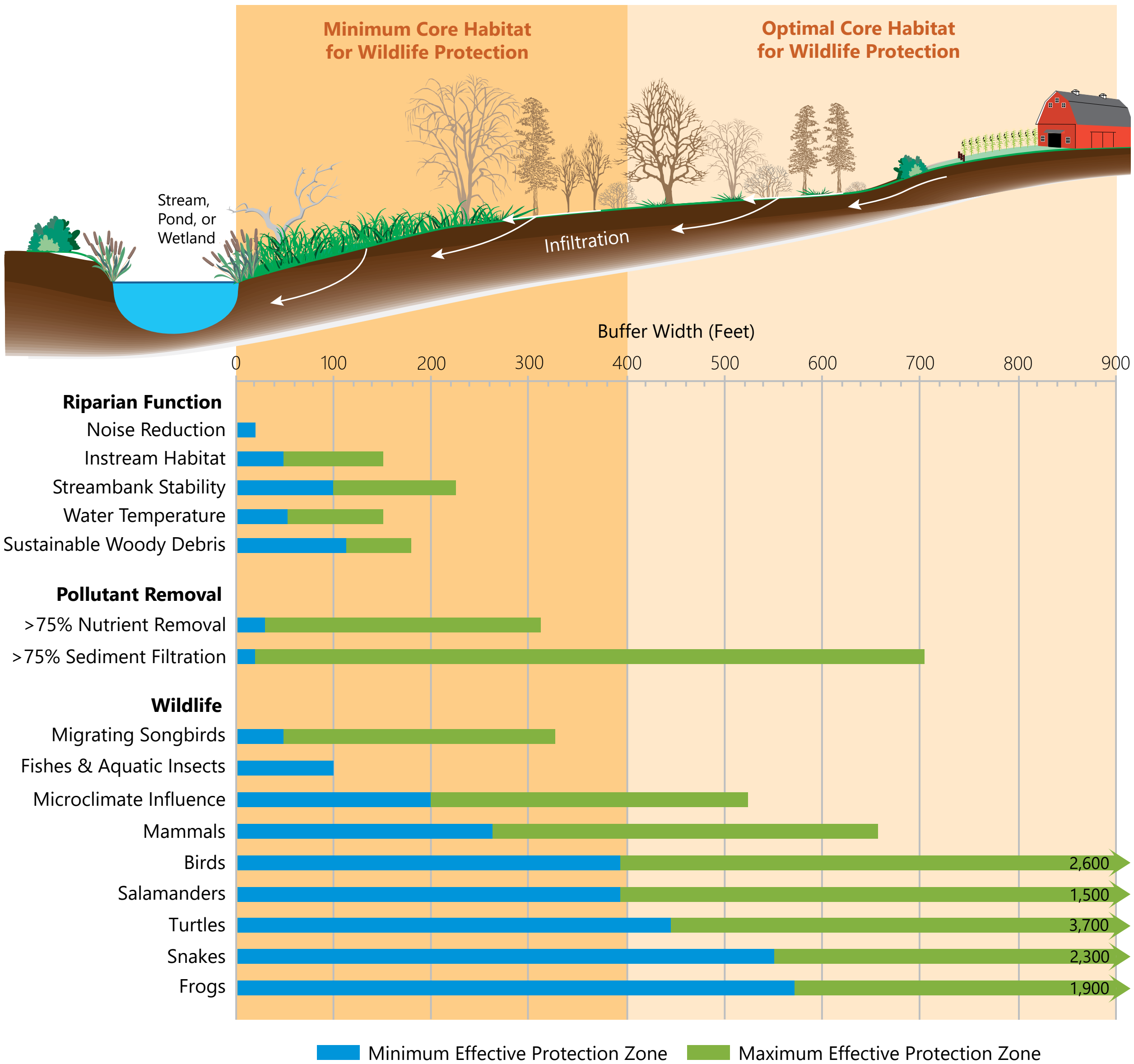
Primary environmental corridors (PEC) have a greater level of land use protections compared to secondary corridors, isolated natural resource areas, or designated natural areas outside of PEC.[102] Increasing the extent of land designated as PEC within the Upper Turtle Creek watershed represents a potential strategy for extending current regulatory protections provided by PEC designation to vulnerable existing and potential riparian buffers as areas within the watershed are restored. Expanding the narrow SEC connection between the PEC

[100] *More information on general and individual permits and required documents can be found at the following location: dnr.wisconsin.gov/permits/water.*

[101] *Where an existing development pattern exists, the shoreland setback for a proposed principal structure may be reduced to the average shoreland setback of the principal structure on each adjacent lot, but the shoreland setback may not be reduced to less than 35 feet from the ordinary high-water mark of any navigable water.*

[102] *Implementation of environmental corridor protection recommendations is envisioned to come about primarily through enactment of appropriate zoning regulations at the county and local levels of government. In addition, the WDNR and the Wisconsin Department of Safety and Professional Services seek to bring about the specific recommendations related to protection of the PECs through their public and private sanitary sewer extension approvals. Essentially, the operational rules of those departments require that the PEC protection and development density recommendations, as set forth in the SEWRPC regional land use plan, be met before State approval of sewer extensions. This State policy can have the effect of imposing more stringent development limitations than set forth in local zoning regulations.*

Figure 3.4
Buffer Widths Providing Specific Conservation Functions



Source: SEWRPC

areas along Turtle Lake and the extensive PEC along Turtle Creek south to Lake Comus presents the greatest opportunity to expand primary environmental corridors in this watershed. Since these two areas already meet the minimum size requirements for designation as a PEC, any lands with sufficient natural resource features adjacent or connecting to this existing PEC could potentially be incorporated into this designation.

Wetlands located within PEC lands have been designated as Advanced Delineation and Identification (ADID) wetlands under Section 404(b)(1) of the Federal CWA and are deemed generally unsuitable for the discharge of dredge and fill material. In addition, the nonagricultural performance standards specified in Section NR 151.125 of the *Wisconsin Statutes*, require a 75-foot impervious surface protective area adjacent to these higher-quality wetlands. This designated protective area boundary is measured horizontally from the delineated wetland boundary to the closest impervious surface.[103] Hence, these wetlands would have additional protections from filling and from being encroached upon by future development, enabling their riparian buffer functions to be retained.

[103] *Runoff from impervious surfaces located within the protective area must be adequately treated with stormwater BMPs.*

Best Management Practices and Programs for Riparian Buffers

Most existing and potential future riparian buffers in the watershed are privately owned and are situated within wetland and agricultural areas. It is the private landowner's choice to maintain or establish buffers. In addition, although riparian buffers can effectively mitigate negative water quality effects attributed to urbanization and certain agricultural management practices, they cannot on their own address all the pollution problems associated with these land uses. Therefore, riparian buffers need to be combined with other management practices, such as infiltration facilities, wet detention basins, porous pavements, green roofs, and rain gardens to mitigate the effects of urban stormwater runoff. To mitigate the effects of agricultural runoff, riparian buffers need to be combined with other management practices, such as barnyard runoff controls, manure storage, filter strips, nutrient management planning, grassed waterways, cover crops, and reduced tillage. It is also important to disconnect any remaining drain tile systems in potential riparian buffer expansion areas in order to maximize pollutant reduction benefits provided by buffers.

Recent research has indicated that converting up to eight percent of cropland at the field edge from production to wildlife buffer habitat leads to increased yields in the remaining cropped areas of the fields, and that this positive effect becomes more pronounced with time.[104] As a consequence, despite the initial loss of cropland for habitat creation, overall yields for an entire field can be maintained, and even increased, for some crops compared to control areas. Although it took about four years for the beneficial effects on crop yield to manifest themselves in this research project, this yield increase was largely attributed to increased abundance and diversity of crop pollinators within the wildlife habitat areas. Such results suggest that at the end of a five-year crop rotation, there would be no adverse impact on overall yield in terms of monetary value or nutritional energy, and that in subsequent years, pre-buffer yields would be maintained or increased. Hence, establishing buffers or sacrificing marginal cropland edges to create wildlife buffer habitat or potential restorable wetland within the Upper Turtle Creek watershed may lead to increased crop yields, so this practice may be economically viable over the longer term. More importantly, these results also demonstrate that lower yielding field edges can be better used as non-crop habitats to provide services supporting enhanced crop production, benefits for farmland biodiversity, and protecting water and soil health.[105]

➤ **Recommendation 3.1: Protect, Restore, Expand, and Connect Riparian Buffers**

The protection, restoration, expansion, and connection of riparian buffer areas represent opportunities to achieve the objective proposed by a Federal initiative to conserve and restore the lands, waters, and wildlife habitat with a national goal of conserving 30 percent of the U.S. lands and waters by the year 2030.[106] The report recommends a ten-year, locally led campaign to conserve and restore vital land and water and aligns well with measures recommended within this watershed plan. It is recommended that all efforts are made to protect and restore existing riparian buffers and establish new riparian buffer areas to the maximum extent practicable – up to, and beyond the 1,000-foot optimum buffer width (see Map 2.20 which identifies existing buffers and areas in need of buffer expansion). Specifically, land managers should focus on the following recommendations regarding riparian buffers.

- Manage and restore existing riparian buffers. Examples of specific measures that can be taken to accomplish this recommendation include actively managing invasive species, promoting establishment of native plant species, and prioritizing buffer areas that have been heavily impacted by emerald ash borer. The Walworth County LWRMP recommends the County initiate a countywide committee designed to identify and address invasive species with priorities in Commission-identified natural areas and Walworth County Parks. This plan supports and reinforces that recommendation.

- Protect existing riparian buffers. Examples of specific measures to accomplish this include acquisition of land by public interest ownership via donation or purchase and establishment of public or private easements; consistent implementation and enforcement of local zoning

[104] *R. Pywell, M.S. Heard, B.A. Woodcock, et al., "Wildlife-Friendly Farming Increases Crop Yield: Evidence for Ecological Intensification,"* Proceedings of the Royal Society B: Biological Sciences, *282(1816), 2015*.

[105] Ibid.

[106] *U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Department of Commerce, and the Council of Environmental Quality,* Conserving and Restoring America the Beautiful, *2021*.

regulations that prohibit any development within the regulatory floodway and ADID wetlands; consistent and effective application and updating of the regulatory framework including local zoning ordinances, shoreland zoning requirements, State wetland regulations, and U.S. Army Corps of Engineers permit program for wetlands; and continuing application of limits on development within SEWRPC-delineated primary environmental corridor and connection of existing buffer lands to PEC, secondary environmental corridors (SEC), and isolated natural resource areas (INRA).

- Encourage and support landowners' participation and enrollment in the Wisconsin Managed Forest Law Program as recommended in the Walworth County LWRMP.

- Establish new riparian buffers to the greatest extent possible throughout the watershed with a minimum target of a 75-foot width from water's edge (150-foot total buffer width) and in optimal goal of a 1,000-foot buffer width (or greater). Map 2.20 indicates that much of the Turtle Creek stream complex north of the Turtle Valley Wildlife Area, most of the northern bank of the Turtle Valley Tributary, and sections of the CTH P Tributary and the CTH O Tributary lack adequate buffers to mitigate surface runoff from agricultural fields and provide necessary habitat for aquatic and terrestrial wildlife.

- Establish connections and corridors between riparian buffer areas to ensure connectivity and continuity of a variety of habitat types. Examples of specific measures that can be taken to implement this recommendation include removing abandoned or nonessential roads and stream crossings where appropriate; limit creation of new road crossings of the streams within the watershed; and implement incentive-based programs to encourage riparian landowners to consider landscaping that would enhance wildlife habitat by providing connections through the lots to larger riparian buffer areas.

Any opportunities that arise within the watershed to either protect existing riparian buffer areas or establish new areas should take top priority as they are presented – no matter where they exist. Beyond this "priority of opportunity," the following basic rules may be useful in prioritizing potential riparian buffer projects.

1. Protect the riparian buffers that currently exist on the landscape. This includes all areas indicated in green on Map 2.20.

2. Provide a minimum width of buffer for water quality protection. This includes potential riparian lands up to 75-feet on both sides of a waterway, as indicated in red on Map 2.20.

3. Provide a minimum width of riparian buffer for wildlife protection. This includes potential riparian lands up to 400-feet on both sides of a waterway, as indicated in orange on Map 2.20.

4. Provide an optimum width of buffer for wildlife protection. This includes potential riparian buffer lands up to and beyond 1,000 feet on both sides of a waterway, as indicated in yellow on Map 2.20.

Urban BMPs

Historically, the approach to manage increases in rates and volumes of runoff within urbanized areas often involved constructing storm sewer and/or open channel systems to quickly convey stormwater to streams or lakes. In recent years, flooding, water quality impairment, and environmental degradation demonstrate the need for an alternative approach to urban stormwater management. Consequently, present-day stormwater management approaches seek to manage runoff using a variety of measures, including detention, retention, infiltration, and filtration, better mimicking the behavior and disposition of precipitation on a more natural landscape.

While urban nonpoint sources are not known to be and are not anticipated to be major contributors of pollutants to the waterways of the Upper Turtle Creek watershed, there is some urban development scattered throughout the watershed, mostly single family residential. The following recommendation address reducing urban nonpoint pollutant loads in the watershed:

- **Recommendation 4.1: Encourage urban pollution source reduction efforts through BMPs**
  Reduce lawn fertilizer use, create rain gardens, and properly store and judiciously apply deicers and other chemicals to prevent them from washing into the waterways. This recommendation should be considered a medium priority.

- **Recommendation 4.2: Promote native plantings in and around existing and new stormwater detention basins**
  Planting native plants in these situations improves detention water filtration, reduces pollutant loading, and provides wildlife habitat. In addition, detention basin management practices should aim to reduce or eliminate fertilizing basin slopes and limit herbicide application and cutting to invasive species only. This should be considered a medium priority.

- **Recommendation 4.3: Retrofit existing and enhance planned stormwater management infrastructure to benefit water quality**
  Water quality can benefit by extending detention times, spreading floodwater, and using features such as grassed swales to convey stormwater. Implementing such works requires close coordination with the municipalities within the watershed. This recommendation should be considered a medium priority.

- **Recommendation 4.4: Combine riparian buffers with other structures and practices**
  A much higher level of pollution removal can be achieved with "treatment trains" combining riparian buffers with better-managed detention basins or new practices such as floating island treatments (see Figure 3.5), grassed swales, and infiltration facilities. This layering of overlapping practices and structures is a more effective way to mitigate the effects of urban stormwater runoff than such practices being used in isolation. This action should be assigned a low priority.

- **Recommendation 4.5: Establish and adopt a stormwater management practice inspection and maintenance program**
  This recommendation originates from the Walworth County LWMP and should be established according to the vision of the Walworth County LURM. This should include developing an inventory of all stormwater BMPs in the County that includes the location, BMP type, and scanned documents associated with the practice. This recommendation should be assigned a high priority.

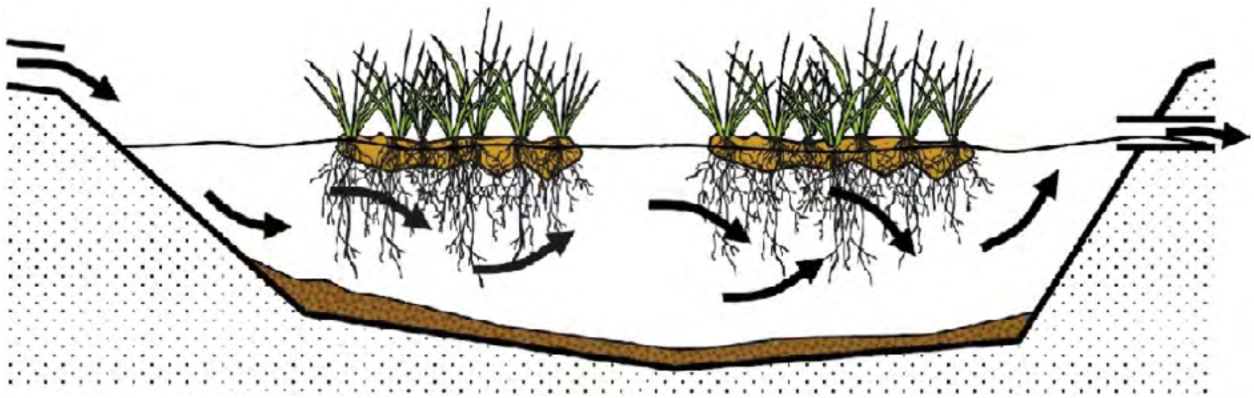
- **Recommendation 4.6: Stringently enforce construction site erosion control and stormwater management ordinances and creatively employ these practices**
  Ordinances must be enforced by responsible regulatory entities in a manner consistent with current practices; however, local citizens can help by reporting potential violations to the appropriate authorities. This recommendation should be considered a low priority.

- **Recommendation 4.7: Maintain stormwater detention basins**
  This should be considered a low priority due to the few basins located in the watershed. Maintaining stormwater basins includes managing aquatic plants, removing and disposing of flotsam or jetsam, ensuring adequate water depth to settle and store pollutants, inspecting and repairing outlet structures, and actively and aggressively managing excess sediment. Specifications associated with the design of stormwater detention basins and maintenance requirements ensure that basins are functioning properly.[107] It is important to remember that stormwater detention basins occasionally require dredging to maintain characteristics that protect the waterways. The frequency of dredging is highly variable and depends upon the design of the basin and the characteristics of the contributing watershed. Regulatory entities should complete basin inspection in a manner consistent with current practices; however, ensuring that the owners of these basins know the importance of meeting these requirements through educational outreach can help ensure continued proper functioning of the ponds. Coordinating with municipalities and neighborhood associations can play an important role.

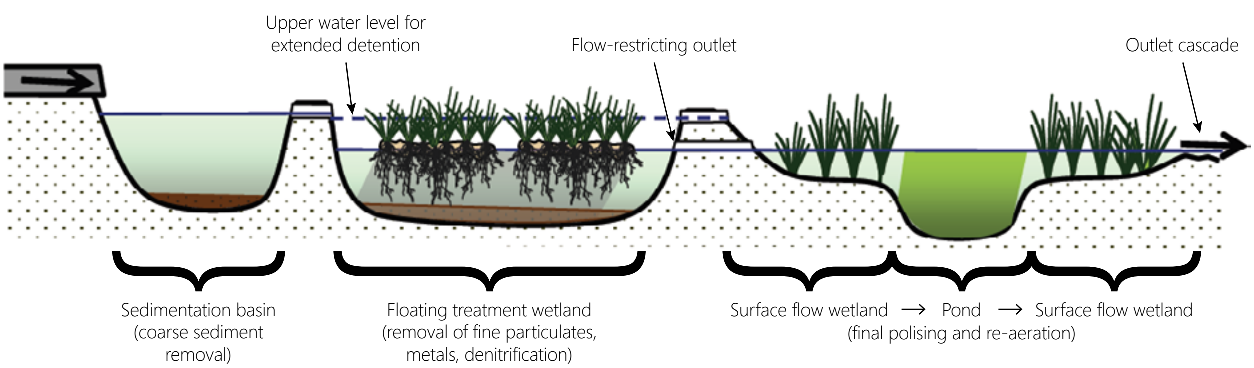
[107] *Technical standards for design and maintenance of wet detention basins and other stormwater management practices can be found at www.dnr.wi.gov/topic/stormwater/standards/postconst_standards.html.*

Figure 3.5
Schematic of Floating Wetland Treatment Design Applications

Emergent plants are grown within a floating artificially constructed material within a wet detention stormwater basin. The roots are directly in contact with the water column and can intercept suspended particles. The roots also provide a high surface area for microbiological activity that aid in adsorbing pollutants.



Conceptual longitudinal cross-section through a "newly designed" stormwater treatment system incorporating floating wetlands, ponds, and surface flow wetlands (not to scale).



Source: I. Dodkins, A. Mendzil, and L. O'Dea, Floating Treatment Wetlands (FTWs) in Water Treatment: Treatment Efficiency and Potential Benefits of Activated Carbon, *FROG Environmental LTD., March 2014; T.R. Headley and C.C. Tanner, "Constructed Wetlands With Floating Emergent Macrophytes: An Innovative Stormwater Treatment Technology,"* Critical Reviews in Environmental Science and Technology, *42: 2261-2310, 2012 and SEWRPC*

➤ **Recommendation 4.8: Promote urban nonpoint source abatement**
In addition to local stormwater ordinances and stormwater management planning, another way to promote cost-effective nonpoint source pollution abatement is for Walworth County to work toward satisfying all conditions required by the Wisconsin Pollutant Discharge Elimination System municipal separate storm sewer system (MS4) discharge permitting process. This should be considered a low priority issue.

➤ **Recommendation 4.9: Collect leaves in urbanized areas**
Because of the modest amount of the watershed found in urban areas, this recommendation should be assigned a low priority. Leaves have been shown to be a very large contributor to total external phosphorus loading to waterbodies in urban settings. Stockpiling leaves in the street where they may be crushed and washed into the waterways or burning leaves in shoreline and ditch areas can create situations where a strong pulse of phosphorus is delivered to the streams by late autumn rains. Residents should be encouraged to use leaf litter within their own yards as a nutrient source or should take advantage of the yard waste collection and leaf disposal programs in existence in those municipalities in the watershed that conduct such programs, such as the City of Delavan.

Protecting Groundwater Supplies

Turtle Creek, many of its tributaries, and Lake Comus receive significant amounts of groundwater, a situation benefiting waterbody health. For example, groundwater discharge sustains dry-weather stream flow, moderates stream temperatures in winter and summer, and maintains water levels in the waterways during dry weather. To help protect the quantity and quality of groundwater discharging to Turtle Creek and its tributaries, management action must focus on the groundwatershed of Lake Comus and Upper Turtle Creek, an area lying mostly to the east of the Lake and Turtle Creek (see Map 2.2). Appropriate management action in this area helps maintain groundwater recharge, avoids unsustainable groundwater extraction and export, and maintains high groundwater quality. Even if groundwater resources are carefully managed within the Upper Turtle Creek groundwatershed, large-scale groundwater extraction beyond the groundwatershed can also influence the amount of groundwater entering and/or leaving the Creek. Therefore, activities already occurring or planned to occur near the Creek's groundwatershed should be scrutinized. Actions helping protect the groundwater supply include the following examples.

➤ **Recommendation 5.1: Curb growth of groundwater demand**

Groundwater supplies all residential, commercial, and industrial potable water demands in the City of Delavan, the Upper Turtle Creek watershed, and greater Walworth County. Additionally, much of the human population of this groundwatershed is served by public sanitary sewers which export wastewater to other watersheds. Therefore, some of the water pumped from local aquifers is exported from the local groundwatershed and no longer can supply baseflow to Turtle Creek, its tributaries, or Lake Comus. This is a vexing problem that often increases over time and has few easy solutions. However, action can be taken to reduce current and future net demand placed on local aquifers. Examples of such concepts are provided below.

- Evaluate if any clean-water discharges now directed to sanitary sewers, or discharge points outside the watershed, can be redirected to discharge points within the area contributing surface water and groundwater to the Upper Turtle Creek watershed. An example would be redirecting clean noncontact cooling water drawn from wells located in the groundwatershed to surface water within the Upper Turtle Creek watershed. Since few opportunities likely exist in this watershed, this recommendation is assigned a <u>low priority</u>.

- Carefully vet the impact of new development, especially those using new high-capacity wells, on groundwater withdrawals in the Lake Comus groundwatershed. The Village of Richfield in Washington County requires a professional analysis of development's impact on local groundwater elevations as a caveat to granting construction permits.[108] This should be assigned a high priority for projects within the Lake's groundwatershed.

- Critically examine new commercial or industrial development proposals that use water consumptively or export water from the groundwatershed. Since most of the Lake's watershed is rural in nature and is anticipated to remain so in the next decades, this recommendation is assigned a <u>low priority</u>.

- Discourage new residential water supply systems in the groundwatershed that rely on private on-site water supply wells yet discharge wastewater to wastewater treatment plants outside of the upper Turtle Creek watershed. This should be assigned a <u>medium priority</u>.

- Carefully evaluate activities within the Lake's groundwatershed that require long-term dewatering (e.g., quarry operations), especially if effluent water discharges to surface-water features draining to areas beyond the Lake's watershed. This should be assigned a <u>high priority</u>.

- Evaluate increased groundwater demands in nearby areas. Examples include new high-capacity wells or increased withdrawals from existing wells, clusters of small wells, or quarry dewatering. Such activities can influence groundwater flow directions and velocities and can change the amount of groundwater entering or leaving the Lake. This should be assigned a <u>medium priority</u>.

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[108] *More information of the Village of Richfield's groundwater protection program may be found at the following website: www.richfieldwi.gov/300/Groundwater-Protection.*

- Advocate actions that cause water providers to institute a potable water conservation campaign. This activity should focus on water now discharged to sanitary sewers in the City of Delavan. This should be assigned a low priority.

➤ **Recommendation 5.2: Preserve or enhance water supplies to groundwater**

Given the significant quantity of groundwater recharge lost through human landscape manipulation, maintaining, or more desirably increasing, stormwater infiltration is very important. This action not only protects surface-water features, encourages stable stream channels, reduces soil erosion, and promotes ecological health, it also helps safeguard groundwater supplying the needs of the area's human population and businesses. Several examples of tactics that help preserve or enhance groundwater recharge follow.

- The County, LCPRD, and local partners should continue to undertake actions promoting soil health. Healthy soils allow more stormwater to infiltrate and retain more nutrients and water benefitting crop growth. Healthy soils are characterized by greater aggregation, abundant soil macroinvertebrates like earthworms, higher root density, and higher concentrations of organic matter.[109] Promoting good soil health is most widely applicable to tilled agricultural lands within the watershed but the principles can also be applied to other lands such as parks and lawns. The LCPRD could help support the growth of the WATERS, a recently formed producer-led group covering Walworth County, including the upper Turtle Creek watershed.[110] The LCPRD and WATERS could collaborate on grant funding from DATCP or the WDNR Surface Water Grant program to implement agricultural practices that reduce soil loss and pollutant loading.[111] The County and LCPRD should consider lending advice and, possibly, renting equipment and offering financial incentives to soil health practitioners. Although agricultural lands throughout the watershed are amenable to this approach, parcels abutting Turtle Creek and its tributaries should be targeted first. Soil health promotion should be assigned a high priority.

- Preserve or enhance natural landscape features promoting groundwater recharge throughout the groundwatershed. Examples of such features include topographically closed depressions, natural areas, and well-vegetated open land. Such areas identified as having moderate, high, or very high groundwater recharge potential should be assigned high priority. The balance of such areas should be assigned a medium priority (see Map 2.2).

- Discourage widespread use of artificial drainage enhancement infrastructure (e.g., field tiles, piped storm sewers, drainage ditches, straightened streams) in areas within the groundwatershed with moderate, high, or very high groundwater recharge potential. Encourage naturalizing hydrology in such areas where such infrastructure already exists (e.g., wetland restoration, stream remeandering, drainage swales substituted for buried pipes). Given the importance of agriculture in the area contributing groundwater to Turtle Creek and Lake Comus, this should be assigned a high priority.

- Promote careful control of new development in the watershed's best groundwater recharge potential areas (see Map 2.2). This helps ensure water supplying local and sometimes regional aquifers is protected. Control can include excluding certain types of development, maintaining recharge potential through thoughtful design, and minimizing impervious surface area. This should be assigned a high priority in areas with moderate, high, and very high groundwater recharge potential and a medium priority in low groundwater recharge potential areas.

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[109] *See Wisconsin Natural Resource Conservation Service, Testing for Soil Health, October 2017 for more information on testing soil health: www.efotg.sc.egov.usda.gov/references/public/WI/NRCS-Soil_Testing-508.pdf.*

[110] *For more information on WATERS and other producer-led groups, see the following link: datcp.wi.gov/Pages/Programs_Services/ProducerLedProjectSummaries.aspx#walworth.*

[111] *Lake districts and producer-led groups are both eligible to apply for WDNR Surface Water Grant program funding. Practices recommended in this plan are eligible for Surface Water Restoration and Management Plan Implementation grant funding. For more information, see the following link: dnr.wisconsin.gov/aid/SurfaceWater.html.*

- Promote policies that protect or enhance infiltration on public and protected lands. High priority should be given to areas identified as having high and very high groundwater recharge potential within the groundwatershed feeding Turtle Creek and Lake Comus. Medium priority should be given to low groundwater recharge potential areas.

- Encourage local regulators to require developers to infiltrate high quality stormwater as an integral part of new development proposals. Water containing high concentrations of road deicers or other contaminants should not be infiltrated. Such stormwater management infrastructure is best located in areas of moderate, high, and very high recharge potential, where this recommendation should be assigned a high priority. Areas of low groundwater recharge potential should be assigned a medium priority.

- Encourage actions that retrofit existing stormwater conveyance systems in urbanized portions of the groundwatershed to promote high-quality stormwater infiltration. Good locations for retrofitted infiltration infrastructure are pockets of moderate, high and very high groundwater recharge potential within the City of Delavan (see Map 2.2). Activities consistent with this recommendation would be modifying existing municipal infrastructure or promoting actions that enhance infrastructure on existing properties. Examples of the latter would be disconnecting rooftop drains from piped stormwater conveyance systems and allowing stormwater to discharge to well-vegetated soil areas.[112] This should be assigned a high priority.

- Advocate for ordinances discouraging excessively broad expanses of impermeable surfaces and/or that consider lost infiltration potential created by development and offset this loss with high-quality runoff infiltration infrastructure located on the site or elsewhere within the groundwatershed. This activity should be assigned a medium priority.

- Purchase land or conservation easements on natural, agricultural, and open lands within Upper Turtle Creek watershed identified as having very high or high groundwater recharge potential and that are desirable for protection for other purposes. Given the potentially high expense of this initiative, it is assigned a low priority.

- Continue to protect wetlands and uplands with an emphasis on preserving groundwater recharge by enforcing town, village, and city zoning ordinances. This activity should be assigned a high priority.

➤ **Recommendation 5.3: Ensure that unneeded wells are properly abandoned**

Unused and improperly abandoned wells can pose a significant threat to groundwater quality and drinking water supplies as they present direct pathways for surface contaminants to reach groundwater aquifers. The proper abandonment of an unused well avoids the possibility of contamination of groundwater by permanently closing and sealing the connection between the land surface and the groundwater. This recommendation is assigned a low priority.

Communication, Information and Education, and Outreach

Civic engagement is essential to implementing watershed plans. Technical advisors and funding agencies are key to successfully completing watershed projects, but having an engaged core of committed municipalities, citizens, landowners, farmers, grassroots organizations, and local agencies is paramount. When the entire group is willing and able to understand each other's goals and are committed to working together, implementation plans lead to successful on-the-ground projects. Stakeholders who are affected by the watershed plan, who can provide information on the issues in the watershed, and who work to implement existing programs or plans that incorporate similar goals should actively participate.

[112] *Rain gardens are depressions that retain water, are vegetated with native plants, and help water infiltrate into the ground. Rain gardens can help reduce erosion and the volume of unfiltered pollution entering a waterbody and can also help augment baseflow to waterbodies. Visit the Healthy Lakes program website for more information on best practices: healthylakeswi.com/*

The goal of the Information and Education element of the Upper Turtle Creek watershed plan is to provide information that local decision makers, landowners, agricultural producers, and watershed residents can use to protect, restore, and improve the natural resources within the watershed. More specifically, this goal is to promote active stewardship among residents, landowners, farmers, community groups, and governmental and non-governmental organizations.

Identifying, communicating with, and supporting willing partners in the watershed is necessary to implement the recommendations and BMPs described throughout this Chapter. The following suggestions are provided to enhance communication, information and education, and outreach regarding nonpoint source BMPs. All are assigned a high priority. Specific engagement strategies, target audiences, communication vehicles, schedule, lead and supporting organizations, outcomes and goals, and estimated costs are summarized in Table 3.2.

- Host or sponsor educational workshops and tours, demonstration projects, and information exchange forums focusing on emerging BMPs. The LCPRD could also potentially host such events on its parcels on Dam Road leased for farming.

- Engage, and possibly subsidize, agricultural producers to implement practices that improve water quality. Provide information, technical support, tools and equipment, and financial support. These efforts could be coordinated with assistance from WATERS, Glacierland RC&D, Walworth County, or other partners engaged with local producers.

- Promote engagement by the farming community in decision-making and equip farmers with monitoring tools and methods.

- Target action-oriented messages about water quality and conservation practices to key groups.

- Produce and distribute newsletters, exhibits, fact sheets, and/or web content to improve communication around these issues.

3.3 PLAN IMPLEMENTATION

The improvements that would result from implementing the recommendations in this plan would represent steps toward achieving the overall goal of restoring and improving the land and water resources of the Upper Turtle Creek watershed. The successful implementation of this plan is contingent upon a strategy of community coordination, partnership among stakeholders, and development of farmer-led watershed-based improvements to develop innovative solutions.

The general recommendations provided in this plan are intended to guide management activities in the watershed. Unless otherwise indicated, general recommendations are intended to be broadly applicable over the entire watershed. These recommendations provide guidance for the management of water resources within the watershed with respect to a variety of general and specific factors and issues that contribute to the problems that this plan addresses.

The specific management measures recommended in this plan (see Table 3.1) represent actions that could partially implement the general recommendations given in this plan. Implementing these projects will contribute to meeting the management objectives related to the goals described earlier in this Chapter.

Plan Adoption

Upon completion of the Upper Turtle Creek watershed plan, a copy will be transmitted to the WDNR with a request that the Department review the plan, find it consistent with the nine key elements required by the USEPA for watershed restoration plans, and forward it to USEPA for review.

The Commission will transmit a copy of the plan to all local legislative bodies within the watershed and to all existing Federal, State, areawide, and local units and agencies of government that have potential plan implementation functions. Adoption of the watershed plan by these bodies is recommended and is considered highly desirable to assure a common understanding among the several governmental levels and to enable their staffs to program the necessary implementation work. In addition, formal plan adoption may be required for some State and Federal financial aid eligibility.

Table 3.2
Information and Education (I&E) Element Matrix for the Upper Turtle Creek Watershed Plan

Education Action[a]	Target Audience	Communication Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Implementation Goals, Behavior Changes	Estimated Cost
(A) Educate elected officials about the completed plan and encourage them to: 1. Adopt the plan 2. Amend municipal, codes, ordinances, and comprehensive plans to recognize recommendations in the plan	Elected officials	Distribute copies of the plan and post plan on websites for digital download Schedule meetings and presentations on the plan and its recommendations as requested Include elected officials in presentations on stormwater best management practices and/or field trips and workshops related to nonpoint BMPs and conservation practices Submit a summary of this 9 key element watershed plan for inclusion in the "County Administrator's Report" Implement Walworth County Stormwater Pollution Prevention Program including education plan for MS-4 communities	Early 2025-2026	LCPRD, Walworth County LURM, RRC, WalCoMet, watershed municipalities, (SEWRPC), (WDNR)	5 meetings, presentations, and workshops between spring 2025 and mid-2026 Knowledge of the components and recommendations in the plan Adoption of plan by the County and municipalities by 2026 Revisions to municipal codes and ordnances	I&E to elected officials and municipal staffs $12,500 (200 hours) Printed copies of plan $625
(B) Provide the watershed plan to the general public and news media, inform and educate them about water pollution; the hazards of and management of yard debris, pet waste, fertilizers, and yard chemicals as they relate to stormwater runoff and groundwater contamination; green infrastructure such as rain barrels and rain gardens; nonnative and invasive species; and recreational opportunities in the watershed Encourage the public to include appropriate plan recommendations in their activities and to request assistance	General public News media	Publish and distribute a brochure summarizing the plan Make copies of the plan and related materials available on the SEWRPC and/or Walworth County LURM website Post links to the plan and related materials on the LCPRD, Walworth County LURM, WalCoMet, RRC, WDNR, municipal and other websites Develop and distribute nutrient management information for non-agricultural use of fertilizers Act as a technical resource to local schools Announce the plan and activities related to plan implementation through LCPRD, LURM. WalCoMet, RRC, municipal, and SEWRPC websites, social media, newsletters, and multimedia. Update the websites on an ongoing basis Provide natural resource, floodplain, and wetland inventory maps Issue news releases announcing the plan, its recommendations, and implementation activities Provide media interviews, photo opportunities and tours	Spring 2025 and at intervals marking implementation progress, major initiatives, photo opportunities, events, and other newsworthy developments Beginning 2025 and continuing through 2034, present periodically at relevant conferences Beginning 2025 and continuing through 2034, workshops addressing topics related to action items B through I	WalCoMet, LCPRD, RRC, watershed municipalities, Walworth County LURM, (SEWRPC)	Ten news releases issued between fall 2025 and 2034 200 brochures distributed by email or downloaded between spring 2025 and 2029 16 presentations and workshops from 2025 through 2034	Cost includes items B through I, which would be accomplished through a coordinated, multi-purpose program which would include the communication vehicles for each of those action items, and which share outcomes, except where additional outcomes are noted for an action item Staff activities $31,250 (500 hours)

Table continued on next page.

Table 3.2 (Continued)

Education Action[a]	Target Audience	Communication Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Implementation Goals, Behavior Changes	Estimated Cost
(C) Provide information on technical assistance and funding assistance to nongovernmental organizations that have the capabilities to implement expanded water quality monitoring, restoration, and other recommended management actions. Encourage them to: 1. Include the recommendations in their activities and proposals for funding and assistance 2. Coordinate their monitoring programs with existing WDNR programs	Nongovernmental organizations including RRC	Distribute letters, copies of the plan, and plan summary brochure Schedule meetings and tours on the plan and its recommendations Publish and distribute online and print materials on the plan on an ongoing basis Conduct educational outreach on conservation design standards through workshops, newsletters, website, and direct contact	Spring 2025 through 2034	UWEX, WDNR, WalCoMet (SEWRPC), (NRCS)	Shared outcomes listed under Action B above[a] Continue current ongoing WAV Level1 monitoring sites on Turtle Creek and CTH O Tributary Expand water quality monitoring to include supplemental monitoring Knowledge of components and recommendations of the plan	Included in Action B above
(D) Provide information and education on plan recommendations and technical and funding assistance to rural landowners and farm operators owning and/or working lands identified for targeted management measures. Encourage them to adopt the recommended management actions in their practices. Pertinent plan recommendation categories include: • Agricultural BMPs • Drain tile system management • Restoring form and function of streams, floodplains, and wetlands • Riparian buffer protection and expansion • Protecting groundwater supplies	Private landowners Agricultural producers Property managers	Provide presentations, workshops, and tours Publish and distribute online and print material related to these topics Promote and coordinate producer-led initiatives that improve soil health Provide demonstration sites Assist landowners and producers with preparing and implementing conservation plans and practices Conduct educational outreach on conservation design standards through workshops, newsletters, website, and direct contact Provide natural resource, floodplain, and wetland inventory maps	Spring 2025 through 2054	Walworth County LURM, RRC, WalCoMet, watershed municipalities, LCPRD, (NRCS), (UWEX), (land trusts), (SEWRPC), (WDNR)	30 presentations and workshops 25 projects initiated Ten news releases issued between fall 2025 and 2034 Knowledge of components and recommendations of the plan	Included in Action B above
(E) Provide information regarding plan recommendations to developers, engineers, and landscapers. Encourage them to adopt the recommended management actions and include them in their proposals	Developers Engineers Landscapers	Publish and distribute online and print material related to these topics Provide demonstration sites Provide presentations, workshops, and tours to include educational outreach on conservation design standards and construction site erosion control and stormwater management Provide natural resource, floodplain, and wetland inventory maps Prepare and distribute a construction site erosion and stormwater management permit handbook	Spring 2025 through 2034	Watershed municipalities, LCPRD, RRC, (Walworth County), (SEWRPC), (WDNR)	Shared outcomes listed under Action B above[a] Knowledge of components and recommendations of the plan	Included in Action B above

Table continued on next page.

Table 3.2 (Continued)

Education Action[a]	Target Audience	Communication Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Implementation Goals, Behavior Changes	Estimated Cost
(F) Provide information on technical and funding assistance for riparian buffers and stream rehabilitation to County and municipal staffs, riparian property owners, and landscapers. Encourage them to adopt the recommended management actions and include them in their activities and proposals	County and municipal staffs Riparian property owners Landscapers	Publish and distribute online and print material related to these topics Provide demonstration sites Provide presentations, workshops, and tours Provide materials to help identify invasive species and prepare press releases on invasive species and their prevention and control Provide natural resource, floodplain, and wetland inventory maps Distribute SEWRPC "Managing the Water's Edge" riparian buffer brochure	Spring 2025 through 2034	Walworth County LURM, RRC, WalCoMet, watershed municipalities, LCPRD, (NRCS), (UWEX), (land trusts), (SEWRPC), (WDNR)	Shared outcomes listed under Action B above[a] Knowledge of components and recommendations of the plan One demonstration site	Included in Action B above
(G) Provide homeowner, condominium, and business associations with the knowledge needed to properly maintain their stormwater management practices	Homeowner associations Condominium associations Business associations	Publish and distribute online and print material related to these topics Provide demonstration sites Provide presentations, workshops, and tours Conduct educational outreach on conservation design standards through workshops, newsletters, website, and direct contact	Spring 2025 through 2034	Watershed municipalities, LCPRD, RRC, (Walworth County), (SEWRPC), (WDNR)	Shared outcomes listed under Action B above[a] Knowledge of components and recommendations of the plan One demonstration site	Included in Action B above
(H) Provide information and education assistance to County and municipal staffs and potential grant recipients regarding educational signs, kiosks, and multimedia	County and municipal staffs Potential grant recipients	Provide presentations, workshops, tours Provide technical assistance and information about financial assistance	Spring 2025 through 2034	RRC, LCPRD, WalCoMet (SEWRPC), (WDNR)	Shared outcomes listed under Action B above[a] Seven projects initiated	Included in Action B above
(I) Measure information and education activities and outcomes	--	Stakeholders report information about their information and education activities Survey of landowners, agricultural producers, homeowners, and businesses to collect information on their knowledge of watersheds, water quality, BMPs, and other issues.	2025 through 2034	LCPRD, Walworth County LURM, RRC, WalCoMet, (SEWRPC)	Conduct survey in 2030	$25,000
(J) Evaluate and adjust information and education element	--	Evaluation conducted at annual meeting of Upper Turtle Creek/Lake Comus watershed plan advisory committee	Annually, 2025 through 2034	LCPRD, Walworth County LURM, RRC, WalCoMet, watershed advisory committee, (SEWRPC)	Make necessary adjustments to information and education element to achieve its goals	--

Note: Acronyms indicate the following:

LCPRD = Lake Comus Protection and Rehabilitation District
LURM = Walworth County Land Use and Resource Management Department
NRCS = USDA Natural Resources Conservation Service
RRC = Rock River Coalition
SEWRPC = Southeastern Wisconsin Regional Planning Commission
UWEX = University of Wisconsin-Madison Division of Extension
WALCOMET= Walworth County Metropolitan Sewerage District
WDNR = Wisconsin Department of Natural Resources

[a] *The information and education program components described under the "Outcomes" section of Action B would be designed to reach multiple project stakeholders and plan implementation organizations. Thus, presentations, workshops, and educational materials would be designed to meet the interests of the general public, as well as the targeted entities identified under Actions B through H.*

Source: SEWRPC

Upon adoption of the plan by a unit or agency of government, it is recommended that the policymaking body of the unit or agency direct its staff to review in detail the elements of the watershed plan. Once such a review is completed, the staff can propose to the policymaking body for its consideration and approval of the steps necessary to fully integrate the watershed plan elements into the plans and programs of the unit or agency of government.

Implementation Schedule and Milestones

An implementation schedule is an important plan element which provides coordination of implementation by indicating when particular management measures and outreach elements should be done relative to other recommendations made in this plan. The schedule also organizes the implementation of projects by allowing a reasonable amount of time for developing the leadership, partnerships, capacity, and funding sources required for project implementation.

Table 3.3 and Table 3.2 present schedules and interim milestones for specific recommended management measures and education and outreach elements, respectively. Interim milestones provide standards against which progress in implementing the plan and success of the plan can be assessed. They establish expectation as to the minimum progress that should be made in restoring the watershed. If minimum progress is not being made, the plan should be reevaluated and revised with new interim milestones. Adjustments to this plan should be based on measured progress towards plan interim milestones and also after any additional new water quality monitoring data, management tools, and/or BMPs are implemented or obtained over time.

As this plan is implemented, it will be important to take a flexible approach to this schedule. One reason for this is that implementation of many of the recommendations provided in this plan require opportunities that may or may not present themselves within the timeframes envisioned in the schedule. For example, recommendations that require the acquisition of land or easements for implementation need the opportunity to purchase lands or easements from private landowners who are willing to sell. Similarly, the ability to install BMPs on private land is dependent upon the cooperation and participation of landowners. There may also be opportunities to achieve cost savings by implementing recommended projects in concert with, or as part of other, unrelated projects. Finally. It is important to note that the availability of funding is constantly changing. Opportunities to fund particular types of projects may be short-lived. Since these opportunities may not always be available, it is important to capitalize on them whenever possible. Because of this, it will be important to take a flexible rather than rigid approach to the application of the implementation schedule.

Maintaining and Revising the Plan

Watershed restoration efforts are processes that can span decades. Even as restoration proceeds, conditions in the watershed can change in ways that can affect the restoration process. Because of this, it is important that the plan is treated as a living document that will adapt to the changing conditions and technologies. Implementation of this plan should include maintenance of the plan, including periodic review of the plan goals, objectives, and elements and adjusting them to changing conditions in the watershed. Plan maintenance should include:

- Monitoring or tracking the implementation of plan recommendations
- An annual review of the plan the local partners and stakeholders to evaluate progress and determine if any adjustments or modifications to the plan recommendations or priorities are warranted
- Periodic updating of the plan and renewal of the finding that it is consistent with the nine key elements that USEPA considers important for watershed plans. In Wisconsin, a finding that a watershed plan is consistent with the nine key elements generally expires after a fixed period

3.4 MEASURING PLAN PROGRESS AND SUCCESS

Monitoring plan progress will be an essential component of achieving the desired water quality goals. Plan progress and success will be measured by water quality improvement, progress in implementing BMPs and other recommended actions, and by participation rates in public awareness and education efforts.

Table 3.3
Implementation Schedule and Milestones for the Upper Turtle Creek Watershed Plan

Recommendations	Indicators	Schedule and Milestones
	Agricultural BMPs	
Increase use of reduced tillage in watershed from 50 percent to at least 77 percent	Number of acres (percentage) of cropland with conservation practice applied	Increase to 60 percent of cropland within 3 years Increase to 77 percent of cropland within 7 years
Increase use of no-till in watershed from 10 percent to at least 22 percent	Number of acres (percentage) of cropland with conservation practice applied	Increase to 15 percent of cropland within 3 years Increase to 22 percent of cropland within 7 years
Increase use of cover crops in watershed from 5 percent to 20 percent	Number of acres (percentage) of cropland with conservation practice applied	Increase to 10 percent of cropland within 3 years Increase to 15 percent of cropland within 7 years Increase to 20 percent of cropland within 10 years
Increase implementation of lands under nutrient management plans from 44 percent to 78 percent	Number of acres (percentage) of agricultural land with nutrient management plan	Increase to 55 percent of cropland within 3 years Increase to 65 percent of cropland within 7 years Increase to 78 percent of cropland within 10 years
Install additional 41,860 linear feet of grassed waterways	Linear feet of grassed waterways installed	Install 10,420 linear feet within 3 years Install 31,350 linear feet within 7 years Install 41,860 linear feet within 10 years
	Restore Hydrologic Functions	
Restore Areas of Potentially Restorable Wetlands (PRW) *Highest Priority Areas* *High Priority Areas* *Moderate Priority Areas*	Number of acres of wetland restored	Restore a total of 1,738 acres of wetland within 30 years Restore 154 acres within 10 years Restore 364 acres within 20 years Restore 1,220 acres within 30 years
Implement projects to improve connections between streams and their functional floodplains. This could include projects such as reconnecting the streams to their historic channel path, encouraging remeandering using toe wood-sod mats, relocating spoil piles adjacent to ditched streams, and/or implementing two-stage channel design	Number of linear feet of stream or number of projects	25,530 linear feet of identified streams are within or on the edge of WDNR owned land. These streams should be prioritized. • Restore 6,300 feet of channel (or 3 projects) within 10 years • Restore 19,000 feet of channel (or 6 projects) within 20 years • Restore 25,530 feet of channel (or 12 projects) within 30 years 3,246 linear feet of identified streams are on private property. These streams should be restored as willing landowners and funding opportunities arise.
Implement projects to fill or plug drainage ditches	Number of linear feet of stream and/or acreage of functional floodplain restored/or number of projects	30,500 linear feet of drainage ditches total Implement projects when drained land no longer produces commodities at a profit, when drained land is left fallow, or when landowners choose restoration
	Riparian Buffer Restoration	
Install minimum 75-foot-wide riparian buffer strips (179 acres)	Number of acres of riparian buffer installed	Install 45 acres within 5 years Install 135 acres within 7 years Install 179 acres within 10 years

Table continued on next page.

Table 3.3 (Continued)

Recommendations	Indicators	Schedule and Milestones
	Water Quality Monitoring	
Continue Level 1 WAV monitoring at 5 locations to monitor water quality on the Turtle Creek mainstem, Turtle Valley Tributary, and CTH O Tributary (see locations on Map 3.7). All monitoring sites should meet WisCALM monitoring guidance.	Number of WAV Level 1 water quality monitoring sites continuously meeting WisCALM monitoring guidance	Maintain WAV Level 1 monitoring sites that meet WisCALM guidance within 1 year
Commence Level 2 WAV monitoring at three Turtle Creek stations and one CTH O Tributary station	Number of monitoring sites upgraded to WAV Level 2	Upgrade one existing Level 1 monitoring site on Turtle Creek to Level 2 monitoring within 3 years Upgrade three remaining monitoring sites on Turtle Creek to Level 2 monitoring within 7 years Upgrade CTH O Tributary monitoring site to Level 2 monitoring within 10 years
Establish a stream flow monitoring program on Turtle Creek, Turtle Valey Tributary, and CTH O Tributary to estimate flow rates using rudimentary techniques	Number of sites that a stream flow is being monitored semi-regularly	Establish 3 stream flow monitoring locations within 3 years
Establish supplemental water quality monitoring to include grab samples collected at various flow events	Number of sites that a grab sample site is established	Establish 3 grab sample monitoring locations within 3 years

Source: SEWRPC

The general recommendations and specific projects called for in this chapter constitute the recommended actions to improve conditions in the Turtle Creek watershed. Tracking implementation of these recommendations measures the effort being expended and constitutes a measure of progress towards improving conditions in the watershed. While the ultimate test of success is shown through monitoring conditions in the watershed, over short-term periods it can be difficult to detect the impact of watershed restoration activities due to factors such as the variability in water quality indicators, the relatively small pollutant load reductions associated with any single best management practice, and the presence of reservoirs of stored pollutants within the watershed. Tracking implementation of the recommendations of this plan can provide valuable information to assess the progress being made toward achieving restoration goals.

Monitoring and information collection programs are invaluable at helping planners, local officials, agency staff, and community members better understand the condition of the water resources of the Turtle Creek watershed. These programs can provide information to determine where management efforts should focus, help better target management programs, and help determine project feasibility. When conducted on an ongoing basis, monitoring programs can reveal trends and changes in watershed conditions, detect new and emerging water quality problems, assess long-term progress in plan implementation, and provide data for evaluating the success of management projects.

Due to the uncertainty of any modeling effort and the efficiencies of the BMPs, an adaptive management approach should be taken with the implementation of the Upper Turtle Creek watershed plan. The effectiveness of the plan should be evaluated annually and every five years coincident with the Walworth County LWRMP update. If progress is not made, the plan should be reevaluated. Adjustments should be made to the plan based on plan progress and any additional new data, management tools, and/or BMPs.

Evaluation of Existing Water Quality Monitoring and Data Collection Programs

Water quality data in Turtle Creek and Lake Comus were only sporadically measured before the lake management planning project was initiated. In CAPR 341, Commission staff endeavored to provide as much insight as possible on the Lake's and Creek's historical water quality using the available data with the context of the lake characteristics. Since the completion of that plan, the LCPRD has continued to monitor water quality within Lake Comus and within Turtle Creek and select tributaries. This monitoring has focused on water temperature, dissolved oxygen, and total phosphorus.

Identification of Additional Monitoring Needs

Water Action Volunteers (WAV) is a statewide program for Wisconsin citizens who want to learn about and improve the quality of Wisconsin's streams and rivers.[113] The program is coordinated through a partnership between the WDNR and the University of Wisconsin – Cooperative Extension. Between May and October, temperature, dissolved oxygen, streamflow, and transparency are monitored monthly by most WAV citizen monitors. Volunteer monitors also assess the aquatic and streamside habitat as well as the stream's macroinvertebrate community, using a biotic index. Habitat assessments are completed once a year, in the summer, while the biotic index is generally assessed twice a year, once in the spring and again in the fall. Sites are sometimes selected for additional nutrient monitoring. Volunteers most often collect monthly samples for total phosphorus but sometimes collect samples for nitrogen and TSS as well. Sites selected for nutrient monitoring are often special project areas such as watersheds with TMDL or 9KE watershed plans. Level 2 and 3 monitors assess parameters such as chloride, specific conductance, and occasionally *E. coli* bacteria, as well as deploy continuous hourly temperature data recorders.

Recommended Water Quality Monitoring Plan

It is important to assess the condition of water quality, biological communities, and habitat in the watershed and determine whether these conditions are improving or deteriorating. It is, therefore, important to establish and maintain a robust program to monitor and assess conditions within the watershed. Such a monitoring program should integrate and coordinate the use of the monitoring resources of multiple agencies and groups, generate monitoring data that are scientifically defensible and relevant to the decision-making process, and manage and report data in ways that are meaningful and understandable to decision makers and other affected parties. This watershed plan recommends maintaining the existing monitoring network and expanding monitoring in the watershed to continue to fill data gaps. Toward these ends, this plan includes the following recommendations for water quality monitoring.

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[113] *See website for more details at watermonitoring.uwex.edu/wav.*

➤ **Recommendation 6.1: Continue to conduct Level 1 WAV monitoring in Turtle Creek and CTH O Tributary**

Volunteers in the Upper Turtle Creek watershed should continue the current ongoing WAV Level 1 monitoring program activities in Turtle Creek and the CTH O Tributary. Monitoring water temperature, dissolved oxygen, as well as total phosphorus, transparency, conductivity, and pH should be included. Water chemistry monitoring in these streams should occur concurrently with stream flow estimation when possible. This recommendation is a high priority. The monitoring stations where existing monitoring efforts should be continued are shown on Map 3.7 and listed below. All water quality stations listed below are currently meeting the Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) monitoring guidance except for Station 10056022 (County HWY P – Turtle Valley Tributary). This plan recommends that all monitoring stations continue or begin to meet WisCALM monitoring guidance.[114]

- SWIMS Station ID 10056022 (*County Hwy P – Turtle Valley Wildlife Area*) – monitoring the Turtle Valley Tributary
- SWIMS Station ID 653018 (*Turtle Creek at Island Road*) – monitoring the upper Turtle Creek mainstem
- SWIMS Station ID 10052470 (*Turtle Creek at Dam Road*) – monitoring the mainstem of Turtle Creek downstream of the CTH P Tributary
- SWIMS Station ID 10044913 (*Unnamed Trib of Turtle Creek at County Highway O*) – monitoring the CTH O Tributary
- SWIMS Station ID 10056091 (*Turtle Creek Below Lake Comus Dam*) – monitoring the mainstem of Turtle Creek as it leaves Lake Comus and before its confluence with Swan Creek

➤ **Recommendation 6.2: Consider expanding to Level 2 WAV monitoring to install programmable water temperature logging devices in Turtle Creek and the CTH O Tributary**

The continuous monitoring provided by temperature logging devices provides substantially more information about stream conditions and suitability for fish species. However, participating in this program requires greater time commitment, including training, equipment calibration, and data entry. This recommendation is a medium priority.

➤ **Recommendation 6.3: Consider implementing continuous turbidity monitoring on Turtle Creek**

The LCPRD, RRC, and/or WalCoMet should consider installing a continuous reading turbidity monitoring device to estimate the amount of suspended sediment within Turtle Creek. Turbidity values may be able to be correlated with TSS and phosphorus loads if appropriate calibration sampling is completed. Monitoring turbidity along the course of Turtle Creek should be assigned a low priority due to higher training, equipment, and maintenance requirements.

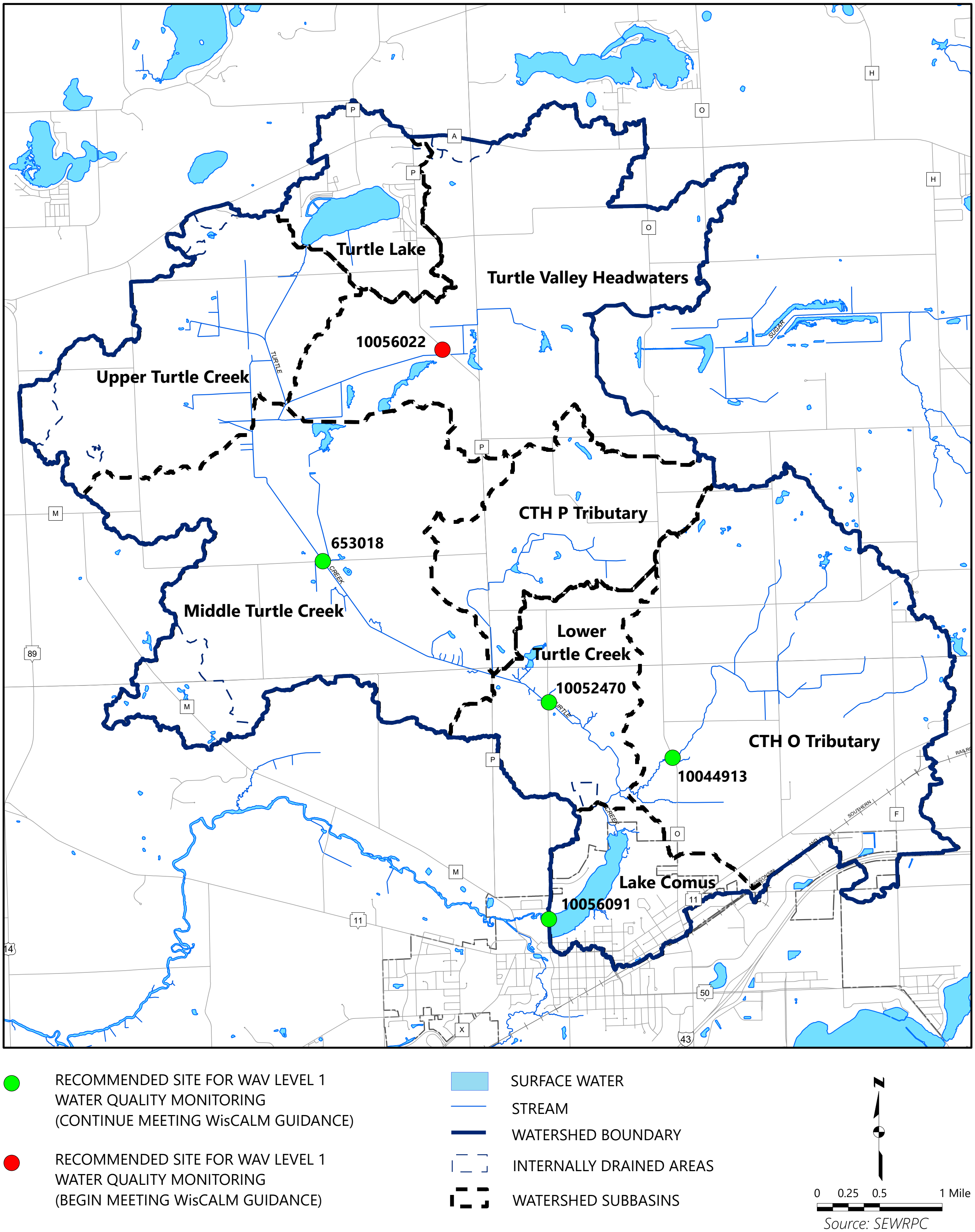
➤ **Recommendation 6.4: Consider supplemental water quality monitoring**

Consider collecting grab samples to represent a cross section of flow events (i.e., low, medium, and high). The sample collector should record the current and recent weather conditions, a qualitative description of flow and water quality (e.g., "creek is very high and turbid"), and the exact location, date, and time where the sample was collected. Sampling parameters should include the following: stream flow, water clarity (measured by transparency tube), total phosphorus, total nitrogen, water temperature, and dissolved oxygen.

Flow rate information allows the actual mass load of phosphorus contributed from the tributaries and the areas they drain to be quantified and compared. Rough stream flow rates can be estimated by measuring water velocities at locations where stream cross sectional area is easily quantified (e.g., culverts and bridges). The total amount of water delivered from each tributary can also be estimated using empirical formulas (e.g., the Rational Method) and models (e.g., TR 55, SWMM, Presto-Lite). These

[114] *The WisCALM guidance document provides a methodology on comparing water quality data against surface water quality standards. The guidance also assists with reporting on the status of surface water quality for the Clean Water Act.*

Map 3.7
Recommended Sites to Continue Level 1 WAV Water Quality Monitoring



Source: SEWRPC

flow estimates can be combined with water quality information collected in the streams to estimate mass loadings from each stream. This information can then be used to target priority tributaries, seasons, and events for water quality analyses. This recommendation may be very valuable for developing future management solutions and tracking progress but requires significant volunteer commitment. Therefore, this recommendation is assigned a medium priority.

Parameters and sampling frequency may be adjusted as necessary to focus resources on the sub-basins identified to have the greatest impact to Turtle Creek and Lake Comus water quality. Depending upon the sub-basin and sample results, action should be taken to help reduce pollutant loadings. For example, if phosphorus was detected in high concentrations in a tributary draining residential areas, efforts to communicate best practices to homeowners should be reinforced, stormwater management infrastructure inspected, actions to protect and expand wetlands and buffers increased, and other factors considered. Intensified and/or expanded monitoring may help pinpoint source areas for particular attention.

- **Recommendation 6.5: Consider implementing a drain tile sampling program**
  The LCPRD, Walworth County, RRC, and/or WalCoMet should consider establishing a volunteer monitoring program to sample drain tile flow for total phosphorus. Drain tiles at five location throughout the Upper Turtle Creek watershed should be sampled twice annually (spring and summer).

- **Recommendation 6.6: Consider implementing sediment depth surveys along the mainstem of Turtle Creek**
  The LCPRD, Walworth County, RRC, and/or WalCoMet should consider surveying sediment depths along the mainstem of Turtle Creek. Sediment depth survey cross sections and measuring protocols should match those described in Chapter.

- **Recommendation 6.7: The WDNR should consider biological monitoring of fishes and macroinvertebrates on Turtle Creek and CTH O Tributary.**
  Biological monitoring of fishes and/or macroinvertebrates at a minimum of once every three to five years may assist in assessing whether implemented BMPs are improving water quality and habitat conditions within the Turtle Creek system. This recommendation is assigned a medium priority.

- **Recommendation 6.8: Local partners should continue conducting other wildlife surveys such as for mussels, amphibians, and reptiles within the Upper Turtle Creek watershed.**
  This recommendation is assigned a medium priority.

- **Recommendation 6.9: Available water quality data collected in the Upper Turtle Creek watershed should be periodically collated, analyzed, and placed into context.**
  These data should be compared to historical monitoring data and to the applicable water quality criteria. Through the use of direct measurements, these comparisons will provide an assessment of trends and changes in conditions and indicate whether conditions, including those relative to the identified impairments, are improving or worsening. These analyses will indicate whether substantial progress is being made toward meeting water quality standards. Volunteers could conduct preliminary investigations using the WDNR Wisconsin Water Explorer Tool (WEx tool) to conduct these analyses.[115] This recommendation is assigned a high priority.

- **Recommendation 6.10: Identify potential partners such as the County Health Department, UW-Whitewater, UW-Extension, Wisconsin Land and Water to test for, track, and maintain information on failing septic systems**
  This recommendation should be carried out as envisioned by the LURM and described in the Walworth County LWRMP. This recommendation is assigned a medium priority.

The continuation and recommended expansion of water quality monitoring in the Turtle Creek watershed will provide several benefits related to the management of surface waters in the watershed. First, observed water quality data are essential to the calibration and validation of water quality models used to assess anticipated future water quality conditions. Expansion of the observed water quality database for the watershed would

[115] *For more information regarding the WDNR Watershed Exploration Tool see dnr.wisconsin.gov/topic/SurfaceWater/WEx.html.*

enable future refinement of the water quality models through additional calibrations. Second, new water quality data will allow assessment of whether these waterbodies are meeting the water quality criteria that support their designated use objectives. Third, monitoring activities will provide information needed for informing the management of these waterbodies.

3.5 COST ANALYSIS

Cost estimates are based on current USDA-NRCS total costs for payment rates, incentives payments to get necessary farmer participation, and current conservation project installation rates. Current conservation project installation rates were obtained through conversations with county conservation technicians, UW-Extension, and NRCS staff. The total cost to implement this watershed plan over 10 years is estimated to be nearly 3.2 million dollars.[116]

Summary of Cost Analysis (Over 10 Years)

- $1.9 million to implement BMPs (see Table 3.1)
- $69,375 needed for Information and Education (see Table 3.2)
- $45,000 needed for Water Quality Monitoring (see Table 3.4)
- $1,275,000 needed for technical assistance (see Table 3.5)

As discussed earlier in the Implementation Schedule and Milestones section, it will be important to take a flexible approach to this schedule. Because of the long-time scales needed for reductions in pollutant loads to be measurable in a complex natural system and limitations on the financial resources available for plan implementation, the plan will realistically be implemented over a time period longer than ten years. As reported in Table 3.3, some recommended management measures are expected to take up to 30 years, or more, to accomplish. When considering those management measures, the total cost to implement this watershed plan over 30 years is estimated to be over 14.2 million dollars.

Operation and Maintenance

This plan will require a landowner to agree to a 10-year maintenance period for practices such as vegetated buffers/wetland restoration, grassed waterways, and streambank stabilization. For practices such as no-till, cover crops, and nutrient management, landowners are required to maintain the practice for each period that cost sharing is available. Upon completion of the operation and maintenance period, point sources may be able to work with operators and landowners to continue implementation of the BMPs under a pollutant trading agreement (non-EPA 319 funding).

3.6 FUNDING AND TECHNICAL ASSISTANCE OPPORTUNITIES

Various types of technical and financial assistance useful in plan implementation are available from County, State, and Federal agencies, as well as not-for-profit organizations. Identifying potential funding sources, including sources other than solely local-level sources, is an integral part of the implementation of a successful watershed plan. Table 3.6 provides basic information for funding sources that may be applicable for implementation of projects recommended in this plan. Funding programs and opportunities are constantly changing. Accordingly, the involved local staffs will need to continue to track the availability and status of potential funding sources and programs. This list is intended to facilitate implementation of the activities set forth in the recommended plan. Some of the programs summarized in Table 3.6 may not be available under all envisioned conditions for a variety of reasons, including local eligibility requirements or lack of funds in Federal or State budgets at a given time. Nonetheless, the list of resources and programs should provide a starting point to identify possible funding and technical assistance opportunities for implementing the watershed plan recommendations. Note that Table 3.6 provides a website address and/or staff contact information for each program. This information should be used to find additional program information as well as the program's most up-to-date grant application process and requirements.

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[116] *As noted, this cost only includes those measures recommended to be implemented over 10 years as indicated in Table 3.3. There are projects that will take well over 10 years to complete, and those costs are not included in this summary.*

The following subsections briefly describe potential local, State, Federal, and non-governmental funding and technical assistance resources available to help fund and implement BMPs and other recommendations in the watershed.

Local

- **Walworth County LURM** – Walworth County has a very active and knowledgeable conservation staff and an excellent resource to provide technical and potentially financial assistance related to conservation practices such as those recommended in this plan. The County's Land and Water Resources Management Plan[117] has been used to target priorities; staff; and State, Federal, and local resources to advance Walworth County's land and water resource management goals.

State

- **Surface Water Grant Program (SWG)** – A WDNR program that offers competitive grants for local governments, counties, lake districts, and other eligible organizations to address a range of surface-water issues.[118] Several subprograms could be useful for implementing plan recommendations and that the LCPRD, City of Delavan, and Walworth County could sponsor. These subprograms include:
  - **Surface Water Restoration** – Provides funds to implement shoreline, in-water, and wetland restoration projects that follow appropriate NRCS guidelines as well as funding to develop ordinances that protect surface water resources. Cost-share is up to 75 percent of eligible costs for up to $75,000 for lakes and $50,000 for rivers.
  - **Management Plan Implementation** – Provides funds to implement recommendations in a WDNR-approved surface water management plan. Eligible projects include nonpoint source pollution control, habitat restoration, water quality improvements, landowner incentives, and management staffing. Cost-share is up to 75 percent of eligible costs for up to $200,000 for lakes and $50,000 for rivers.
  - **Healthy Lakes and Rivers** – Provides funding to implement approved best practices for shoreland landowners following technical guidance. Practices include fish sticks, native plantings, water diversions, rain gardens, and rock infiltration. Cost-share is up to 75 percent of eligible costs for up to $25,000.
  - **Clean Boats, Clean Waters** – Provides funding to help prevent spread of aquatic invasive species through education and monitoring at boat launches. Eligible costs include supplies, training, and payment to any paid staff or in-kind donations from volunteers. Cost-share is up to 75 percent of eligible costs for up to $4,000 per boat launch.

Table 3.4
Estimated Costs for Water Quality Monitoring Recommendations

Recommendations	Cost ($)
Volunteers collecting monthly water quality samples at each of five sites from May – October for ten years	30,000
Volunteers collecting total phosphorus samples at five drain tiles sites twice annually (spring and summer) for ten years	6,000
Volunteers measuring sediment depth at Creek cross-sections every five years	4,000
Monitoring equipment and maintenance costs, including mileage	5,000
Total	45,000

Source: SEWRPC

Table 3.5
Estimated Costs for Technical Assistance

Recommendations	Cost ($)
Conservation/Project Coordinator Staff Time (1,000 hours per year for ten years)	750,000
Rural Technician Staff Hours (1,000 hours per year for ten years)	525,000

Source: Walworth County LURM and SEWRPC

[117] *Walworth County Land Use and Resource Management,* Walworth County Land and Water Resource Management Plan: 2021 - 2030, *2020.*

[118] *For more information on the WDNR Surface Water Grant program, see www.dnr.wisconsin.gov/aid/SurfaceWater.html and Wisconsin Department of Natural Resources, 2021 DNR Surface Water Grant Application Guide, July 2021: www.dnr.wi.gov/files/pdf/pubs/cf/CF0002.pdf.*

Table 3.6
Potential Funding Programs to Implement Recommendations of the Upper Turtle Creek Watershed Plan

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
1	Captain Planet Foundation (CPF)	Small Grants Program (i.e., "ecoTech" and "ecoSolution" grants)	U.S.-based schools and nonprofit organizations with an annual operating budget of less than $3 million	1. Projects that provide hands-on environmental opportunities for youth 2. Projects that use the environment for applied and STEM learning 3. Projects that have real environmental outcomes 4. Projects that inspire youth and communities to participate in environmental stewardship activities	Grants range between $500 and $2,500	info@captainplanetfdn.org (404) 522-4270
2	Charles Stewart Mott Foundation	Environmental Program (i.e., "Addressing the Freshwater Challenge" and "Special Initiatives")	Nonprofit conservation and environmental organizations	1. Projects that seek to strengthen the environmental community 2. Projects that implement effective public policies related to water conservation in the Great Lakes region	Grants - no maximum given	mott.org email: info@mott.org (800) 238-5651
3	Clif Bar Family Foundation	Clif Bar Family Foundation Small Grants	Nonprofit organizations	Projects that use a holistic approach toward: 1. Creating healthy food systems 2. Increasing outdoor activity 3. Reducing environmental health hazards 4. Building stronger communities	Average assistance of $7,000 provided	clifbarfamilyfoundation.org email: familyfoundation@clifbar.com (510) 596-6383
4	Cornell Douglas Foundation	Cornell Douglas Foundation	Environmental organizations	Funding areas include: 1. Environmental health and justice 2. Land conservation 3. Sustainability of resources 4. Watershed protection	Grants range between $15,000 and $50,000	cornelldouglas.org (301) 229-3008 email: cdf@cornelldouglas.org
5	Doris Duke Charitable Foundation	Environment Program	Nonprofit organizations	Projects that focus on: 1. Land conservation 2. Wildlife and energy development 3. Enhancing conservation	Multi-year grants averaging from $100,000 to $1 million	Ddcf.org Program Director for the Environment: (212) 974-7000 email: env@ddcf.org
6	James E. Dutton Foundation	James E. Dutton Foundation	Organizations or individuals working on projects that benefit wildlife, animal causes, environmental preservation, and outdoor education	Support efforts for wildlife or animal rescue; enhancement of habitat conservation; responsible land management, increased public awareness of conservation and the environment	Awards the total cost of accepted projects	jamesduttonfoundation.org email: silvercreek.fenske@gmail.com (414) 640-0523
7	The Joyce Foundation	Environment Program (i.e., "The Great Lakes and Drinking Water" Program)	Nonprofit organizations, educational institutions, and government agencies	Efforts that will: 1. Improve water infrastructure 2. Prevent unsustainable diversions from the Great Lakes 3. Prevent groundwater depletion 4. Reduce polluted runoff in rural and urban areas 5. Prevent the introduction and spread of aquatic invasive species 6. Support equitable water policy 7. Ensure safe water systems and infrastructure	Awards the total cost of accepted projects	joycefdn.org email: info@joycefdn.org (312) 782-2464
8	Natural Resources Foundation of Wisconsin	C.D. Besadny Conservation Fund	Public charities; federal, state, or local units of government; Indian tribes; and accredited schools, colleges, or universities	Grassroots conservation and education projects that benefit Wisconsin's lands, waters, and wildlife	Grants range from $500 to $2,000	www.wisconservation.org/grants/cd-besadny-conservation-grants Director of Conservation Programs: Caitlin Williamson Caitlin.Williamson@Wisconservation.org (608) 409-3109
9	Natural Resources Foundation of Wisconsin	The Go Outside Fund	Public charities, federal, state, or local units of government, Indian tribes; or accredited schools, colleges, or universities	Projects that engage children in significant outdoor, nature-based learning activities	Grants range from $100 to $500	www.wisconservation.org/grants/go-outside-fund Director of Conservation Programs: Caitlin Williamson Caitlin.Williamson@Wisconservation.org (608) 409-3109

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Table 3.6 (Continued)

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
10	Natural Resources Foundation of Wisconsin	The Norma and Stanley DeBoer Quiet Trails Fund	Public charities, federal, state, or local units of government, Indian tribes; or an accredited schools, colleges, or universities	1. Creating and maintaining public walking, hiking, or skiing trails 2. Increasing access for people with disabilities 3. Identification of trail locations and signage 4. Surveying 5. Purchasing trail materials 6. Construction 7. Trail maintenance	Grants range from $500 to $1,000	www.wisconservation.org/grants/quiet-trails-fund Director of Conservation Programs: Caitlin Williamson Caitlin.Williamson@Wisconservation.org (608) 409-3109
11	Natural Resources Foundation of Wisconsin	The Teachers Outdoor Environmental Education Fund	K-12 Wisconsin public school teachers	1. Projects that demonstrate a clear connection to classroom learning and standards 2. Projects that have a significant component of outdoor activity	Up to $1,000	wisconservation.org/grants/teachers-outdoor-environmental-education-fund Director of Conservation Programs: Caitlin Williamson Caitlin.Williamson@Wisconservation.org (608) 409-3109
12	Natural Resources Foundation of Wisconsin	Wisconsin Rare Plant Preservation Fund	Public charities, federal, state, or local units of government, Indian tribes; or an accredited schools, colleges, or universities	Projects that protect Wisconsin's rare plants and lichens through monitoring, inventorying, and preservation	$500-$1,000	wisconservation.org/grants/rare-plant-preservation-fund Director of Conservation Programs: Caitlin Williamson Caitlin.Williamson@Wisconservation.org (608) 409-3109
13	National Fish and Wildlife Foundation (NFWF)	Acres for America	State, local, municipal, and tribal governments and nonprofit organizations	1. Conserve critical habitats for birds, fish, plants, and wildlife 2. Connect existing protected lands and protect migration routes 3. Provide access to the outdoors 4. Ensure the future of local economies that depend on forestry, ranching and recreation	About $3.5 million total will be available in 2021	nfwf.org/programs/acres-america Conservation Programs Coordinator: Kimberly Shriner Kimberly.Shriner@nfwf.org
14	National Fish and Wildlife Foundation	Bring Back the Natives	Local, state, federal, and tribal governments and agencies; special districts such as conservation districts, planning districts, utility districts; nonprofit organizations; schools; and universities	Supports projects that conserve aquatic ecosystems such as: 1. Restoring connectivity 2. Restoring riparian and instream habitat and water quality 3. Invasive species management 4. Innovative approaches to fish conservation	Awards totaling $500,000 available in competitive grant proposals	nfwf.org/programs/bring-back-natives Water Investments Coordinator: Hannah Karlan Hannah.Karlan@nfwf.org
15	National Fish and Wildlife Foundation	Five Star and Urban Waters Restoration Program	Nonprofit organizations, state government agencies, local governments, municipal governments, Indian tribes and educational institutions	Project priorities include: 1. On-the-ground projects that restore and create wetlands, coastal, or riparian areas 2. Environmental outreach, education, and training 3. Community partnership projects that involve five or more partners (public or private entities) 4. Measure results in specific, measurable ecological, educational and community benefits	Grant assistance between $20,000 and $50,000	nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program Community Stewardship Program Coordinator: Carrie Clingan Carrie.Clingan@nfwf.org
16	National Fish and Wildlife Foundation	Resilient Communities Program	Nonprofit organizations, tribes, and local, state, and federal government agencies	Projects that include: 1. Adaptation through conservation 2. Community capacity-building that helps communities understand environmental risks 3. Scalable, nature-based resilience solutions benefiting affordable housing and/or small businesses	Grants range from $100,000 to $500,000 depending on project	nfwf.org/programs/resilient-communities-program Community Stewardship Program Coordinator: Carrie Clingan Carrie.Clingan@nfwf.org
17	Southeastern Wisconsin Invasive Species Consortium (SEWISC)	SEWISC Assistance Program	Individuals, nonprofit organizations, community and civic groups, private businesses, and units of government	Projects to lessen the impacts of invasive species in southeastern Wisconsin	Up to $2,000 provided in grant money with a required 25 percent match of the project budget	sewisc.org

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Table 3.6 (Continued)

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
18	U.S. Army Corps of Engineers (USACE)	Aquatic Ecosystem Restoration Program	State and local units of government	Modification of hydrology in and along water bodies	Planning costs after $100,000 is 50 percent cost-shared. Design and implementation are cost-shared 65 percent federal and 35 percent non-federal	CELRC_Planning_Econ@usace.army.mil (312) 846-5580
19	U.S. Army Corps of Engineers	Emergency Streambank and Shoreline Protection Program	State and local units of government	Streambank or shoreline erosion projects that will help protect public buildings and infrastructure	Planning costs after $100,000 require 50 percent local cost-share. Implementation costs are shared at 65 percent federal and 35 percent non-federal contributions	CELRC_Planning_Econ@usace.army.mil (312) 846-5580
20	U.S. Army Corps of Engineers	Great Lakes Fishery and Ecosystem Restoration Program	State and local units of government, public agencies, private interests, nonprofit organizations	Projects to protect and/or restore the fishery, ecosystems and beneficial uses of the Great Lakes	Planning costs after $100,000 is cost-shared at 65 percent federal and 35 percent non-federal. Implementation is cost-shared at 65 percent federal and 35 percent non-federal	CELRC_Planning_Econ@usace.army.mil (312) 846-5580
21	U.S. Army Corps of Engineers	Small Flood Risk Management Program	State and local units of government	Construct site-specific flood protection projects or improvement of flood control works	Planning costs after the first $100,000 is 50 percent cost shared. Implementation is cost-shared at 65 percent federal and 35 percent non-federal	CELRC_Planning_Econ@usace.army.mil (312) 846-5580
22	U.S. Army Corps of Engineers	Snagging and Clearing for Flood Damage Reduction	State and local units of government	Removal of accumulated snags and debris from stream channels to prevent flooding	Planning costs after the first $100,000 is 50 percent cost shared. Implementation is cost-shared at 65 percent federal and 35 percent non-federal	CELRC_Planning_Econ@usace.army.mil (312) 846-5580
23	U.S. Department of Agriculture-Farm Services Agency (FSA)	Conservation Reserve Program (CRP)	Landowner or producer of the land for at least 12 months	1. Wildlife habitat improvement projects 2. Water quality improvement projects that reduce erosion, runoff, and leaching 3. Projects that will continue to benefit the land 4. Air quality improvement projects such as reducing wind erosion	Annual rental payments and 50 percent cost-share assistance	fsa.usda.gov/programs-and-services/conservation-programs Local Farm Service Agency Office: fsa.uniongrove@usda.gov
24	U.S. Department of Agriculture-Farm Services Agency	Emergency Conservation Program (ECP)	Agricultural producers and ranchers	Practices that would recover and improve existing conservation practice(s) damaged by a natural disaster or severe drought	Assists up to 75 percent of approved restoration costs	fsa.usda.gov/programs-and-services/conservation-programs Local Farm Service Agency Office: fsa.uniongrove@usda.gov
25	U.S. Department of Agriculture-Forest Service	Community Forest Program	Tribal entities, local governments, and qualified conservation nonprofit organizations	Projects aimed to acquire and establish forests that will provide community and economic benefits through active forest management, clean water, wildlife habitat, educational opportunities, and public access for recreation	Program pays up to 50 percent of project costs and requires a 50 percent non-federal match	fs.usda.gov/managing-land/private-land/community-forest Eastern Region Forest Legacy Program: Kirston Buczak kirston.buczak@usda.gov (414) 297-3609
26	U.S. Department of Agriculture-Natural Resources Conservation Service (NRCS)	Agricultural Conservation Easement Program: *Agricultural Lands*	Eligible lands for agricultural easements include cropland, rangeland, grassland, pastureland and non-industrial private forest	Projects that protect working agricultural lands	Assists up to 75 percent of the easement value depending on environmental significance of the land	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010

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Table 3.6 (Continued)

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
27	U.S. Department of Agriculture-Natural Resources Conservation Service	Agricultural Conservation Easement Program: *Wetlands Reserve*	Eligible lands include farmed or converted wetland that can be restored	Projects that restore, protect, and enhance wetlands	Assists 50 to 100 percent of the restoration costs and easement value	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010
28	U.S. Department of Agriculture-Natural Resources Conservation Service	Conservation Stewardship Program (CSP)	Tribal entities, agricultural producers, ranchers, and private non-industrial forests	Maintain, improve, or expand conservation practices on agricultural lands	Assistance is based on conservation practices	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010
29	U.S. Department of Agriculture-Natural Resources Conservation Service	Emergency Watershed Protection Program (EWP)	Public and private landowners after natural disaster Eligible sponsors include cities, counties, towns, conservation districts, or any federally-recognized Native American tribe or tribal organization	Projects that will: 1. Remove debris from stream channels, road culverts, and bridges 2. Reshape and protect eroded streambanks 3. Correct damaged or destroyed drainage facilities 4. Establish vegetative cover on critically eroding lands 5. Repair levees and structures 6. Repair conservation practices	Up to 75 percent provided in assistance	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010
30	U.S. Department of Agriculture-Natural Resources Conservation Service	Environmental Quality Incentives Program (EQIP)	Tribal, agricultural producers, and private non-industrial forests, and degraded wetlands	Projects that will enhance wildlife habitat, soil, and water quality on working agricultural lands and forests	Up to $450,000 based on conservation practices	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010
31	U.S. Department of Agriculture-Natural Resources Conservation Service	Regional Conservation Partnership Program (RCPP)	Landowners and agricultural producers, state, local, or tribal governments, nonprofits, and higher education	Conservation practices that will increase the restoration and sustainable use of soil, water, wildlife, and related natural resources on regional or watershed scales	Annual assistance of $300 million per year nationally	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010
32	U.S. Department of Agriculture-Natural Resources Conservation Service	Watershed Protection and Flood Protection Program	Federal, state, and local government agencies, and tribal governments	Plans that will address: 1. The protection and restoration of watersheds from erosion, floodwater, and sediment impacts 2. Enhancement of water and land conservation practice 3. Economic impacts related to natural resources	Financial and technical assistance provided	nrcs.usda.gov Local NRCS Office Contact: Brandi Richter Brandi.richter@wi.usda.gov (262) 747-3010
33	U.S. Environmental Protection Agency (USEPA)	Environmental Education Grants (EE)	Local educational institutions, environmental agencies, and nonprofit organizations	Projects that address one or more of the following: 1. Improving air quality 2. Clean and safe water 3. Safety of chemicals 4. Land revitalization	75 percent cost-share provided for a Federal total of $50,000 to $100,000	epa.gov/education/grants EPA Region 5: (312) 353-4293
34	U.S. Environmental Protection Agency	Environmental Justice Small Grants Program	Incorporated nonprofit organizations —including, but not limited to, environmental justice networks, faith-based organizations, and tribal organizations	Community-driven projects that engage, educate, and empower communities to better understand local environmental and public health issues and develop strategies for addressing those issues	Up to $75,000 depending on availability of funds	epa.gov/environmentaljustice/environmental-justice-small-grants-program Office of Environmental Justice: (202) 564-2515 EPA Region 5: (312) 353-4293
35	U.S. Environmental Protection Agency	Great Lakes Restoration Initiative Program (GLRI)	States, tribes, local governments, universities, and nongovernmental organizations in the Great Lakes region	Projects associated with: 1. Toxic substances and Areas of Concern (AOC) 2. Invasive species 3. Nonpoint source pollution impacts on nearshore health 4. Habitats and species restoration 5. Foundations for future restoration actions	After EPA and its partner agency agree on program and project, the EPA will appropriate the money to provide funding	epa.gov/great-lakes-funding Michael Russ Russ.michael@epa.gov

Table continued on next page.

Table 3.6 (Continued)

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
36	U.S. Federal Emergency Management Agency (FEMA)	Building Resilient Infrastructure and Communities (BRIC)[a]	Applicants: states, territories, and Tribal governments Sub-applicants: local and tribal governments and state and tribal agencies	Funds may be used for: 1. Capability- and capacity-building activities 2. Hazard mitigation projects 3. Management costs	FEMA will distribute up to $500 million with 25 percent local match required s States distribute up to $600,000 per applicant	fema.gov/grants/mitigation/building-resilient-infrastructure-communities Wisconsin Division of Emergency Management dma.wi.gov/DMA/wem/mitigation/hma
37	U.S. Federal Emergency Management Agency	Hazard Mitigation Grant Program (HMGP)	State agencies and participating NFIP communities	1. Floodproofing 2. Relocation 3. Elevation of structures 4. Property acquisition	75 percent federal cost-share assistance, 12.5 percent state match, and 12.5 percent local match	fema.gov/grants/mitigation/hazard-mitigation Wisconsin Division of Emergency Management dma.wi.gov/DMA/wem/mitigation/hma
38	U.S. Fish and Wildlife Service (USFWS)	National Fish Passage Program	Individuals, nonprofit or national organizations, and local governments	Projects that: 1. Restore fish passage 2. Develop community infrastructure resilience 3. Rebuild fish populations 4. Improve recreational and commercial fisheries 5. Restore free flowing waters	On average the program contributes about $70,000 per project. There is no upper limit to project funding. Generally, a 50 percent match is required from federal or non-federal sources	fws.gov/fisheries/fish-passage.html National Fish Passage and Aquatic Habitat Coordinator: Dr. Michael Bailey michael_bailey@fws.gov Regional Fish Passage Coordinator: Jessica Hogrefe jessica_hogrefe@fws.gov
39	U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program	Private landowners	Priority projects include: 1. Livestock fencing 2. Alternate water supply/construction 3. Streambank stabilization 4. Restoration of in-stream aquatic habitat planting 5. Prescribed burning 6. Native grass and forb planting 7. Wetland restoration 8. Riparian reforestation	Reimbursement of project expenses Cost-share varies, maximum project award of $25,000	fws.gov/partners USFWS State Coordinator: Kurt Waterstradt Kurt_Waterstradt@fws.gov (608) 221-1206
40	Wisconsin Board of Commissioners of Public Lands	State Trust Fund Loan Program	Municipalities and school districts	Any public purpose including infrastructure	Loans at competitive rates	bcpl.wisconsin.gov Richard Sneider: (608) 261-8001 Richard.sneider@wi.gov
41	Wisconsin Citizen-Based Monitoring Network	Wisconsin Citizen-Based Monitoring Partnership Program	Local units of government, lake districts and associations, school districts, river management organizations, colleges, universities, technical schools, nonprofit conservation organizations	Citizen-based monitoring of aquatic and terrestrial species, natural communities and environmental components such as water, soil, and air	Up to $5,000 per project in assistance	wiatri.net dnr.wisconsin.gov Water Resources Management Specialist: Rachel Sabre Rachel.Sabre@Wisconsin.gov (262) 574-2133
42	Wisconsin Conservation & Education Foundation	Wisconsin Conservation & Education Foundation	Environmental and natural resources organizations, Wisconsin educators, and individuals	Projects that promote public education to enhance natural resources, environmental stewardship, and outdoor heritage through publications and events	Provides grant money through individual donations and the annual fundraiser banquet, which on average, brings in $20,000	wiconservationfoundation.org
43	Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP)	Clean Sweep Program	Counties, towns, villages, cities, tribes, sanitary and sewerage districts, or regional planning commissions	Collection and disposal of household hazardous wastes, agricultural pesticides, and prescription drugs	Grant program provides reimbursement	datcp.wi.gov/Pages/Programs_Services/CleanSweep.aspx Clean Sweep Program Coordinators: Monica Sipes (608) 224-4536 Sally Ballweg (608) 224-4522

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Table 3.6 (Continued)

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
44	Wisconsin Department of Agriculture, Trade and Consumer Protection	Nutrient Management Farmer Education Grants (NFME)	Local organizations	1. Providing nutrient management training, plan writing, soil testing, and training 2. Offer nutrient management training, education, and support	Provides assistance between $2,500 to $20,000	datcp.wi.gov/Pages/Programs_Services/NMFEGrants.aspx Contact: Mark Witecha (608) 224.4605 Markj.witecha@wisconsin.gov
45	Wisconsin Department of Agriculture, Trade and Consumer Protection	Soil and Water Resource Management Program	County conservation and resource management officials	1. Soil and water conservation on farms 2. Land and water resource management plans 3. Support of county conservation staff 4. Cost-share grants to landowners to implement conservation practices 5. Certifying designs by soil and water professionals	Pays for conservation staff and provides landowner cost-sharing to implement conservation practices	datcp.wi.gov Kim Carlson: kim.carlson@wisconsin.gov (608) 224-4610 Susan Mockert: susan.mockert@wisconsin.gov (608) 224-4648
46	Wisconsin Department of Natural Resources (WDNR)	Clean Water Fund Program (CWFP)	Municipalities, town sanitary districts, lake protection and rehabilitation districts, and metropolitan sewerage districts	Projects to control and treat urban stormwater runoff	Loans at an interest rate of 65 percent of the current market rate	dnr.wisconsin.gov/aid/EIF.html
47	Wisconsin Department of Natural Resources	County Conservation Aids (CCA)	County and tribal governments	1. Aquatic habitat development 2. Aquatic vegetation management 3. Lake and stream rehabilitation and improvement	50 percent state cost-share	dnr.wisconsin.gov/aid/CountyConservation.html CCA Grant Program Manager: Beth Norquist (715) 839-3751 Elizabeth.Norquist@Wisconsin.gov
48	Wisconsin Department of Natural Resources	Dam Removal Grant Program	Counties, cities, villages, towns, lake districts, and private dam owners	1. Dam removal planning 2. Dam removal 3. Restoration of impoundment	State covers 100 percent of project costs up to $50,000	dnr.wisconsin.gov/aid/DamRemoval.html State Dam Safety Engineer: Tanya Lourigan (608) 444-2089 Dam Grant Program Manager: Wendy Peich (608) 264-9207
49	Wisconsin Department of Natural Resources	Knowles-Nelson Stewardship Program	Local units of governments and qualified nonprofit organizations	1. Acquisition of land and easements for conservation and recreation 2. Developing and improving recreational facilities 3. Streambank protection 4. Restoring fish and wildlife habitat	50 percent cost-share assistance provided	dnr.wisconsin.gov/topic/Stewardship WDNR Regional Grant Specialist: Sara Debruijn (414) 263-8704 Sara.debruijn@wisconsin.gov
50	Wisconsin Department of Natural Resources	Land and Water Conservation Fund Program	State agencies and local units of government	1. Planning for acquisition of parks 2. Land acquisition for parks and open space 3. Supporting facilities that enhance recreational opportunities	50 percent cost-share assistance provided	dnr.wisconsin.gov/aid/LCWF.html WDNR Regional Grant Specialist: Sara Debruijn (414) 263-8704 Sara.debruijn@wisconsin.gov gov
51	Wisconsin Department of Natural Resources	Municipal Dam Grant Program	Cities, towns, villages, counties, tribes, and lake districts	1. Dam maintenance 2. Dam repair 3. Dam modification or abandonment 4. Dam removal	For repair the State covers 50 percent of the first $400,000; 25 percent of the next $800,000; and for removal the State covers 100 percent of the first $400,000	dnr.wisconsin.gov/aid/DamMunicipal.html State Dam Safety Engineer: Tanya Lourigan (608) 444-2089 Dam Grant Program Manager: Wendy Peich (608) 264-9207
52	Wisconsin Department of Natural Resources	Municipal Flood Control Grants	Cities, villages, towns, tribes, and metropolitan sewerage districts	1. Structure and land acquisition 2. Structure floodproofing 3. Riparian restoration 4. Flood storage 5. Stormwater storage/detention 6. Flood mapping	State grant covers up to 70 percent of eligible costs	dnr.wisconsin.gov/aid/MunFloodControl.html Elizabeth Kuisis Financial Assistance Specialist (608)-400-3005

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Table 3.6 (Continued)

ID	Administrator of Grant Program	Name of Funding Program(s)	Eligibility	Types of Projects and Funding Eligibility Criteria	Assistance Provided	Contact Information
53	Wisconsin Department of Natural Resources	Recreational Trails Program	Municipal governments, state and federal agencies, and incorporated organizations	1. Maintenance and restoration of existing trails 2. Development or rehabilitation of trailside and trailhead facilities 3. Construction of new trails 4. Land acquisition for trails	State grant covers up to 50 percent of eligible project costs	dnr.wisconsin.gov/aid/RTP.html Bobbi Winebar Wisconsin Department of Natural Resources 2984 Shawano Avenue Green Bay, WI 54313 (920) 461-2595
54	Wisconsin Department of Natural Resources	Surface Water Grants Program	Counties, municipalities, other local unites of government, lake districts, natural resource agencies, tribal governing agencies, higher educational institutions, town sanitary districts, and eligible organizations	1. Surface water education, planning, and restoration 2. Comprehensive Lake and watershed management planning 3. Aquatic invasive species prevention and control 4. Land acquisition	Planning grants may be awarded for up to 67 percent of total project costs, management grants cost-share of up to 75 percent, wetland restoration up to 100 percent cost share	dnr.wisconsin.gov/aid/SurfaceWater.html Grant Program Manager: Laura MacFarland (715) 499-0309 Regional Lake, Streams, or AIS Biologist: Chrissy Kozik (414) 897-5776 Christine.Kozik@wisconsin.gov
55	Wisconsin Department of Natural Resources	Targeted Runoff Management Grant Program	Cities, villages, towns, counties, regional planning commissions, tribal governments and special purpose lake, sewerage and sanitary districts	1. Construction of structural BMPs 2. Implementation of nonstructural cropping practices 3. Implementation of State agricultural performance standards	State grant covers up to 70 percent of eligible costs. Funding is limited to $600,000 for large-scale projects and $225,000 for small-scale projects	dnr.wisconsin.gov/aid/TargetedRunoff.html Nonpoint Source Program Grant Manager: Corinne Johnson (608) 267-9385 Regional Nonpoint Source Coordinator: Jesse Bennett (414) 458.0448 Jessiah.Bennett@wisconsin.gov
56	Wisconsin Department of Natural Resources	Urban Nonpoint Source and Storm Water Management Grant Program	Cities, villages, towns, counties, regional planning commissions, tribal governments, and lake, sewage or sanitary districts	1. Stormwater Planning 2. Education and Information activities 3. Ordinance development and enforcement 4. Training 5. Construction of structural stormwater BMPs 6. Storm sewer rerouting and removal 7. Streambank stabilization	Planning grants – cost share up to 70 percent and reimbursement amount cannot exceed $85,000 Construction grants – cost share up to 50 percent and reimbursement amount cannot exceed $150,000	dnr.wisconsin.gov/aid/UrbanRunoff.html Nonpoint Source Program Grant Manager: Corinne Johnson (608) 267-9385
57	Wisconsin Department of Natural Resources	Wisconsin Forest Landowner Grant Program	Private non-industrial forest landowners	1. Stewardship plan preparation 2. Tree planting 3. Forest health improvement 4. Soil and water protection and improvement 5. Wetland and riparian protection 6. Wildlife habitat enhancement 7. Threatened and endangered resource maintenance and enhancement	Reimburses up to 50 percent of cost of eligible practices	dnr.wisconsin.gov/aid/ForestLandowner.html Program Manager: Kristin Lambert (608) 212-0320
58	Wisconsin Department of Natural Resources	Wisconsin Wetland Conservation Trust	Wetland impacts requiring mitigation within the same watershed as the impact	Wetland restoration projects that align with other federal funding opportunities (i.e., USFWS Partners for Fish and Wildlife Habitat, Fish Passage Program, or Fish Habitat Partnership)	Sale of wetland credits	dnr.wisconsin.gov/topic/Wetlands/wwct James Brodzeller (608) 574-0573 James.brodzeller@wisconsin.gov
59	Wisconsin Department of Safety and Professional Services	Wisconsin Fund–Private Onsite Wastewater Treatment System Replacement or Rehabilitation Financial Assistance Program	Owners of principal residences and small businesses who meet income limits	Replacement or rehabilitation of failing onsite wastewater treatment systems that were built before July 1, 1978	Maximum grant award of $7,000	dsps.wi.gov/Pages/Programs/WisconsinFund/Default.aspx DSPS Division of Industry Services: Tanya Herranz Tanya.Herranz@wi.gov (608) 266-6796

[a] *FEMA announced the ending of the BRIC program in April 2025.*

Source: SEWRPC

- Land Acquisition (nested under the previous item)

  - **Land Acquisition** – Provides funding to permanently acquire land to protect surface waters. Eligible costs include costs associated with appraisal, land survey fees, title costs, and any historical, cultural, or environmental assessments. Cost-share is up to 75 percent of eligible costs for up to $200,000 for lakes and $50,000 for rivers.

- **Targeted Runoff Management (TRM) Grant Program** – WDNR program that offers competitive grants for local governments for controlling nonpoint source pollution. Grants reimburse costs for agricultural or urban runoff management practices in critical areas with surface water or groundwater quality concerns. The cost-share rate for TRM projects is up to 70 percent of eligible costs.[119]

- **Soil and Water Resources Management Grant Program** - DATCP program that provides funds to Counties allowing them to enter cost-share contracts with landowners implementing eligible conservation practices. The cost-share rate depends on the conservation practice being implemented but can be up to 70 percent for practices associated with NR 151 performance standards and up to 90 percent if the landowner qualifies for economic hardship. Practices required as part of a CAFO or other WPDES permit are ineligible for cost-sharing.[120]

- **Farmland Preservation Program** – DATCP program that provides a tax credit per acre to eligible farmlands complying with NR 151 agricultural performance standards. Tax credits can vary from $5.00 to $10.00 per acre, depending on the zoning status of the farmland.[121] As discussed in Section 3.4, "Pollutant and Sediment Sources and Loads," cultivated lands within the Upper Turtle Creek watershed are zoned for farmland preservation and thus eligible farms can receive a $7.50 per acre tax credit if in compliance with NR 151.

- **Notice of Intent/Discharge Grant Program** – Joint WDNR and DATCP program that provides funds to local governmental units working with livestock operation owners and/or operators that have received a Notice of Discharge or Notice of Intent to Issue a Notice of Discharge from WDNR. Eligible BMPs include those designed to improve water quality affected by livestock pollutant discharge. The cost-share rate for these projects is up to 70 percent of eligible costs.[122]

Federal

- **Environmental Quality Incentives Program (EQIP)** – USDA NRCS program that provides financial and technical assistance to implement conservation practices addressing natural resource concerns.[123] Farmers receive flat rate payments for installing and implementing runoff management practices. The following agricultural practices are eligible for cost sharing:

  - Cover crop
  - Critical Area Planting
  - Diversion
  - Fence
  - Field Border
  - Filter Strip
  - Forage and Biomass Planting
  - Grade Stabilization Structure
  - Grassed Waterway
  - Heavy Use Area Protection
  - Lined Waterway or Outlet
  - Livestock Pipeline
  - Mulching
  - Obstruction Removal
  - Prescribed Grazing
  - Streambank and Shoreline Protection
  - Strip Cropping
  - Surface for Water Control
  - Subsurface Drain
  - Terrace
  - Trails and Walkways
  - Tree/Shrub Establishment
  - Tree/Shrub Site Preparation
  - Underground Outlet
  - Vegetated Treatment Area
  - Water and Sediment Control Basin
  - Water Well
  - Watering Facility
  - Wetland Restoration

[119] *For more information on TRM, see www.dnr.wisconsin.gov/aid/TargetedRunoff.html.*

[120] *For more information, see www.datcp.wi.gov/Pages/Programs_Services/SWRMGrantResources.aspx.*

[121] *For more information, see www.datcp.wi.gov/Pages/Programs_Services/FarmlandPreservation.aspx.*

[122] *For more information, see www.dnr.wisconsin.gov/aid/NOD.html.*

[123] *For more information on EQIP, see www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip.*

- **Conservation Reserve Program (CRP)** – A land conservation program administered by the USDA Farm Service Agency. Farmers enrolled in the program receive a yearly rental payment for environmentally sensitive land that they agree to remove from production. Contracts are 10 to 15 years in length. Eligible practices include buffers for wildlife habitat, wetland buffers, riparian buffers, wetland restoration, filter strips, grass waterways, shelter belts, living snow fences, contour grass strips, woodland establishment, and shallow water areas for wildlife.[124]

- **Conservation Reserve Enhancement Program (CREP)** – Joint effort between County, State, and the Federal government providing funds for practice installation, rental payments, and an installation incentive. Administered by the Farm Service Agency. Interested parties can enter a 15-year contract or perpetual contract conservation easement. Eligible practices include filter strips, buffer strips, wetland restoration, tall grass prairie and oak savanna restoration, grassed waterway, and permanent native grasses.[125]

- **Agricultural Conservation Easement Program (ACEP)** – USDA NRCS program that consolidates three former programs (Wetlands Reserve Program, Grassland Reserve Program, and Farm and Ranchlands Protection Program). Under this program, NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land.[126]

- **Conservation Stewardship Program (CSP)** – USDA NRCS program that offers funding for participants that take additional steps to improve resource condition. The program provides two types of funding through five-year contracts: 1) annual payments for installing new practices and maintaining existing practices and 2) supplemental payments for adopting a resource-conserving crop rotation.[127]

- **Farmable Wetlands Program (FWP)** – USDA Farm Service Agency program designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. The Farm Service Agency runs the program through the Conservation Reserve Program with assistance from other government agencies and local conservation groups.[128]

- **Aquatic Ecosystem Restoration Program (AERP)** – United States Army Corps of Engineers (USACE) program to plan, design, and implement aquatic ecosystem restoration projects located in the public interest and that have a non-federal public agency sponsor willing to maintain and rehabilitate the project site.[129]

- **Partners for Fish and Wildlife Program** – United Stated Fish & Wildlife Service program providing technical assistance and cost-share funding to incentivize fish and wildlife habitat restoration on privately owned lands.[130]

- **Hazard Mitigation Assistance** - Federal program administered by FEMA to provide funding for eligible mitigation planning and projects that reduce disaster losses and protect life and property from future disaster damages. The three programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Building Resilient Infrastructure

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[124] *For more information on CRP, see www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program.*

[125] *For more information on CREP, see www.datcp.wi.gov/Pages/Programs_Services/CREPLandowners.aspx.*

[126] *For more information on ACEP, see www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep.*

[127] *For more information on CSP, see www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp.*

[128] *For more information on FWP, see www.fsa.usda.gov/programs-and-services/conservation-programs/farmable-wetlands/index.*

[129] *For more information on AERP, see www.sas.usace.army.mil/Missions/CAP/Section-206-Aquatic-Ecosystem-Restoration.*

[130] *For more information on the Partners for Fish and Wildlife Program, see www.fws.gov/midwest/partners/getinvolved.html#a.*

and Communities Program (BRIC).[131] Since Walworth County has an approved hazard mitigation plan, eligible local units of government within the Turtle Creek watershed may be able to obtain access to funding through these programs.[132]

Non-Governmental Organizations

- **Glacierland RC&D** – Non-profit organization that promotes sustainable agriculture by hosting education events like pasture walks, farmer-led discussions, and workshops, as well as assisting producers with technical advice like developing grazing plans and on-farm consultations.[133]

- **Kettle Moraine Land Trust** – Non-profit land trust based in East Troy, Wisconsin that works to preserve high-quality natural habitats through land acquisition, conservation easements, and partnerships with Walworth County and WDNR.

- **Producer-led Groups** – Producers who join WATERS or another DATCP-funded producer led group may be eligible for cost-sharing of agricultural BMPs. Additionally, these groups can be an excellent technical and social resource, especially to producers who are interested in learning more about or testing these practices for the first time.[134]

- **Rock River Coalition** – Non-profit organization that works to enhance the environmental, recreational, cultural, and economic resources of the Rock River Basin. This organization works on water quality monitoring, invasive species prevention, education, and stream restoration projects through the Basin.[135]

- **Wisconsin Waterfowl Association** – Non-profit organization focused on conserving and restoring wetland and waterfowl habitat in Wisconsin. Among other activities, the Wisconsin Waterfowl Association provides technical expertise on project design and grant funding opportunities as well as a potential funding match to other funding sources.[136]

3.7 SUMMARY

A draft of this nine key element plan for the Upper Turtle Creek watershed was reviewed and approved by both the LCPRD and WDNR staff (see Appendix B). In their review, WDNR staff found that this plan met the elements of a 9KE plan as detailed by the Environmental Protection Agency.[137] Consequently, recommended projects in this plan should be eligible for financial support through Clean Water Act Section 319 funding. This plan would not have been possible without assistance from the LCPRD, WDNR, Walworth County, and tireless support from local volunteers. Commission staff encourage stakeholders within the watershed to utilize this plan to acquire funding and implement projects and practices that will help improve water quality conditions within the upper Turtle Creek watershed.

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[131] *HMGP funding is generally 15 percent of the total amount of Federal assistance provided to a State, Territory, or federally-recognized tribe following a major disaster declaration. FMA funding depend on the amount congress appropriates each year for those programs. Individual homeowners and business owners may not apply directly to FEMA. Eligible local governments may apply on their behalf. See website for more information at www.fema.gov/hazard-mitigation-assistance#. FEMA announced the ending of the BRIC program in April 2025*

[132] *Walworth County Emergency Management, Natural Hazards Mitigation Plan: 2014-2018 Walworth County, Wisconsin*, Prepared by Civi Tek Consulting, LLC*, April 2015*.

[133] *For more information on Glacierland RC&D, see www.glacierlandrcd.org.*

[134] *For more information on WATERS, see www.facebook.com/people/Watershed-Protection-Group-of-Walworth-County/61574947742360. or datcp.wi.gov/Pages/Programs_Services/ProducerLedProjectSummaries.aspx#walworth.*

[135] *See the Rock River Coalition website at the following link: rockrivercoalition.org.*

[136] *For more information on the Wisconsin Waterfowl Association, see www.wisducks.org.*

[137] *dnr.wisconsin.gov/topic/Nonpoint/9keyElement.*

APPENDICES

APPENDIX A

STEPL POLLUTANT LOADING RESULTS WITH RECOMMENDED PRACTICES

Commission staff modeled pollutant loading and load reductions from current conditions using the United States Environmental Protect Agency Spreadsheet Tool for Estimating Pollutant Load (STEPL) model.[138] STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). The land uses considered are urban land, cropland, pastureland, feedlot, forest, and a user-defined type. The pollutant sources include major nonpoint sources such as cropland, pastureland, farm animals, feedlots, urban runoff, and failing septic systems. The types of animals considered in the calculation are beef cattle, dairy cattle, swine, horses, sheep, chickens, turkeys, and ducks. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

The input data include state name, county name, weather station, land use areas, agricultural animal numbers, manure application months, population using septic tanks, septic tank failure rate, direct wastewater discharges, irrigation amount/frequency, and BMPs for simulated watersheds. When local data are available, users may choose to modify the default values for USLE parameters, soil hydrologic group, nutrient concentrations in soil and runoff, runoff curve numbers, and detailed urban land use distribution. Pollutant loads and load reductions are automatically calculated for total nitrogen, total phosphorus, BOD5, and sediment. The following appendix provides information regarding the model simulation used for this planning effort. Model results may be provided upon request.

[138] *For more information on STEPL, see www.epa.gov/nps/spreadsheet-tool-estimating-pollutant-loads-stepl.*

STEPL Data Inputs
State: Wisconsin
County: Walworth
Weather Station: Walworth Mean

Land Use

Export input/output data: Export Data

☑ Treat all the subwatersheds as parts of a single watershed ☐ Groundwater load calculation

State: Wisconsin | County: Walworth | Weather Station: _WI-Walworth_Mean

Calculate Manure Application Months: Manure Application

1. Input watershed land use area (ac) and precipitation (in)

Rain correction factors: 0.867, 0.432

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event	2010 land use
W1	229.4	329.4	36.0	147.2	117.3	0	0-24%	859.215964	34	111	0.607	Turtle Lake Subbasin
W2	154.6	2921.6	142.8	175.5	766.1	0.4	0-24%	4160.96665	34	111	0.607	Turtle Valley Headwaters
W3	68.1	1732.9	42.8	291.3	354.6	0.6	0-24%	2490.37022	34	111	0.607	Northern Turtle Creek
W4	108.0	1198.4	92.7	77.0	198.0	0	0-24%	1674.01643	34	111	0.607	CTH P Trib Subbasin
W5	156.7	2616.0	197.9	486.5	993.6	1	0-24%	4451.82662	34	111	0.607	Middle Turtle Creek
W6	425.9	4022.2	107.3	107.0	231.5	0.4	0-24%	4894.10244	34	111	0.607	CTH O Trib Subbasin
W7	73.6	929.3	40.9	57.2	292.1	0.4	0-24%	1393.53341	34	111	0.607	Southern Turtle Creek
W8	400.8	232.6	56.5	51.3	103.7	0	0-24%	844.845462	34	111	0.607	Lake Comus Subbasin

Agricultural Animals

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland	2010 land use
W1	0	0	0	5	5	0	0	0	0	0	Turtle Lake Subbasin
W2	0	600	0	25	15	0	10	0	6	6	Turtle Valley Headwaters
W3	0	300	0	25	20	0	10	0	6	6	Northern Turtle Creek
W4	0	0	0	15	25	0	0	15	0	0	CTH P Trib Subbasin
W5	500	500	0	100	25	16	10	0	6	6	Middle Turtle Creek
W6	0	1500	0	60	25	0	5	0	6	6	CTH O Trib Subbasin
W7	0	200	0	20	3	0	0	0	0	0	Southern Turtle Creek
W8	0	0	0	0	0	0	0	0	0	0	Lake Comus Subbasin
Total	500	3100	0	250	118	16	35	15			

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family	Urban-Cultivat	Vacant	Open Space	Total % Area
W1	229.441097	15	10	10	10	10	30	5	5	5	100
W2	154.606078	15	10	10	10	10	30	5	5	5	100
W3	68.0909003	15	10	10	10	10	30	5	5	5	100
W4	107.963229	15	10	10	10	10	30	5	5	5	100
W5	156.733616	15	10	10	10	10	30	5	5	5	100
W6	425.862503	15	10	10	10	10	30	5	5	5	100
W7	73.6425206	15	10	10	10	10	30	5	5	5	100
W8	400.756534	15	10	10	10	10	30	5	5	5	100

Septic Systems

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	65	2.43	2	0	0
W2	45	2.43	2	0	0
W3	30	2.43	2	0	0
W4	63	2.43	2	0	0
W5	90	2.43	2	0	0
W6	186	2.43	2	0	0
W7	42	2.43	2	0	0
W8	57	2.43	2	0	0

Soil Conditions

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland				
	R	K	LS	C	P	R	K	LS	C	P
W1	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W2	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W3	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W4	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W5	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W6	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W7	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000
W8	140.000	0.329	0.528	0.180	0.991	140.000	0.320	1.240	0.000	1.000

Watershed	Forest					User Defined				
	R	K	LS	C	P	R	K	LS	C	P
W1	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W2	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W3	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W4	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W5	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W6	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W7	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000
W8	140.000	0.320	0.517	0.003	1.000	140.000	0.329	0.517	0.003	1.000

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc.
W1	○	◉	○	○	B	0.080	0.055	0.160	0.000
W2	○	◉	○	○	B	0.080	0.055	0.160	0.000
W3	○	◉	○	○	B	0.080	0.055	0.160	0.000
W4	○	◉	○	○	B	0.080	0.055	0.160	0.000
W5	○	◉	○	○	B	0.080	0.055	0.160	0.000
W6	○	◉	○	○	B	0.080	0.055	0.160	0.000
W7	○	◉	○	○	B	0.080	0.055	0.160	0.000
W8	○	◉	○	○	B	0.080	0.055	0.160	0.000

Runoff Curves and Nutrient Concentrations

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

7. Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L-Croplan	**1.9**	**0.3**	**4**	0
1a. w/ manure	8.1	2	12.3	0
2. M-Croplan	**2.9**	**0.4**	**6.1**	0
2a. w/ manure	12.2	3	18.5	0
3. H-Croplan	**4.4**	**0.5**	**9.2**	0
3a. w/ manure	18.3	4	24.6	0
4. Pastureland (see Table 10 for default values with manure)				
5. Forest	**0.2**	**0.1**	**0.5**	0
6. User Defin	**0.2**	**0.1**	**0.5**	0

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportatior	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultiva	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7a. Nutrient concentration in shallow groundwater (mg/l) and E. coli (MPN/100ml)(may be modified)

Landuse	N	P	BOD	E. coli
Urban	1.5	0.063	0	0
Cropland	1.44	0.063	0	0
Pastureland	1.44	0.063	0	0
Forest	0.11	0.009	0	0
Feedlot	6	0.07	0	0
User-Defined	0	0	0	0

9. Input irrigation area (ac) and irrigation amount (in)					
Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	329.381666	0	0	0	0
W2	2921.60152	0	0	0	0
W3	1732.94859	0	0	0	0
W4	1198.38018	0	0	0	0
W5	2616.0444	0	0	0	0
W6	4022.1592	0	0	0	0
W7	929.316089	0	0	0	0
W8	232.591489	0	0	0	0

10. Pastureland Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)				
Land use	N	P	BOD	E. coli
1. L-Pasture	**4**	**0.3**	**13**	0
1a. w/ manure	4	0.3	13	0
2. M-Pasture	**4**	**0.3**	**13**	0
2a. w/ manure	4	0.3	13	0
3. H-Pasture	**4**	**0.3**	**13**	0
3a. w/ manure	4	0.3	13	0

Input Ends Here.

Pollutant Loads

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	E. coli Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	E. coli Reduction
	lb/year	lb/year	lb/year	t/year	Billion MPN/	lb/year	lb/year	lb/year	t/year	Billion MPN/
W1	2560.2	741.3	7287.1	217.5	0.0	479.7	240.8	804.5	79.5	0.0
W2	25391.1	8217.4	45382.0	1724.1	0.0	7932.9	4498.7	4956.2	743.2	0.0
W3	16204.6	5127.2	27943.4	1021.0	0.0	4149.7	2403.6	2540.4	383.2	0.0
W4	5755.5	2091.6	13127.0	710.7	0.0	1840.1	943.6	2074.4	302.4	0.0
W5	25601.3	7941.3	45280.0	1551.9	0.0	7117.7	4431.4	4694.0	701.9	0.0
W6	34947.6	11258.4	64289.0	2386.1	0.0	11132.4	6255.4	7378.7	1067.1	0.0
W7	5855.7	1922.7	11755.8	551.4	0.0	1157.4	859.4	1390.0	202.3	0.0
W8	2968.0	694.6	9522.7	177.6	0.0	394.4	181.5	891.0	58.4	0.0
Total	119284.0	37994.5	224587.1	8340.3	0.0	34204.3	19814.2	24729.1	3538.1	0.0

Watershed	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	E. coli Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction	%E. coli Reduction
	lb/year	lb/year	lb/year	t/year	Billion MPN/	%	%	%	%	%
W1	2080.5	500.5	6482.7	138.0	0.0	18.7	32.5	11.0	36.5	0.0
W2	17458.2	3718.8	40425.8	980.9	0.0	31.2	54.7	10.9	43.1	0.0
W3	12054.9	2723.6	25403.0	637.8	0.0	25.6	46.9	9.1	37.5	0.0
W4	3915.4	1148.0	11052.6	408.3	0.0	32.0	45.1	15.8	42.5	0.0
W5	18483.6	3509.9	40586.0	849.9	0.0	27.8	55.8	10.4	45.2	0.0
W6	23815.2	5003.1	56910.3	1319.1	0.0	31.9	55.6	11.5	44.7	0.0
W7	4698.3	1063.3	10365.9	349.0	0.0	19.8	44.7	11.8	36.7	0.0
W8	2573.6	513.2	8631.7	119.2	0.0	13.3	26.1	9.4	32.9	0.0
Total	85079.7	18180.3	199858.0	4802.2	0.0	28.7	52.2	11.0	42.4	0.0

2. Total load by land uses (with BMP)					
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	E. coli Load (Billion
Urban	6788.81	1025.14	25164.44	149.16	0.00
Cropland	64298.26	16054.09	149869.26	4610.82	0.00
Pastureland	2256.32	169.22	7333.03	0.00	0.00
Forest	195.24	105.40	467.34	12.97	0.00
Feedlots	10586.47	370.53	14115.29	0.00	0.00
User Defined	595.18	315.16	1441.10	29.28	0.00
Septic	359.38	140.76	1467.47	0.00	0.00
Gully	0.00	0.00	0.00	0.00	0.00
Streambank	0.02	0.01	0.03	0.01	0.00
Groundwater	0.00	0.00	0.00	0.00	0.00
Total	85079.67	18180.31	199857.97	4802.24	0.00

APPENDIX B

WDNR REVIEW COMMENTS

Review Comments for Watershed Plan and EPA 9 Key Elements – section 319 funds

Plan Name: A NINE KEY ELEMENT PLAN FOR UPPER TURTLE CREEK - Walworth County, WI
Plan Date: February 2025
Watershed HUC - 070900021403

Background: Upper Turtle Creek is a 21,000 acre (HUC 12) sized watershed located within Walworth County and the Rock River basin – which has an approved TMDL for total phosphorus and sediment (Rock River TMDL 2011 report). Lake Comus is located at the outlet of the watershed and is highly eutrophic with low water clarity, algal blooms, and a depauperate aquatic plant community. Turtle Creek exceeds state standards for total phosphorus and is frequently highly turbid with a substantial buildup of flocculent sediment along the bottom. Lake Comus and Turtle creek were both listed as impaired from non-point source total phosphorus on the WDNR's 2022 303(d) list. Excessive soil runoff and nutrient loading, primarily from agricultural nonpoint sources, within the lake's watershed contribute to the ongoing water quality problems in the Lake and Turtle Creek.

The Lake Comus Protection and Rehabilitation District(LCPRD) manages Lake Comus and has been studying issues affecting the lake, Turtle Creek, and the Upper Turtle Creek watershed. The LCPRD requested assistance of the SE Wisconsin Regional Planning Commission and Walworth County Land Conservation Department staff to prepare this watershed based plan in order to improve water quality and aquatic life conditions within Turtle Creek and Lake Comus. This plan builds upon and supplements the 2019 Lake Management Plan for Comus lake (CAPR 341), reflects the Rock River 2011 TMDL report findings and reduction goals (for reach 80), and aligns with Walworth County's 2020 Land and Water Resource Management Plan.

1. **Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve the load reductions in this plan (and any other goals identified in the watershed based plan).** Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including rough estimate of number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control).

   ☒Plan meets this requirement:
   Sections 1.2, 1.3, 2.1, 2.2 and 2.3 of plan reflect element 1 criteria. Agriculture is the predominant land use (66% of total acres) and is identified as the primary source of nutrient and sediment pollution in the watershed; residential and transportation land uses, located in the north or south ends of the watershed, are also identified as significant pollutant sources.

   The plan cites and reflects the 2012 Rock River TMDL Report findings and load reduction goals for reach 80 (i.e., 49% total phosphorus and 25% sediment reduction for non-point sources) which includes Lake Comus and the upper Turtle Creek watershed. The plan also documents how much of Turtle Creek and its tributaries have been highly modified and channelized to largely to improve drainage for agricultural production, which also o contributes to water quality problems in the creek and the lake. Last, recent WQ monitoring within the watershed, including a Targeted Watershed Assessment in 2017 by the WDNR, confirm subbasins with predominant ag land use have higher phosphorus and sediment concentrations in the watershed than areas with lower ag land use.

Causes and sources of agricultural pollution in the watershed plan are identified using significant subcategory levels: acres of cropland following cash grain, sod, dairy, plant nursery or other agricultural crop rotations/operation types, number/extent of animal feeding operations (dairy, beef, horse, hogs), cropland acres with NM plans, cropland acres using reduced or no till tillage, locations/acres with hydrologic modifications (i.e., tiles draining agricultural fields, infilled culverts impeding water flow downstream, and pumping operations that may alter the flow direction of the water by withdrawing water to provide irrigation to agricultural fields). WQ monitoring results in plan describe some drain tile monitoring results that confirm drain tiles are contributing water exceeding total phosphorus standards and thus further study into their total phosphorus loading to Turtle Creek and its tributaries is warranted.

☐Plan does not meet this requirement. The following information is required:

2. **An estimate of load reductions expected for the recommended management measures described in item 3 (below)**. Estimates should be provided at the same level as in item 1 above (e.g., total load reduction expected for dairy cattle feedlots or acres of row crops under improved nutrient management or sediment control).

   ☒ Plan meets this requirement:

   Sections 2.3 of plan reflects element 2 criteria. The STEPL model was used to estimate pollutant loads and load reductions for the watershed. DNR staff consulted with SEWRPC staff extensively during review of this plan to help revise STEPL modeling inputs and outputs to reflect past and current watershed conditions. Three STEPL pollutant load reduction estimates are shown in the plan:
   - 2011 - baseline – extent of BMPs adopted in watershed when Rock River TMDL was approved in 2012
   - 2022 - interim - BMP adoption in watershed from 2011-2022 period
   - 2032 - future – Additional BMPs to meet or exceed Rock River TMDL 49% TP and 25% TSS reduction goals)

   The 2011 estimate reveals the CTH O Tributary, Middle Turtle Creek and Turtle Valley Headwaters sub-basins had higher pollutant loading than the other sub-basins in the watershed. The 2022 estimate confirms significant adoption of practices and load reductions occurred in the watershed between 2011 and 2022; reductions were accomplished via adoption of NM plans, cover crops, reduced tillage, barnyard practices and grassed waterways (to reduce gully erosion). These adopted practices helped make solid interim progress towards meeting the Rock River TMDL TP and TSS reduction goals for Reach 80. The 2032 future load reduction estimate either meets or exceeds Rock River TMDL Reach 80 TP (49%) and TSS (25%) reduction goals for the watershed. The 2032 estimate focuses upon implementation of additional cropland (NM plan, no till tillage, cover crops), structural (barnyard runoff controls and grassed waterways) and other BMPs (land retirement) in the watershed to meet TMDL reduction goals.

   ☐ Plan does not meet this requirement. The following information is required

3. **Description of the NPS management measures that will need to be implemented to achieve load reductions in item 2, and identification (using a map or description) of the critical areas in which those measures will be needed** to implement the plan.

☒ Plan meets this requirement:

The following plan information meets element 3 criteria:

- Section 2.3 - describes the extent and types of current practices adopted in the watershed (as of 2022), results from a 2023 survey of watershed conditions and describes the CTH O Tributary, Middle Turtle Creek and Turtle Valley Headwaters sub-basins have higher pollutant loading, derived from STEPL model, than the other sub-basins in the watershed.
- Section 3.2 - (Pages 93-117 – Agriculture;117-119 Urban), Table 3 and Map 3 – Parcel Prioritization, Additional Ag BMPs and Hydro Restorations – describe critical areas in the watershed for focusing practices to meet, or exceed the Rock River TMDL TP and TSS load reduction goals described in plan.
- Map 2 Riparian Buffers and Map2 Phosphorus - identify critical areas in watershed for focusing BMPs.
- Table 3.Implementation Milestones

The plan also describes existing water quality monitoring results for the watershed and has milestone to complete additional monitoring during the plan's ten year schedule. Using existing/future WQ data with other plan information (i.e., inventory maps of ag lands, animal feeding operations, etc) can help further identify additional critical areas in the watershed for practices.

☐ Plan does not meet this requirement. The following information is required:

4. **Estimate of the amounts of technical and financial assistance needed, costs, and/or the sources and authorities that will be relied upon to implement this plan.**

☒ Plan meets this requirement:
Sections 3.5, 3.6 and Table3 (Mgmt Measures, I and E, WQ costs, Tech costs, Funding Programs) in the plan are consistent with element 4 cost and tech assistance criteria. Section 3.2 (pages 97-115) reference the authority granted under NR 151 Agricultural and Non-agricultural performance standards, NR 115 and the Farmland Preservation Tax Credit program will be relied upon to help implement the plans reduction goals. Last, the plan describes the how the Lake Comus Protection District, City of Delavan, Town of Delavan, and other municipalities also have capacity to encourage, educate and incentivize the adoption of these agricultural and other watershed BMPs that reduce nonpoint source loading within the watershed, via the Surface Water Restoration and Management Plan Implementation subprograms of the WDNR Surface Water Grant program.

☐ Plan does not meet this requirement. The following information is required:

5. **An information/education component used to enhance public understanding of the project and early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.**

☒ Plan meets this requirement:
Section 3.6 (Communication, Information and Education, and Outreach - pages 123-126) and Table 3 – Information and Education in plan is consistent with element 5 criteria.

☐ Plan does not meet this requirement. The following information is required:

6. **A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.**

☒ Plan meets this requirement:
Section 3.3 Implementation Schedule and Milestones, Section 3.5 Cost Analysis, Table 3. Implementation Milestones and Table 3.I&E confirm the plan has a ten-year implementation schedule. This information reflects element 6 criteria.

With that said, the plan also describes a longer schedule than ten years may be necessary for the following reasons:

- long-time scales needed for reductions in pollutant loads to be measurable in a complex natural system
- funding availability/limitations
- limited landowner cooperation to install BMPs or agree to acquisition or easements of private land
- delaying projects in order to achieve cost savings by implementing a project in concert with, or as part of other, unrelated project(s).
- restoring Wetlands and Stream/Floodplain functions to the extent described in plan may take up to 30 years to fully implement.

Last, the plan describes plan adjustments should be based on measured progress towards plan interim milestones and also after any additional new water quality monitoring data, management tools, and/or BMPs are implemented or obtained over time.

☐ Plan does not meet this requirement. The following information is required:

7. **A description of interim, measurable milestones for determining whether the NPS management measures or other control actions are being implemented.**

☒ Plan meets this requirement:

Section 3.3, Implementation Schedule and Milestones, Section 3.4, Table 3. Implementation Milestones and Table 3.I&E are consistent with element 7 criteria.

Interim milestones for most practices in plan reflect 3, 7 and 10 year intervals. However, the plan describes restoring Wetlands and Stream/Floodplain functions in watershed may take up to 30 years to fully implement. Chapter 3, pages 91-92 describes 7 Management Objectives for Water Quality. The interim milestones in plan reflects/is consistent with the plan's management objectives.

The plan recognizes:

- Interim milestones provide standards to measure progress and plan implementation over time and also to identify minimum progress;
- If minimum progress is not being made, the plan will need to be reevaluated and revised with new interim milestones;

- Monitoring of plan progress will be an essential component of achieving the desired water quality goals. Plan progress and success will be measured by water quality improvement, progress in implementing best management practices and other recommended actions, and by participation rates in public awareness and education efforts.
- Due to the uncertainty of any modeling effort and the efficiencies of the best management practices, an adaptive management approach should be taken with during plan implementation.
- The effectiveness of the plan should be evaluated annually and every five years coincident with the Walworth County LWRMP update. If progress is not made, the plan should be reevaluated. Adjustments should be made to the plan based on plan progress and any additional new data, management tools, and/or BMPs.
- Adjustments to the plan should be based on measured progress towards meeting plan interim milestones and also after any additional new water quality monitoring data, management tools, and/or BMPs are implemented or obtained over time.

☐ Plan does not meet this requirement. The following information is required:

8. A set of criteria that can be used to determine whether load reductions are being achieved over time and substantial progress is being made toward attaining WQ standards and, if not, the criteria for determining whether the plan needs to be revised, or if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

☒ Plan meets this requirement:

Collectively, sections 3.3 and 3.4, Table 3. Implementation Milestones and Table 3.I&E in plan reflect element 8 criteria.

The plan describes progress and success will be measured by establishing increased water quality monitoring efforts in the watershed (see recommendation 6.1), via measured water quality improvement, progress in implementing best management practices and other recommended actions (described in Table 3. Implementation milestones) and by participation rates in public awareness and education efforts.

The plan calls for evaluating effectiveness annually, using interim milestones, and every five years coincident with the Walworth County LWRMP update. If progress is not made, the plan should be reevaluated. Adjustments should be made to the plan based on plan progress and any additional new data, management tools, and/or BMPs.

The plan recognizes: interim milestones will provide standards to measure progress and plan implementation over time and also to identify minimum progress; if minimum progress is not being made, the plan will need to be reevaluated and revised with new interim milestones.

☐ Plan does not meet this requirement. The following information is required:

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against criteria established in item 8 immediately above.

☒ Plan meets this requirement:
Sections. 2.2, 3.4, Table 3. Implementation Milestones, Recommendations 6.1 – 6.9, Table3-WQ costs, increasing WAV monitoring meet element 9 criteria.

The plan describes the watershed has a complete 2016-17 Targeted Watershed Assessment by the WDNR and additional monitoring within the watershed has been completed by the LCPRD staff and volunteers from 2019-2021. The majority of monitoring in this watershed has focused upon measuring temperature, DO, TSS and Phosphorus concentrations within Turtle Creek main stem or tributary streams, primarily during the growing season; limited sampling of agricultural drain tile outlets was also completed. The results confirm total phosphorus concentrations in the watershed's streams consistently exceed the stream and small river TP standard of 0.075mg/l while the concentrations in Lake Comus exceed the impoundment TP standard of 0.040 mg/l. Accordingly, Turtle Creek, the CTH O tributary, and Lake Comus were included on the 2024 impaired on the 303(d) list with total phosphorus from non-point sources as the contributing pollutant.

This existing WQ monitoring information for the watershed can be used to help assess effectiveness of plan implementation efforts/milestones, over the plan's ten year schedule (per element 8). The plan recognizes that Continued summer monthly water quality monitoring at selected stations in the watershed (and lake Comus) is necessary to monitor progress towards meeting TMDL goals. Chapter 3 of plan provides recommendations regarding continuing and expanding water quality monitoring efforts within the Upper Turtle Creek watershed.

Last, the plan also identifies how peaks in total phosphorus concentrations (at the Dam Road and CTH O tributary sites) are associated with periods of elevated rainfall, indicating that Turtle Creek becomes a more significant source of phosphorus and sediment to Lake Comus during periods of heavy precipitation and runoff. Phosphorus is tightly bound to soil particles, so as the soil is eroded during heavy precipitation events, the Creek becomes turbid and phosphorus transport rates greatly increase. Because total annual precipitation has been increasing over the past century as have the number and intensity of large rainfall events occurring each year, the plan estimates runoff events in the watershed have and will continue to affect phosphorus and sediment loading to Turtle Creek and Lake Comus.

☐ Plan does not meet this requirement. The following information is required: