Delavan Lake Watershed Implementation Plan

Funded and Sponsored By:

Town of Delavan, Walworth County, Wisconsin

Final Report

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Prepared & Submitted By:

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1.0 Introduction and Executive Summary

This document reflects work leading to a Delavan Lake Watershed Implementation Plan, concentrating on urban, residential and upland agricultural practices and structures to address soil losses from agricultural fields, sedimentation and phosphorus deposition to Delavan Lake. In an effort to preserve and protect **Delavan Lake** and its water quality, the **Town of Delavan**, with assistance from Berrini & Associates, LLC and Northwater Consulting, has completed a **Watershed Implementation Plan** that encompasses the entire Delavan Lake Watershed. The purpose of this planning effort was to identify opportunities for implementing Best Management Practices (BMPs) that can reduce soil erosion and nutrient loading to Delavan Lake. This planning effort complements and expands upon previous and ongoing efforts by the Town of Delavan, the Delavan Lake Improvement Association, the Delavan Lake Sanitary District, the U.S. Geological Survey, the Natural Resources Conservation Service (NRCS), Walworth County Dept. of Land Use and Resource Management (LURM), the Kettle Moraine Land Trust (KMLT), and the Southeastern Wisconsin Regional Planning Commission (SEWRPC).

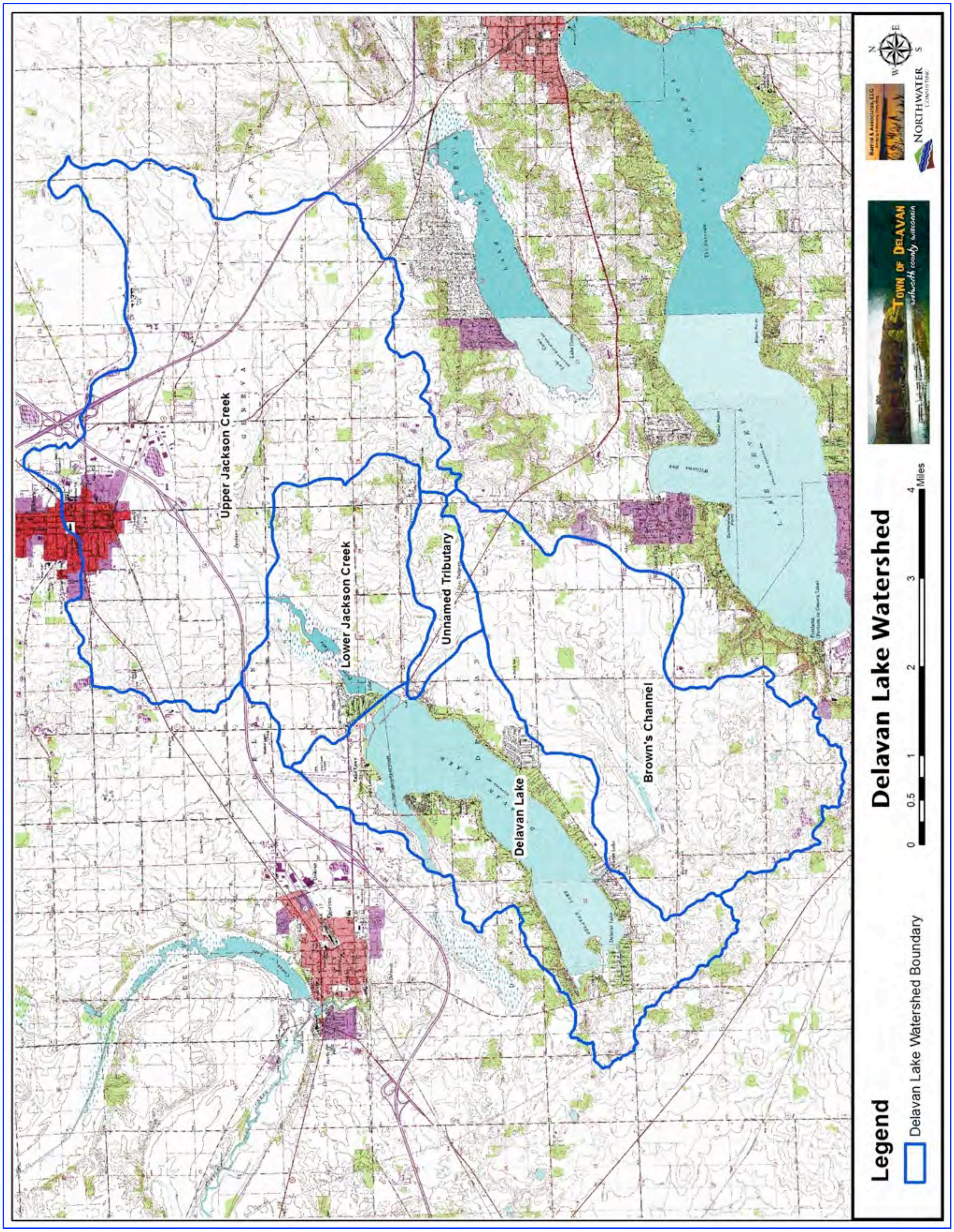
It is the intent of the authors of this plan that the necessary outreach, education and implementation activities are conducted to address concerns related to lake and watershed nutrient loads. The intent is not to delay upland watershed and in-lake implementation work and, therefore, this document will serve as a foundation from which to proceed with protecting Delavan Lake.

Delavan Lake is a 2,072-acre public access drainage lake located within the limits of both the Town and City of Delavan. It is an economically valuable resource that provides numerous recreational opportunities for Delavan and surrounding communities, such as boating, fishing, swimming and scenic enjoyment. The **Delavan Lake Watershed** consists of approximately 26,315 acres of land, primarily drained by **Jackson Creek** and **Brown's Channel,** along with direct surface runoff from adjacent areas surrounding the lake, as shown by the blue watershed boundary lines in Figure 1.

This Watershed Implementation Plan builds upon the *"Lake Management Plan for Delavan Lake"* (SEWRPC, 2002). It summarizes watershed conditions and includes a watershed characterization. This plan outlines watershed impairments, causes and sources, defines critical areas, and identifies specific BMPs and other management measures. It provides estimated pollutant loading quantities and expected load reductions associated with the implementation of recommended management measures. The plan also provides estimates of probable cost, water quality targets, responsible parties, technical and financial assistance opportunities, milestones and schedule, an education and outreach summary and component and, finally, a water quality monitoring strategy.

This Delavan Lake Watershed Implementation Plan is being developed to improve and preserve the water quality of Delavan Lake and its tributaries by reducing soil erosion and controlling nonpoint source (NPS) pollutant loading, while providing water quality protection to Delavan Lake. This long-term Plan includes identifying specific sources of sediment and phosphorus loading, and recommends specific BMPs for future implementation. It is consistent with U.S. Environmental Protection Agency (USEPA) and Wisconsin Department of Natural Resources (WDNR) watershed-based plan guidance, and it addresses the nine key elements of a watershed-based plan.

Figure 1 – Delavan Lake Watershed



Section 2.0 of the report includes a watershed characterization with various components, such as geology and soils, topography and slope, climate, landuse, hydrology, environmental corridors, etc. This characterization of the Delavan Lake Watershed was necessary to provide a baseline understanding of current conditions for further analysis. Section 3.0 includes a detailed analysis of pollutant loading causes and sources. A significant focus of this plan includes identifying causes and sources of sediment and phosphorus loading to the lake, as well as BMP recommendations for future implementation. A detailed review of previous and current planning efforts was completed; a detailed GIS analysis was conducted and a custom landuse layer was developed; a watershed-wide field assessment or windshield survey was completed. All available information was developed into a GIS map-based model or *SWAMM* (Spatial Watershed Assessment & Management Model). Using information on soils, landuse and precipitation, this geospatial model has the ability to identify and quantify sources of pollutant loads at the field or parcel level. Based on model output results, a series of maps were generated that not only identify the sources of sediment and phosphorus loadings, but estimate and display annual loading by landuse and by location. Model results combined with an analysis of available map data indicated that the primary causes and sources of sediment and nutrient loading in the watershed are: 1) Agriculture and Cropped Highly Erodible Soils, 2) Urban Runoff, 3) Septic Systems and 4) a lack of Detention. Section 3.0 identifies and describes the critical areas or locations throughout the watershed where implementation activities should be focused with the intent of achieving the most cost-effective results. Critical areas for the Delavan Lake Watershed include Highly Erodible Land (HEL), urban runoff, septic systems and septic limiting soils, eroding gullies and agricultural tillage practices identified through a field assessment of the watershed. Actions addressing these critical areas will have the greatest value and benefit to the watershed.

Section 4.0 includes discussions on pollutant loading, NPS management measures, BMPs and estimated load reductions. Overall NPS pollutant load estimates in the Delavan Lake Watershed are presented in this section. Estimates are provided for loading resulting from direct runoff, observed conditions, and modeled land use categories. In addition, methodologies for estimating gully and stream bank erosion are presented. Graphical figures and tables that identify and summarize sediment and phosphorus loading by landuse and physical location, and descriptions of the various applicable BMPs and their estimated load reductions, are also provided. In the Delavan Lake Watershed, basin-wide practices include Cover Crops, No-Till Farming, Wetlands, Grassed Waterways, Filter Strips, Detention Basins/Ponds, Rain Gardens, Rain Barrels, Rock Infiltration Basins and Porous Pavement, and can be applied to the majority of urban and agricultural areas within the watershed. BMP quantities, expected load reductions (phosphorus and sediment) and locations are presented in this section. The information is broken out for the Delavan Lake Watershed as a whole. Individual tables in Appendix C provide annual load reductions by Basin-Wide BMP and Figures 23 to 27 show the distribution of each recommended Basin-Wide BMP location within the watershed.

Both a change in tillage to No-Till and the widespread adoption of cover crops will have the greatest benefit on water quality and achieve the highest total load reductions. Installing filter strips and detention ponds upstream of Delavan Lake will also achieve large reductions in phosphorus and sediment. In the urban areas of the watershed, detention basins and bioswales are effective practices and will result in the greatest load reductions, in addition to providing flood reduction benefits. A total of 9,886 acres have been identified and recommended for a gradual future shift to No-Till farming practices. If all recommended acreage implements No-Till practices, annual load reductions of approximately 485 pounds of phosphorus and 2,507 tons of suspended sediment will occur. If 50 percent of the recommended acreage implements No-Till practices, annual load reductions of approximately 242 pounds of phosphorus and 1,254 tons of suspended sediment will occur. This represents per-acre load reductions of approximately 0.05 pounds of phosphorus and 0.25 tons of sediment annually. It should be noted that although No-Till farming with Cover Crops incorporated reduces soil erosion and nutrient loading most effectively, there may be cases where switching to No-Till is not accepted by a particular landowner and the use of minimum or conservation tillage methods should be considered, particularly when maximum crop residue is maintained and applicable BMPs, such as grass waterways and suitable buffers and detention, can be cooperatively implemented. Cover crops can still be implemented effectively in conservation tillage systems with adequate assistance from NRCS, LURM or UW Extension.

Site-specific BMPs are those practices where a field visit, combined with the analysis of specific parcels, has resulted in the identification of a feasible project at a specific location. Each practice presented in this section will need to be approved by the landowner and submitted concurrently with this plan as part of an implementation grant application. Site-specific practices are located throughout the watershed upstream of Delavan Lake and include WASCBs/Sediment Basins, a Terrace, Grassed Waterways, a Pond, Grade Control/Riffles, a Feed Area Waste System, and a Pasture Management System. Load reductions and BMP quantities are included in Table 21 and Figure 28 illustrates their location within the watershed. Once implemented, these practices will reduce pollutant loads delivered to Delavan Lake annually by approximately 616 lbs. for phosphorus and 1,207 tons for sediment. Several high-priority locations have been identified that either include various BMP installations and/or conversion from cropland to developments with detention and buffers. In addition, supplemental nonpoint source management measures have been recommended to assist in achieving and maintaining water quality goals. These management measures include:

1. Conducting landowner outreach, site visits and the identification/treatment of additional gully erosion in locations not visually observed during field reconnaissance efforts.
2. Hiring a Watershed Plan Coordinator part-time to assist with implementation of the plan.
3. Completing selective stream bank stabilization at an eroding meander bend on Jackson Creek.
4. Continuing with implementation of in-lake management measures.
5. Conducting maintenance of existing BMPs and nutrient trapping structures.

The continued need for in-lake management includes measures such as selective maintenance dredging, shoreline and bank stabilization, aquatic plant management, excessive carp removal, etc. More information is required to determine the feasibility of these measures. Recommendations include:

1. Completing maintenance dredging within the upstream end of Brown's Channel beginning approximately 500 feet from East Lake Shore Drive.
2. Completing a post-dredge survey of the North Inlet dredging area completed in 2011 for future planning purposes.
3. Completing a shoreline assessment of the entire perimeter of Delavan Lake to identify any locations that are eroding and could benefit from shoreline protection and stabilization.

4. Continuing with aquatic plant management activities by DLSD that include harvesting rooted aquatic plants and to consider methods of removing excessive filamentous algae and duckweed rather than allowing this growth to die and decompose in the lake. An evaluation and analysis of harvested aquatic plants from a nearby Wisconsin lake indicated that there was approximately 0.15 pounds of phosphorus per harvested cubic yard.
5. Strategically removing carp on an annual basis is highly recommended for Delavan Lake to reduce and manage carp populations, particularly throughout the North Inlet area.
6. Consulting with USGS to complete an updated internal nutrient loading analysis for Delavan Lake and to determine if any remedial measures, such as alum treatments, etc., are warranted.

Based on recent USGS monitoring data obtained at Mound Road and at Highway 50, it is evident that existing BMPs, such as the Mound Road Ponds and adjacent wetlands, the perennially vegetated Delavan North Inlet, and the Brown's Channel system, have functioned effectively at trapping and filtering suspended sediment and phosphorus prior to being delivered to the lake. Therefore, the maintenance of these existing BMPs is highly recommended. The implementation of recommended watershed BMPs, both Specific Locations and Watershed Wide, will be a gradual process and will require an ongoing commitment by the Town and other stakeholders to reach out to urban and agricultural landowners to participate and assist in efforts to protect Delavan Lake. It has been pointed out in this report that significant reductions in nutrient loading to the lake can be achieved by voluntarily implementing a variety of BMPs. The prioritized BMP lists target and prioritize locations where the most significant benefits can be achieved for the amount of dollars expended. Implementation success for recommended watershed BMPs will reduce future loadings and will improve the effectiveness and lifespan of existing BMPS. The immediate and ongoing maintenance of existing BMPs, such as Brown's Channel, the Mound Road Ponds and Jackson Creek Wetland, and the North Inlet can be completed because of land ownership and should be a top priority for immediate implementation. It was pointed out in this report that converting agricultural row cropland into a conservation subdivision development with adequate onsite detention and buffers can provide substantial sediment and nutrient load reductions. These predicted load reductions were specifically noted for the proposed Shores of Delavan Lake subdivision and for the Baker Parcel, and would apply to other similar land use conversions that may arise, provided sufficient detention and conservation buffering is included.

In addition to prioritizing BMPs by the amount of nutrient load reductions expected compared to the total cost expended (as shown in Section 5.1, Estimates of Probable Cost and Recommended Priorities), an additional Tiered system is suggested for prioritizing focused efforts by sub-watershed (Figure 33). This Tiered system is based on modeled loading estimates and proximity to the lake. The close proximity of the Delavan Lake Sub-Watershed delivers a higher per-acre concentration of phosphorus than other areas of the watershed and was given an overall higher priority Tier 1 designation. The Lower Jackson Creek Sub-Watershed is also Tier 1 based on modeled sediment loads, followed by Tier 2 Brown's Channel Sub-Watershed, Tier 3 Unnamed Tributary and Tier 4 Upper Jackson Creek Sub-Watershed. This priority gradation from high to moderate does not diminish the importance of implementing Tier 3 and Tier 4 BMPs, it simply means they are less critical priorities for focused efforts and decision making based on modeled loading results and proximity to the lake.

2.0 Watershed Characterization

The Delavan Lake Watershed lies totally within Walworth County, which is located in southeastern Wisconsin. The glacial drainage lake receives runoff primarily from Jackson Creek and drainage into Brown's Channel, with surface runoff from land surrounding the lake. This 2,072-acre public access drainage lake is located within the limits of both the Town and City of Delavan and is an economically valuable resource that provides numerous recreational opportunities for Delavan and surrounding communities, such as boating, fishing, swimming and scenic enjoyment. The watershed (HUC 12 071300110402) includes an area that drains directly to Delavan Lake. The watershed area for Delavan Lake is approximately 26,315 acres.

2.1 Geology & Soils

The Delavan Lobe of the Lake Michigan glacier formed Delavan Lake during the Wisconsin Glaciation. The drainage basin within the limits of the watershed contains glacial deposits of unconsolidated materials that range from 150 feet in thickness in the northeastern portion to 450 feet in the southeastern portion of the watershed. Glacial end moraines are present near the southwestern end of the lake outward to the watershed boundary and several small areas of the central part of the watershed; ground moraines are also present throughout the remainder of the watershed.

Soils in the Delavan Lake Watershed consist primarily of clay loams, silty clay loams and sandy clay loams (see Figure 2). The three primary soil associations consist of Pella-Kendall-Elburn, which are poorly drained silty clay loams; Miami-McHenry, which are well-drained clay loams and silty clay loams; and Plano-Griswold, which are well-drained silty clay loams and sandy clay loams. The most common soil types found in the watershed include: Miami silt loam, 2-6% slopes (20.0%); Pella silt loam (15.5%); Miami silt loam, 0-2% slopes (6.7%); McHenry silt loam, 2-6% slopes (6.5%); Plano silt loam, 0-2% slopes (5.6%); Plano silt loam, 2-6% slopes (5.6%). A complete listing of all soil types and associated area in acres can be found in Table 1.

Figure 2 – Watershed Soils Map

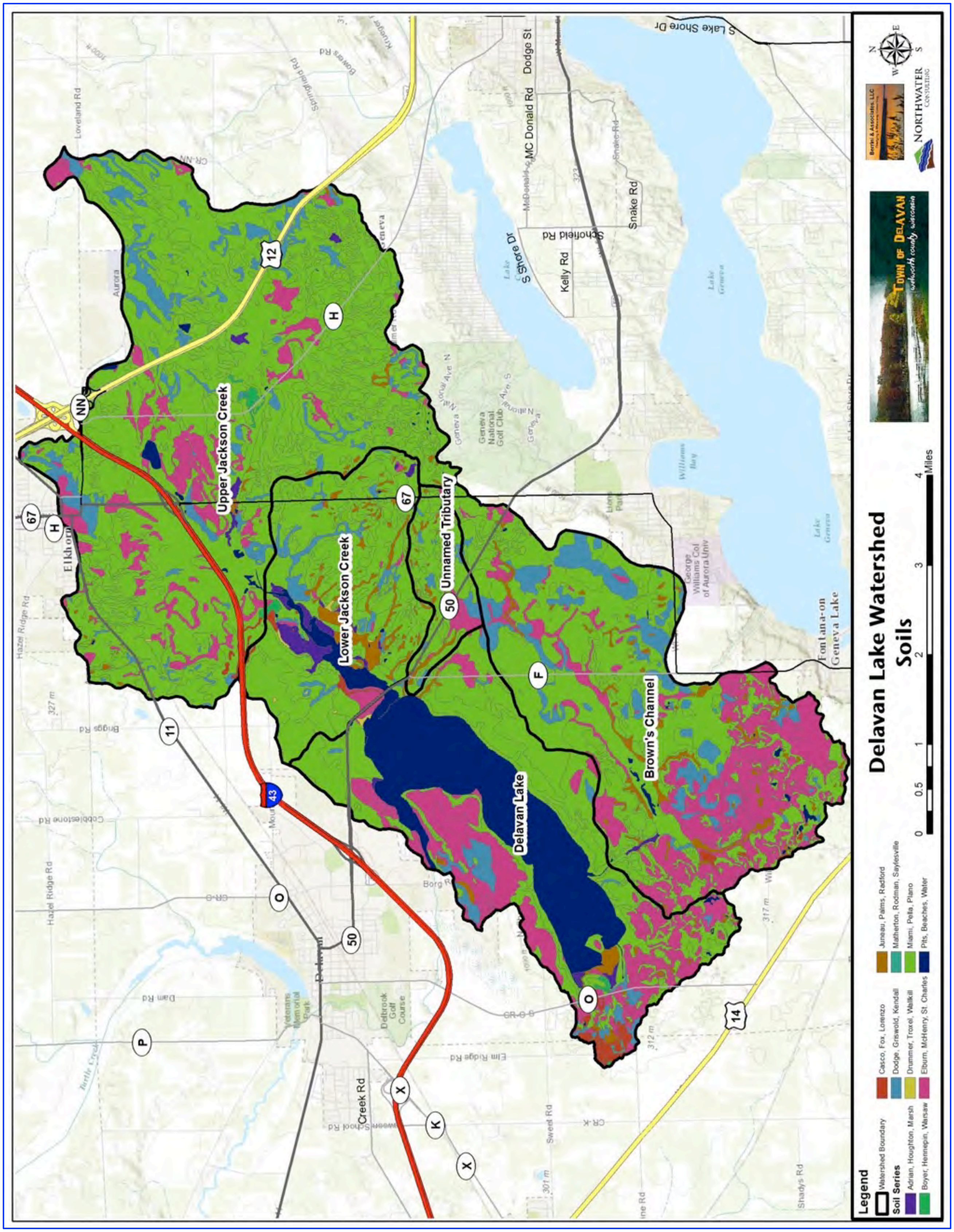


Table 1 – Soil Types in the Delavan Lake Watershed

Soil Type	Total Area (acres)	Percent of Total Area
Miami silt loam, 2 to 6 percent slopes	5,268.5	20.0%
Pella silt loam	4,075.0	15.5%
Water	2,075.1	7.9%
Miami silt loam, 0 to 2 percent slopes	1,760.9	6.7%
McHenry silt loam, 2 to 6 percent slopes	1,721.0	6.5%
Plano silt loam, 0 to 2 percent slopes	1,482.4	5.6%
Plano silt loam, 2 to 6 percent slopes	1,465.7	5.6%
Miami loam, 6 to 12 percent slopes, eroded	793.2	3.0%
St. Charles silt loam, 0 to 2 percent slopes	736.2	2.8%
Elburn silt loam, 1 to 3 percent slopes	681.6	2.6%
Griswold silt loam, mottled subsoil variant, 0 to 3 percent slopes	662.3	2.5%
Miami loam, sandy loam substratum, 6 to 12 percent slopes, eroded	654.7	2.5%
Dodge silt loam, 0 to 2 percent slopes	640.4	2.4%
Kendall silt loam, 1 to 3 percent slopes	462.9	1.8%
Conover silt loam, 1 to 3 percent slopes	412.1	1.6%
St. Charles silt loam, 2 to 6 percent slopes	410.5	1.6%
Miami loam, sandy loam substratum, 12 to 20 percent slopes, eroded	397.8	1.5%
Radford silt loam, 0 to 3 percent slopes	379.9	1.4%
McHenry silt loam, 2 to 6 percent slopes, eroded	369.4	1.4%
Dodge silt loam, 2 to 6 percent slopes	233.2	0.9%
Miami loam, 12 to 20 percent slopes, eroded	173.9	0.7%
Palms muck	153.9	0.6%
Juneau silt loam, 1 to 3 percent slopes	147.7	0.6%
Miami silt loam, 6 to 12 percent slopes, eroded	109.8	0.4%
Houghton muck	107.4	0.4%
McHenry silt loam, 6 to 12 percent slopes, eroded	94.4	0.4%
Miami silt loam, 6 to 12 percent slopes	80.0	0.3%
Marsh	75.1	0.3%
Plano silt loam, 6 to 12 percent slopes	71.1	0.3%
Griswold loam, 6 to 12 percent slopes, eroded	56.3	0.2%
McHenry silt loam, 6 to 12 percent slopes	48.7	0.2%
Plano silt loam, gravelly substratum, 0 to 2 percent slopes	42.5	0.2%
Miami loam, sandy loam substratum, 20 to 35 percent slopes, eroded	40.9	0.2%
Casco loam, 6 to 12 percent slopes, eroded	38.6	0.1%
St. Charles silt loam, gravelly substratum, 0 to 2 percent slopes	36.7	0.1%
Fox silt loam, 2 to 6 percent slopes	33.3	0.1%
Lorenzo loam, 6 to 12 percent slopes, eroded	30.3	0.1%
Miami loam, sandy loam substratum, 2 to 6 percent slopes	29.0	0.1%
Boyer complex, 2 to 6 percent slopes	27.9	0.1%
McHenry silt loam, 6 to 12 percent slopes	22.8	0.1%
Griswold loam, 2 to 6 percent slopes	22.7	0.1%
Adrian muck	21.9	0.1%
Lorenzo-Rodman complex, 12 to 20 percent slopes, eroded	19.6	0.1%

Soil Type	Total Area (acres)	Percent of Total Area
Warsaw silt loam, 2 to 6 percent slopes	18.2	0.1%
Casco loam, 12 to 20 percent slopes, eroded	16.0	0.1%
Elburn silt loam, gravelly substratum, 1 to 3 percent slopes	13.9	0.1%
Wet alluvial land	10.6	0.0%
Hennepin-Miami loams, sandy loam substratum, 20 to 35 percent slopes	10.4	0.0%
Troxel silt loam, 0 to 3 percent slopes	9.5	0.0%
Casco-Fox silt loams, 6 to 12 percent slopes, eroded	8.6	0.0%
St. Charles silt loam, gravelly substratum, 2 to 6 percent slopes	8.5	0.0%
Griswold loam, 12 to 20 percent slopes, eroded	7.2	0.0%
Casco-Rodman complex, 20 to 30 percent slopes, eroded	6.8	0.0%
Casco-Rodman complex, 12 to 20 percent slopes, eroded	6.4	0.0%
Fox silt loam, 0 to 2 percent slopes	5.4	0.0%
Drummer silt loam, gravelly substratum	5.0	0.0%
Wallkill silt loam	5.0	0.0%
Casco soils, 12 to 20 percent slopes, severely eroded	3.5	0.0%
Sandy lake beaches	3.4	0.0%
Casco loam, 2 to 6 percent slopes, eroded	1.9	0.0%
Saylesville silt loam, 2 to 6 percent slopes	1.8	0.0%
Miami sandy loam, sandy loam substratum, 2 to 6 percent slopes	1.4	0.0%
Borrow pit	1.3	0.0%
Matherton silt loam, 1 to 3 percent slopes	1.2	0.0%
Saylesville silt loam, 2 to 6 percent slopes	1.0	0.0%
Fox silt loam, 6 to 12 percent slopes, eroded	0.6	0.0%
Lorenzo loam, 2 to 6 percent slopes	0.4	0.0%
Total	**26,315**	**100.0%**

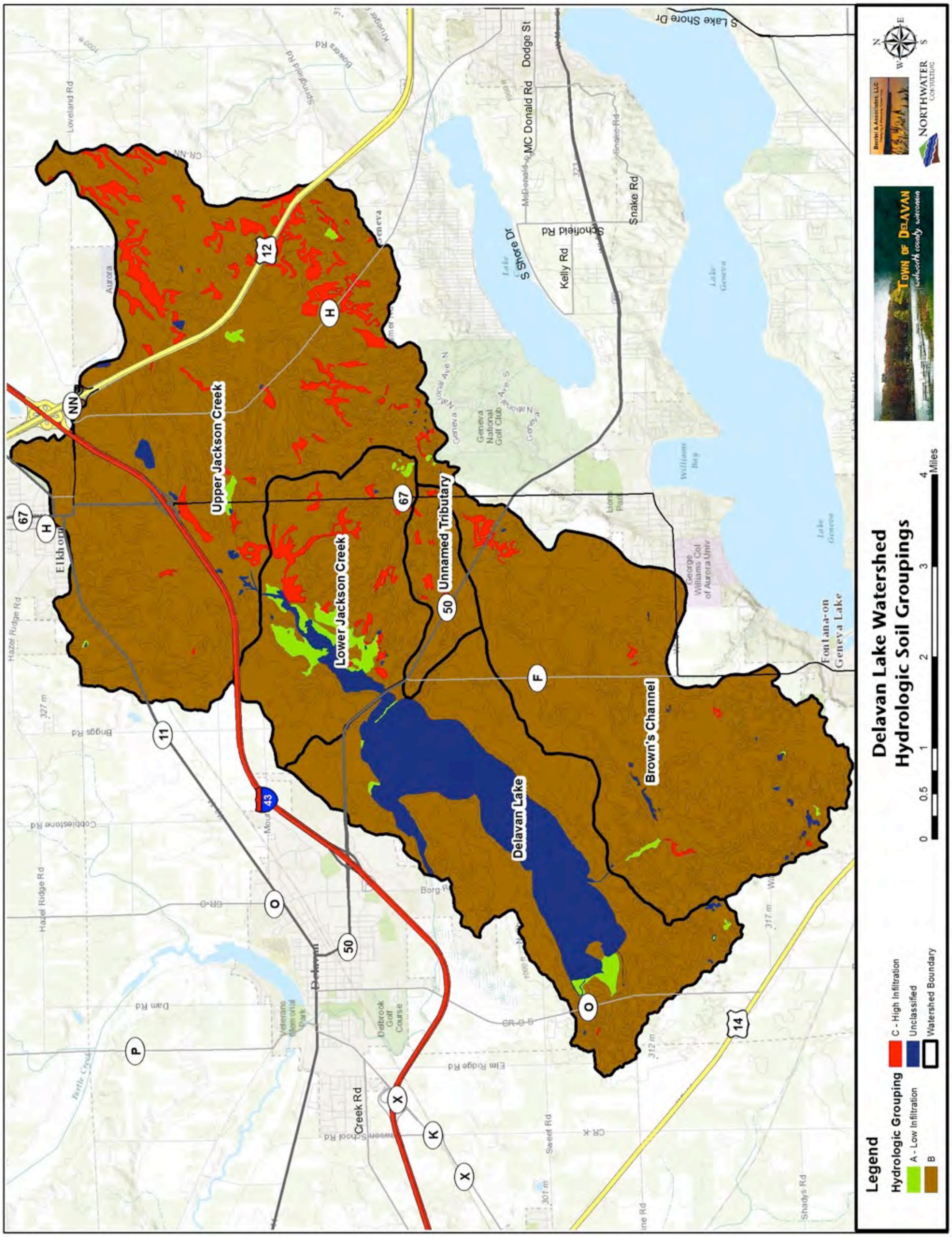
2.2 Hydrologic Soil Groupings

The NRCS has classified soils into four hydrologic soil groups based on the infiltration capacity and runoff potential of the soil. The soil groups are identified as A, B, C, and D (see Figure 3). Group A has the greatest infiltration capacity and least runoff potential, while group D has the least infiltration capacity and greatest runoff potential. Unclassified groupings represent water (Northwater, 2014). Table 2 provides a breakdown of hydrologic groupings and Figure 3 indicates the distribution of hydrologic soil groups within the watershed. The watershed consists of primarily B Group soils, or 87% of the entire watershed (22,795 acres); this indicates both moderate infiltration capacity and runoff potential. Hydrologic Group C soils are the second most dominant grouping with 1,082 acres (4%) within the watershed. The relatively small sections of Group C soils will exhibit higher rates of runoff and less infiltration; the majority of the Group C soils exist within the Upper Jackson Creek Sub-Watershed.

Table 2 – Hydrologic Soil Groupings

Sub-watershed Name	Watershed Area (Acres)	A	Percent A	B	Percent B	C	Percent C	D	Percent D	Unclassified	Percent Unclassified
Brown's Channel	6,393	13	0.21%	6,277	98.18%	67	1.04%	0	0%	36	0.57%
Delavan Lake	5,598	65	1.17%	3,708	66.24%	1	0.02%	0	0%	1,824	32.58%
Lower Jackson Creek	3,107	242	7.78%	2,527	81.34%	186	6.00%	0	0%	152	4.88%
Unnamed Tributary	705	0	0.00%	676	95.90%	29	4.17%	0	0%	0	0.00%
Upper Jackson Creek	10,512	41	0.39%	9,607	91.39%	799	7.60%	0	0%	64	0.61%
Grand Total	**26,315**	**362**	**1.37%**	**22,795**	**86.62%**	**1,082**	**4.11%**	**0**	**0%**	**2,076**	**7.89%**

Figure 3 – Hydrologic Soil Groupings



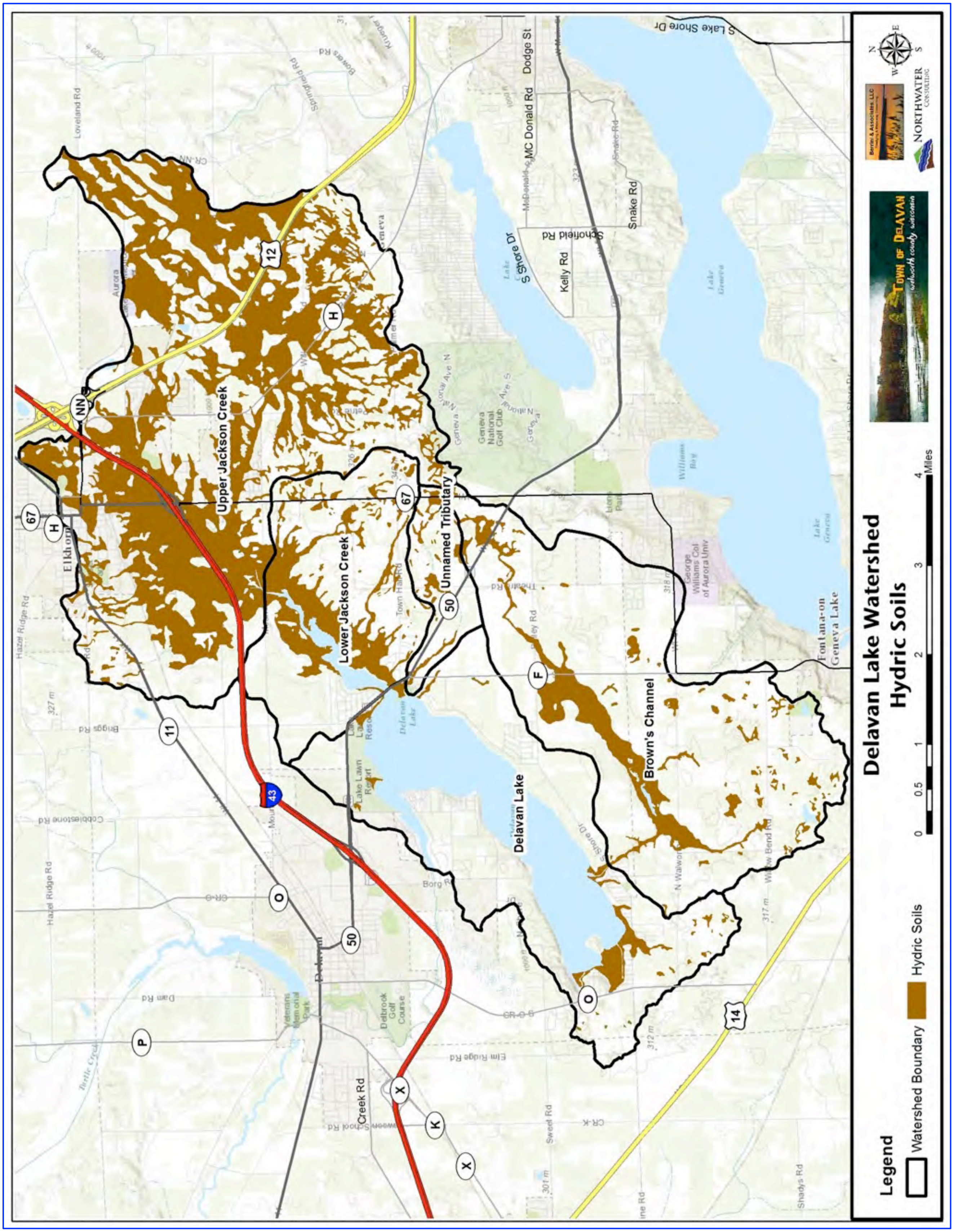
2.3 Hydric Soils

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of wetland vegetation (NRCS, 2014). Hydric soils are scattered throughout the watershed and are an indicator of former wetlands and potential areas for wetland development. The greatest concentrations of hydric soils are found in the Upper Jackson Creek Sub-Watershed. Hydric soils are typically wet and will flood, if proper drainage, overland or through field tiles, is not available. There are over 12 different hydric soils within the watershed totaling 7,068 acres (27%). Table 3 provides a breakdown of the area of hydric soils by sub-watershed and Figure 4 indicates their location within the watershed. The Upper Jackson Creek and Lower Jackson Creek sub-watersheds have the highest overall percentage of hydric soils; 50% and 24%, respectively, compared to a 26% average for the watershed as a whole. As an indicator of the potential for wetland development, understanding where hydric soils are located is valuable information for future wetland restoration activities.

Table 3 – Hydric Soils in Watershed

Sub-watershed Name	Watershed Area (Acres)	Hydric Soils (Acres)	Percent Hydric Soils
Brown's Channel	6,393	771	12.06%
Delavan Lake	5,598	217	3.87%
Lower Jackson Creek	3,107	751	24.19%
Unnamed Tributary	705	107	15.14%
Upper Jackson Creek	10,512	5,222	49.68%
Grand Total	**26,315**	**7,068**	**26.86%**

Figure 4 – Hydric Soils Map



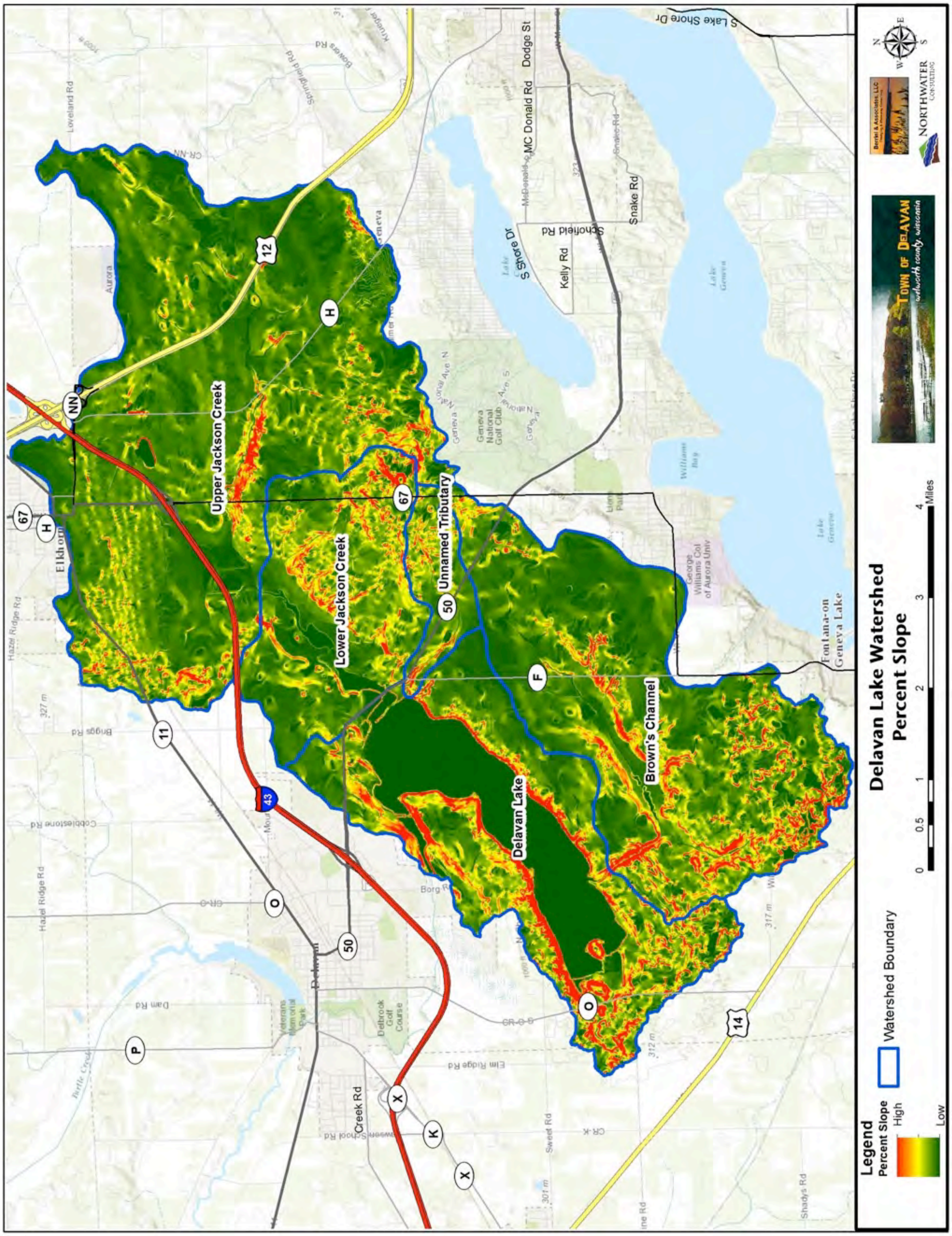
2.4 Topography and Slope

Percent slope was calculated for the watershed using a 10-meter digital elevation model (DEM). Average percent slope for the entire watershed is 2.38%. Table 4 lists the maximum and average percent slope by sub-watershed and Figure 5 illustrates percent slope for the watershed. The color gradations in the legend represent slopes ranging from Low (green) to High (red). The numerical slope ranges are: 0% to 3.5% for low (green), 3.5% to 11% for medium (yellow) and 11% to 47% for high (red). The basin is generally flatter in the headwaters of Upper Jackson Creek with a slight increase in slope moving downstream toward Delavan Lake. The Delavan Lake and Unnamed Tributary sub-watersheds have the highest average slope and the steepest slopes were located in the Delavan Lake and Upper Jackson Creek sub-watersheds.

Table 4 - Percent Slopes in Watershed

Sub-watershed Name	Maximum Slope %	Average % Slope
Delavan Lake	47	2.61
Upper Jackson Creek	47	1.72
Brown's Channel	31	2.37
Unnamed Tributary	19	2.70
Lower Jackson Creek	30	2.49
Average (entire watershed)	**35**	**2.38**

Figure 5 – Percent Slopes in Watershed



2.5 Climate

The Delavan Lake watershed has a humid continental climate with cold winters and hot summers. The National Weather Service (NWS) maintains a weather station at Lake Geneva and Whitewater. Since Delavan Lake and its watershed are situated in between and adjacent to these stations, average values are presented in this Plan. The average long-term precipitation (2000-2014) recorded at both stations is 36.88 inches. The maximum annual precipitation observed from 2009 to 2014 was 45.6 inches (2013) and the minimum annual precipitation was 29.3 inches (2012). On average, there are 136.7 days with precipitation of at least 0.01 inches and 49.17 days with precipitation greater than 0.2 inches. Average snowfall is approximately 45.6 inches per year. Average maximum and minimum temperatures recorded at Delavan are 25.9 degrees F and 7.5 degrees F in January, and 83.0 degrees F and 60.5 degrees F in July (1970-2013 data). The average temperature recorded in January is 16.7 degrees F and the average temperature recorded in July is 71.8 degrees F.

2.6 Landuse & Landcover

In order to understand sources contributing to the lake impairments, it is necessary to characterize landcover or landuse in the watershed. For the purposes of estimating pollutant loading quantities presented in Section 5.2, a custom GIS landuse layer was generated for the watershed (Figure 1). This layer was created for the watershed using existing data provided by Walworth County, combined with analysis of recent and available aerial imagery (2014) and information collected during a watershed windshield survey. This custom layer represents a current snapshot of landuse and landcover in the watershed and is more detailed than other regional and national landcover datasets. Watershed-wide landuse statistics are provided in Table 5 and in Figure 6. Agricultural row crops encompass 51% of the watershed, open water (ponds and lakes) cover 8% and forest covers 8%. Wetland, rural open space, urban open space and residential single-family low density are also of importance and account for 17% of the watershed area.

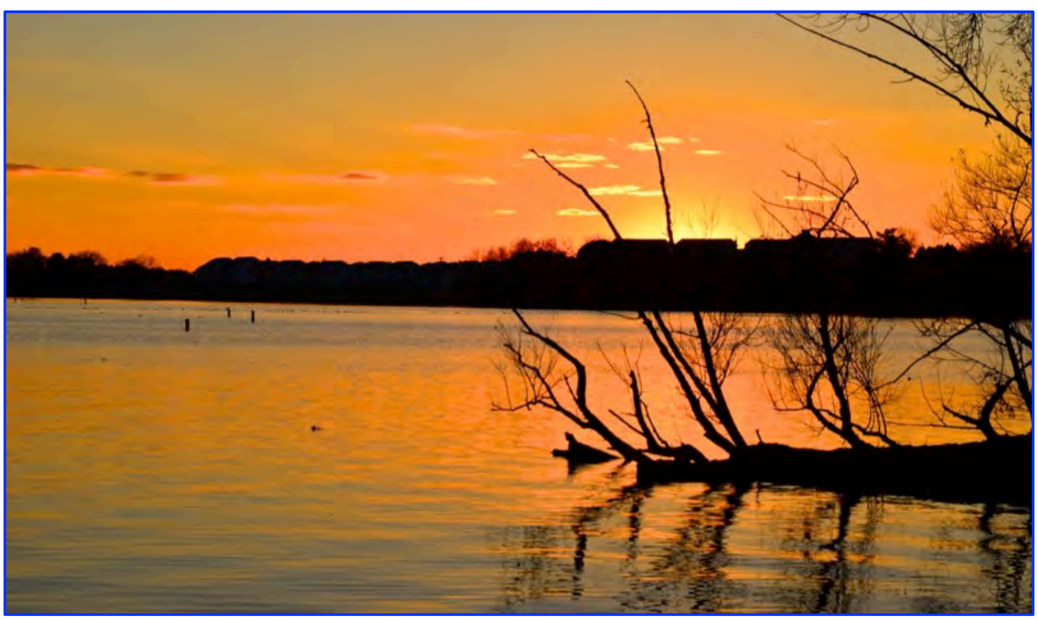


Figure 6 - Watershed Landuse & Landcover

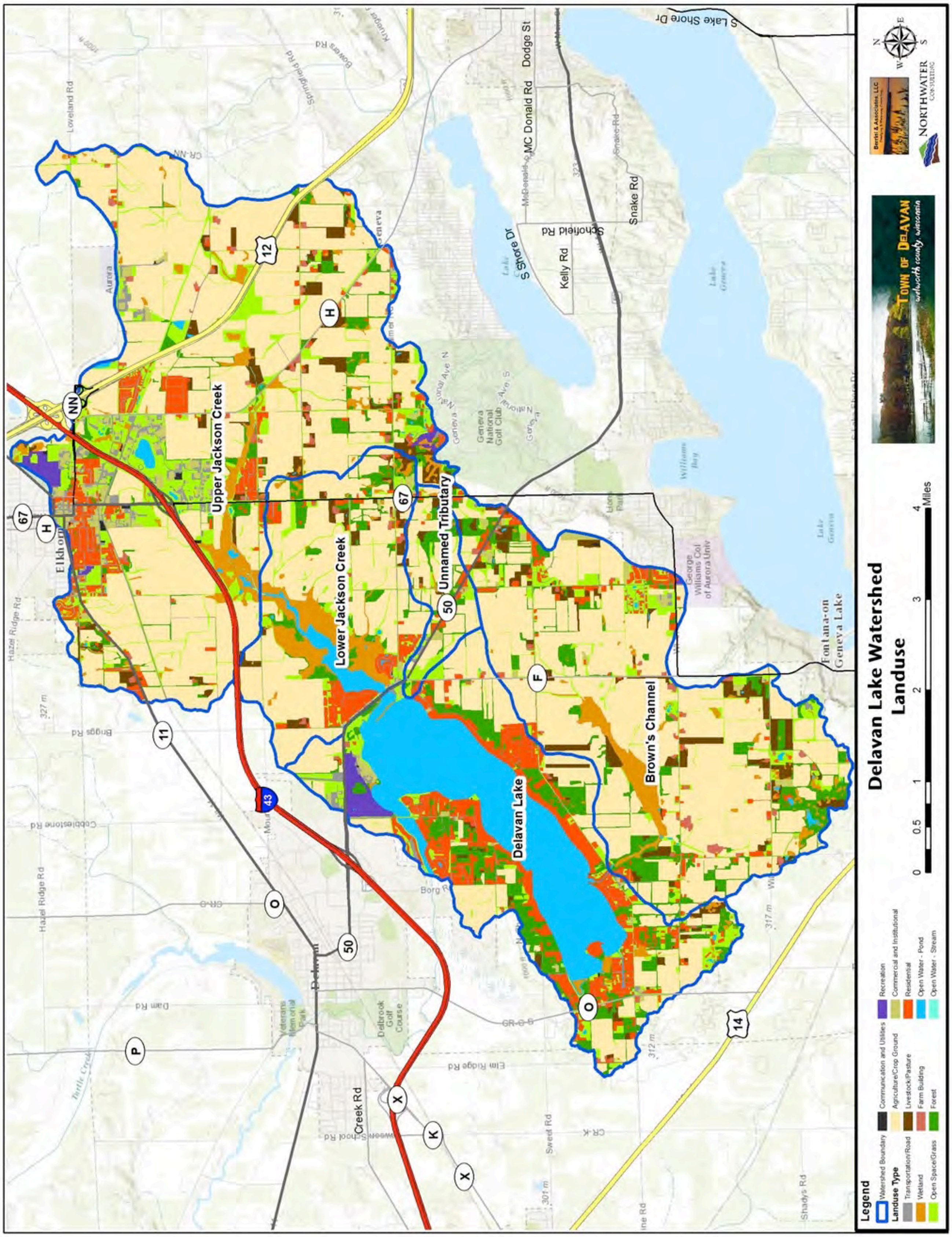


Table 5. Watershed Landuse & Landcover

Landuse Category	Total Acres	Percent of Watershed
Cropland; Row Crops	13,351	51%
Open Water - Pond	2,053	8%
Forest	2,053	8%
Wetland	1,187	5%
Rural Open Space	1,182	4%
Urban Open Space	1,142	4%
Residential Single-Family Low Density	1,141	4%
Pasture	959	4%
Residential Single-Family Medium Density	707	3%
Freeway	294	1%
Local Street	268	1%
Farm Building	226	1%
Orchards and Nursery	220	1%
Parking	210	1%
Recreation - Park	200	1%
Wholesaling and Storage	141	1%
Golf Course	124	0.47%
Retail	119	0.45%
Multi-Family Low Rise	95	0.36%
Government and Institutional	94	0.36%
Arterial Road	78	0.30%
Open Space - Road	73	0.28%
Recreation - Cultural	67	0.25%
Sod Farm	61	0.23%
Manufacturing	52	0.20%
Residential Two-Family	40	0.15%
Railroad Right-of-Way	30	0.11%
Mobile Homes	21	0.08%
Communication and Utilities	20	0.07%
Resource Extraction	19	0.07%
Feed Area	12	0.05%
Composting	11	0.04%
Open Water - Stream	10	0.04%
Residential Single-Family Suburban Density	8	0.03%
Air Terminal and Hangar	7	0.02%
Bus Terminal	6	0.02%
Air Field	6	0.02%
Local Street - Permeable	6	0.02%
Truck Terminal	5	0.02%
Landfill	5	0.02%
Cemeteries	4	0.02%
Confinement	4	0.01%
Freeway Wetland	3	0.01%
Arterial Road Wetland	0.3	0.001%

Agricultural products are primarily corn and soybean, with livestock grazing operations throughout. Understanding landuse information is important because many lake water quality concerns that relate to sediment and nutrient loading are tied to contributions from row crop agriculture, pasture, and residential areas. Tables 6 through 10 list all landuse categories by sub-watershed. Brown's Channel and Upper Jackson Creek contain the greatest percentage and acreage of row crops; Delavan Lake contains the least. Although the majority of the Delavan Lake Sub-watershed is dominated by open water, it also contains relatively high percentages of row crops, single-family residential and forest. Lower Jackson Creek contains the highest overall percentage of wetland area and Browns Channel contains the highest percentage of pasture.

Table 6. Browns Channel Sub-Watershed Landuse & Landcover

Landuse Category	Total Acres	Percent of Sub-watershed
Cropland; Row Crops	3,928	61%
Forest	599	9%
Pasture	394	6%
Wetland	284	4%
Rural Open Space	261	4%
Residential Single-Family Low Density	179	3%
Urban Open Space	168	3%
Orchards and Nursery	154	2%
Farm Building	83	1%
Residential Single-Family Medium Density	70	1%
Wholesaling and Storage	49	1%
Recreation - Park	36	1%
Freeway	34	1%
Arterial Road	30	0.5%
Open Water - Pond	24	0.4%
Local Street	21	0.3%
Resource Extraction	19	0.3%
Government and Institutional	15	0.2%
Parking	12	0.2%
Composting	10	0.2%
Retail	7	0.1%
Cemeteries	4	0.1%
Feed Area	4	0.1%
Golf Course	3	0.04%
Communication and Utilities	2	0.03%
Open Water - Stream	0.5	0.01%
Mobile Homes	0.4	0.01%

Table 7. Delavan Lake Sub-Watershed Landuse & Landcover

Landuse Category	Total Acres	Percent of Sub-watershed
Open Water - Pond	1,820	33%
Cropland; Row Crops	1,166	21%
Forest	735	13%
Residential Single-Family Low Density	594	11%
Residential Single-Family Medium Density	315	6%
Urban Open Space	185	3%
Rural Open Space	140	3%
Golf Course	101	2%
Pasture	80	1%
Local Street	74	1%
Recreation - Park	61	1%
Orchards and Nursery	59	1%
Wetland	58	1%
Retail	41	1%
Freeway	36	1%
Multi-Family Low Rise	33	1%
Parking	31	1%
Farm Building	20	0.4%
Arterial Road	10	0.2%
Residential Single-Family Suburban Density	8	0.1%
Government and Institutional	7	0.1%
Air Terminal and Hangar	7	0.1%
Air Field	6	0.1%
Local Street - Permeable	6	0.1%
Wholesaling and Storage	4	0.1%
Residential Two-Family	1	0.03%
Communication and Utilities	1	0.02%
Open Space - Road	1	0.02%

Table 8. Lower Jackson Creek Sub-Watershed Landuse & Landcover

Landuse Category	Total Acres	Percent of Sub-watershed
Cropland; Row Crops	1,689	54%
Wetland	387	12%
Forest	231	7%
Open Water - Pond	138	4%
Rural Open Space	138	4%
Pasture	107	3%
Residential Single-Family Low Density	97	3%
Urban Open Space	89	3%
Residential Single-Family Medium Density	79	3%
Multi-Family Low Rise	34	1%
Freeway	29	1%
Local Street	27	1%
Farm Building	23	1%
Wholesaling and Storage	9	0.3%
Parking	8	0.3%
Retail	8	0.3%
Government and Institutional	6	0.2%
Manufacturing	3	0.1%
Feed Area	2	0.1%
Open Space - Road	2	0.1%
Communication and Utilities	0.5	0.02%
Open Water - Stream	0.4	0.01%
Mobile Homes	0.2	0.01%
Arterial Road Wetland	0.2	0.01%

Table 9. Unnamed Tributary Sub-Watershed Landuse & Landcover

Landuse Category	Total Acres	Percent of Sub-watershed
Cropland; Row Crops	381	54%
Forest	111	16%
Rural Open Space	49	7%
Residential Single-Family Low Density	45	6%
Urban Open Space	41	6%
Pasture	23	3%
Recreation - Park	12	2%
Wetland	11	2%
Freeway	11	2%
Wholesaling and Storage	6	1%
Parking	5	1%
Retail	5	1%
Local Street	3	0.4%
Farm Building	1	0.2%
Government and Institutional	1	0.1%
Composting	0.3	0.05%
Open Water - Pond	0.2	0.03%

Table 10. Upper Jackson Creek Sub-watershed Landuse & Landcover

Landuse Category	Total Acres	Percent of Sub-watershed
Cropland; Row Crops	6,186	59%
Urban Open Space	659	6%
Rural Open Space	594	6%
Wetland	447	4%
Forest	376	4%
Pasture	355	3%
Residential Single-Family Medium Density	243	2%
Residential Single-Family Low Density	226	2%
Freeway	185	2%
Parking	153	1%
Local Street	145	1%
Farm Building	100	1%
Recreation - Park	90	1%
Wholesaling and Storage	72	1%
Open Water - Pond	71	1%
Open Space - Road	70	1%
Recreation - Cultural	67	1%
Government and Institutional	65	1%
Sod Farm	61	1%
Retail	58	1%
Manufacturing	50	0.5%
Residential Two-Family	39	0.4%
Arterial Road	38	0.4%
Railroad Right-of-Way	30	0.3%
Multi-Family Low Rise	28	0.3%
Mobile Homes	20	0.2%
Golf Course	20	0.2%
Communication and Utilities	16	0.2%
Open Water - Stream	9	0.1%
Orchards and Nursery	7	0.1%
Bus Terminal	6	0.1%
Feed Area	5	0.1%
Truck Terminal	5	0.1%
Landfill	5	0.1%
Confinement	4	0.03%
Freeway Wetland	3	0.03%
Arterial Road Wetland	0.04	0.0004%

2.7 Landuse Detention in Watershed

Landuse in the watershed was evaluated to determine the extent to which storm water detention was in place. Using GIS, landuse polygons were coded based on whether or not they drained directly to a pond, wetland or detention structure specifically intended to capture runoff. Only sixteen out of the forty-four landuse categories that make up the watershed contain some type of detention or runoff control; of the fourteen categories with detention, only 7%, or 310 acres, have some type of runoff control in place. Comparing the total area in the watershed with detention with the total area of the watershed, only 1% of the watershed has detention in place.

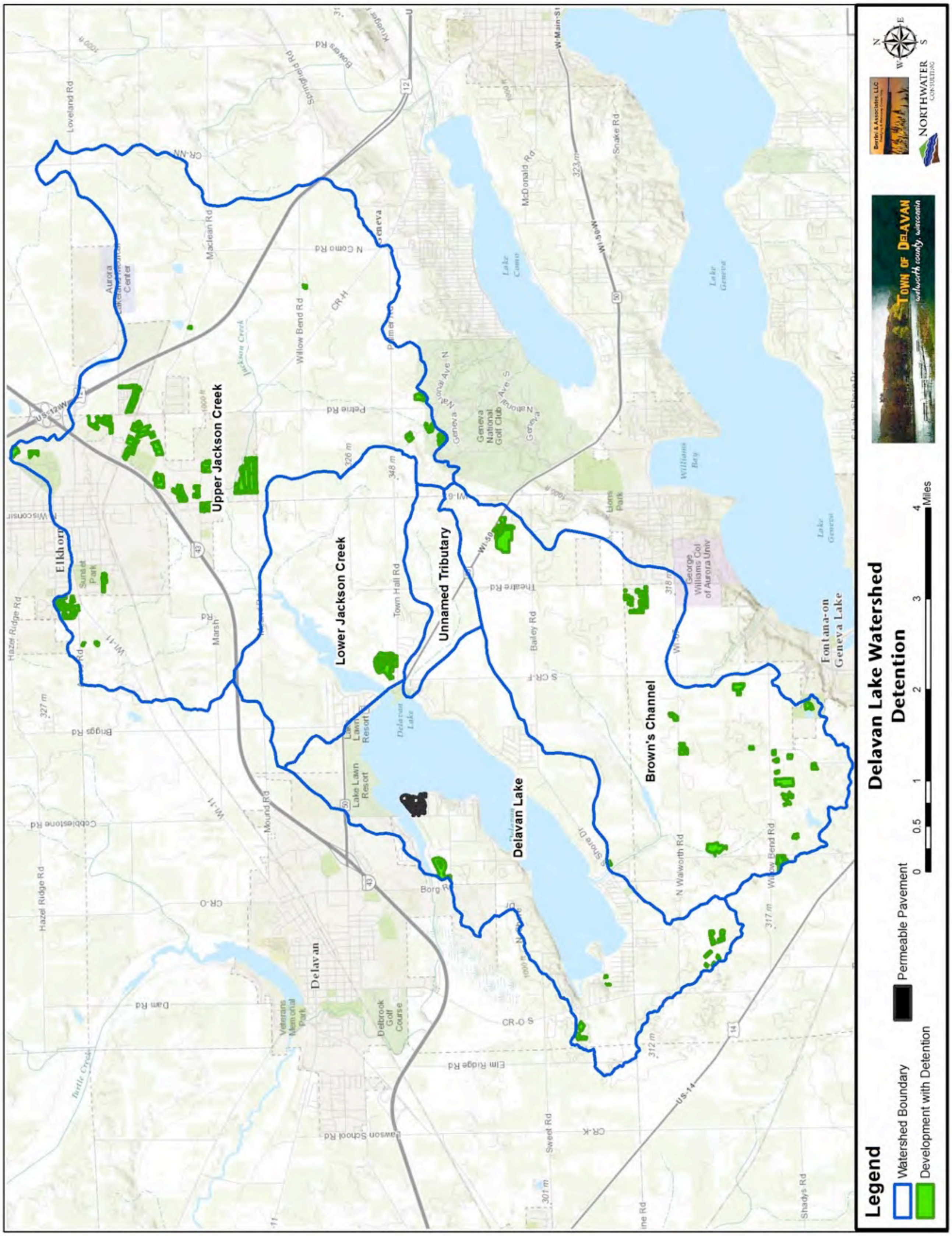
Of the total watershed road area (649 acres), only 1% (6 acres) is permeable.

Roads Area (acres)	Roads with Detention (acres)	Percentage Detained
649	6	1%

Of the total watershed area developed as residential areas (2,017 acres), only 4% (76 acres) have some type of detention in place.

Residential Area (acres)	Residential Area with Detention (acres)	Percentage Detained
2,017	76	4%

Figure 7 – Existing Storm Water Detention in Watershed



2.8 Watershed Hydrology

There is one active USGS monitoring site and gaging station in the watershed located on Jackson Creek, upstream of the lake at Mound Road (USGS gage number 05431016). However, other locations with gaging stations have historically monitored stream flows, suspended sediment and phosphorus at the lake outlet; at Highway 50 and upstream of the current location on a tributary to Jackson Creek near Elkhorn, WI (see Figure 8). The current station, combined with other inactive stations, has allowed USGS to calculate mean daily discharges and nutrient loads, which have been used to calibrate the model used to estimate nutrient loads in this Watershed Plan. The drainage area upstream of the active gage at Mound Road is 10,512 acres, or approximately 40 percent of the entire watershed. According to the National Hydrography Dataset (NHD), there are a total of 39.3 miles of streams in the watershed, 15.7 miles of which are major streams; the remaining streams in the watershed are small tributaries, ephemeral streams and ditches (see Figure 9). Historical data indicate that the active monitoring station at Mound Road has observed an average annual inflow of 4,769 cfs (cubic feet per second) that ranges from a low of 1,376 cfs in 2003 to a high of 7,697 cfs in 2013. The low annual inflow observed in 2003 occurred during a very dry year with only 25.2 inches of total rainfall and the high range of observed annual inflows in 2013 occurred during a much wetter-than-normal year with a total of 45.5 inches of rainfall.

Figure 8 – USGS Monitoring and Gaging Sites

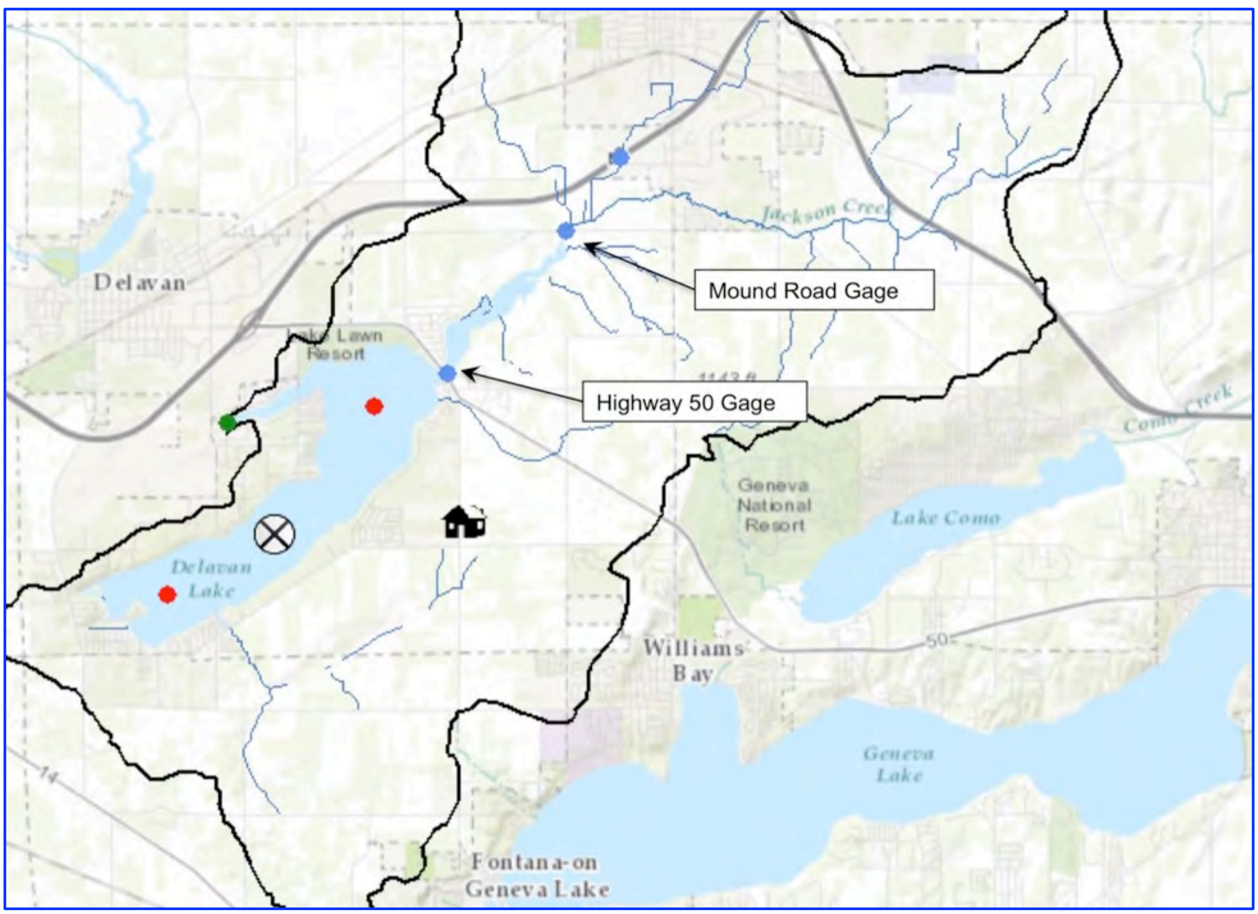
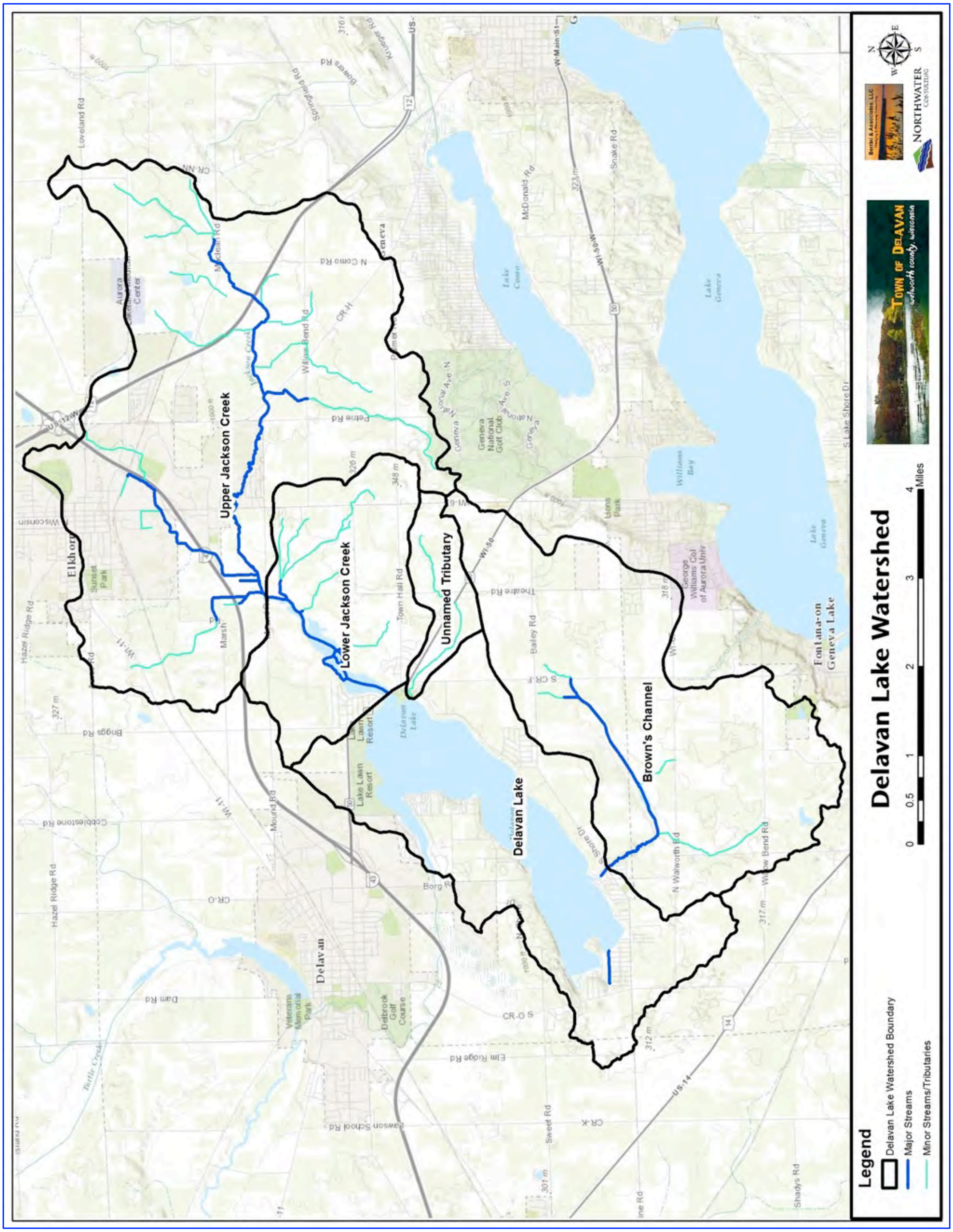


Figure 9 - Watershed Streams & Open Water



2.9 Environmental Corridors

Environmental Corridors in Walworth County include both Primary and Secondary Environmental Corridors. Primary Environmental Corridors include a variety of important natural resource and resource-related elements, as detailed in the 2035 Walworth County Land Use Plan, and are at least 400 acres in size, two miles in length, 200 feet in width and are primarily located along major stream valleys, around major lakes, and along the Kettle Moraine. These Primary Environmental Corridors contain almost all of the best remaining woodlands, wetlands, and wildlife habitat areas in the County, and represent a composite of the best remaining elements of the natural resource base. Secondary environmental corridors also contain a variety of resource elements, as detailed in the 2035 Land Use Plan. They are often remnant resources from primary environmental corridors, which have been developed for intensive urban or agricultural purposes and generally connect with the primary environmental corridors and are at least 100 acres in size and one mile in length. Secondary environmental corridors are generally located along the small perennial and intermittent streams within the County. Secondary environmental corridors facilitate surface-water drainage, maintain pockets of natural resource features, and provide corridors for the movement of wildlife, as well as for the movement and dispersal of seeds for a variety of plant species. (Walworth County, 2011)

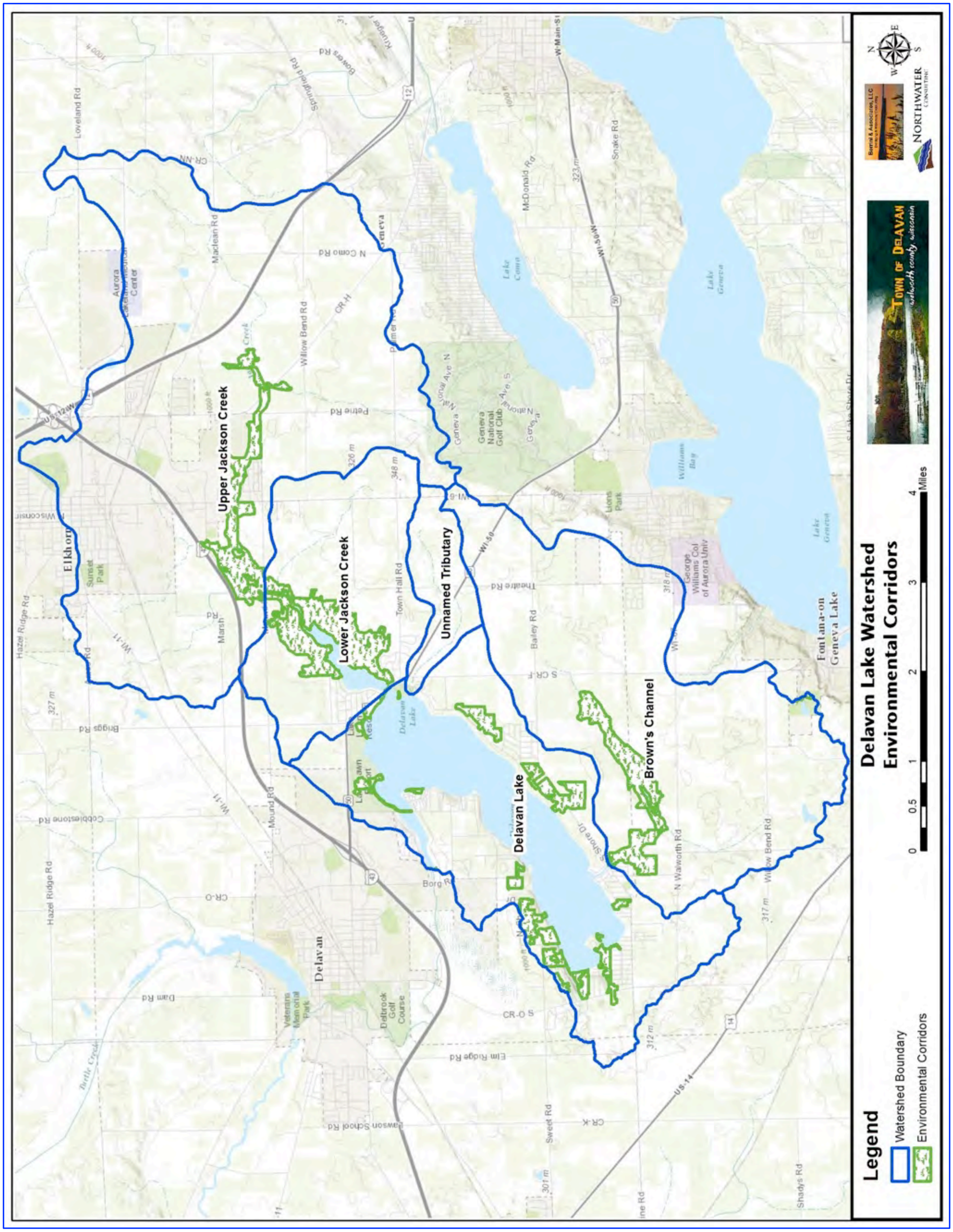
Based on a map layer created by Walworth County, there are approximately 1,450 acres of designated environmental corridors within the Delavan Lake Watershed. Table 11 lists their extent by sub-watershed and Figure 10 shows their distribution within the basin.

Table 11. Environmental Corridors by Sub-watershed

Sub-watershed Name	Watershed Area (Acres)	Environmental Corridor (Acres)	Environmental Corridor (Percent)
Brown's Channel	6,393	302	4.72%
Delavan Lake	5,598	367	6.56%
Lower Jackson Creek	3,107	445	14.31%
Unnamed Tributary	705	0	0.00%
Upper Jackson Creek	10,512	336	3.20%
Grand Total	**26,315**	**1,450**	**5.51%**

The greatest relative percentage of Environmental Corridors exists within the Lower Jackson Creek sub-watershed, which includes approximately 445 acres, or 14%, of the total sub-watershed area. The unnamed tributary sub-watershed does not include any designated environmental corridors.

Figure 10 – Environmental Corridors



2.10 Existing Wetlands

Wetlands are scattered throughout the watershed, primarily at locations of hydric soils or adjacent to tributary drainages such as Lower Jackson Creek prior to entering Delavan Lake. Wetlands reduce storm water runoff and filter sediment and nutrients before reaching waterways. The vegetative communities within the wetlands bind excess nutrients within the living plant tissue while providing additional wildlife habitat. Existing wetlands should be protected and enhanced to provide both water quality, flooding and wildlife habitat benefits to the watershed.

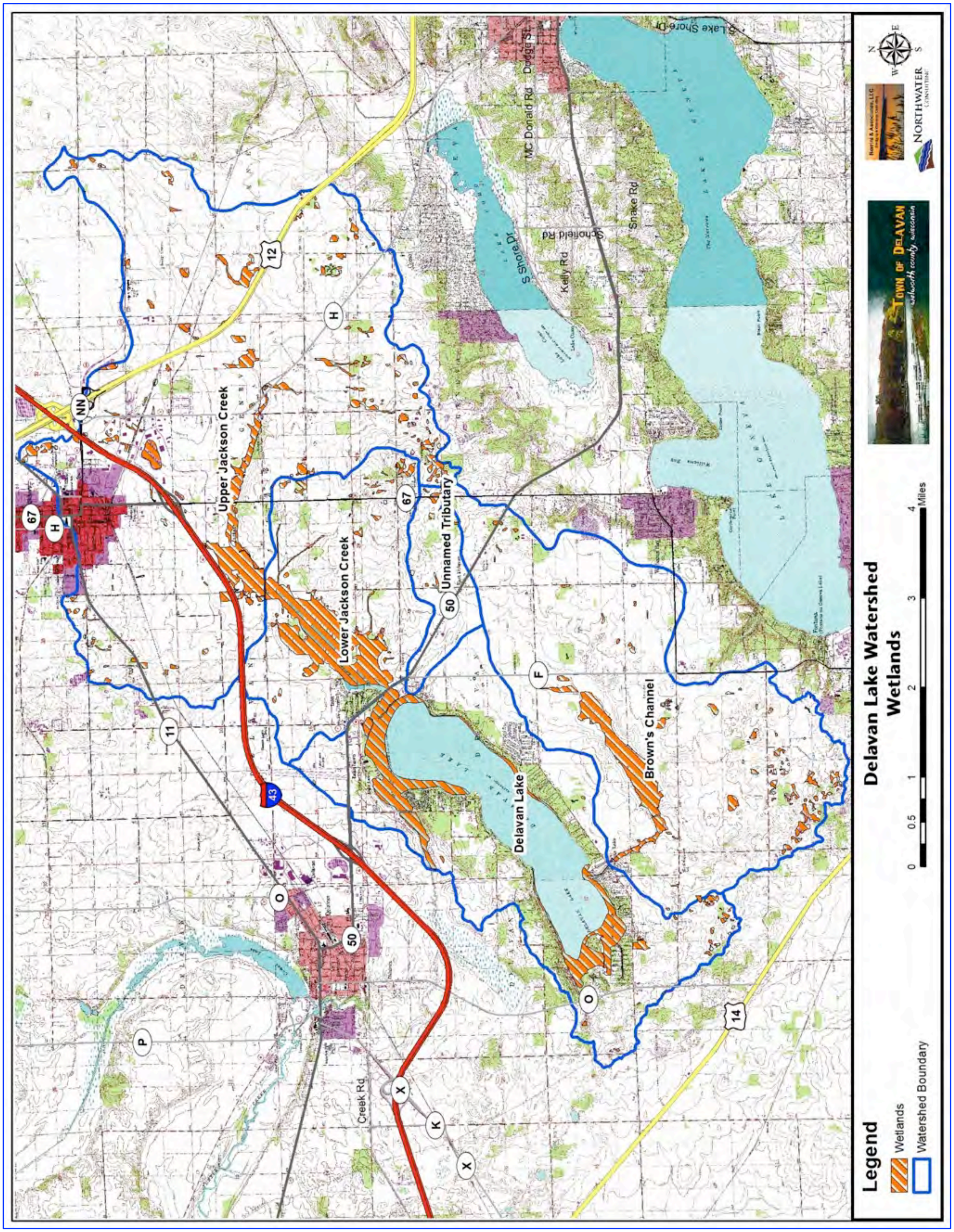
In this section, wetlands were evaluated using a data set provided by Walworth County. This data set represents all mapped wetlands in the watershed, including areas such as the Delavan Lake shoreline that can also be classified as open water (see Figure 11). Section 2.6, describing watershed landuse, lists total wetland area as 1,185 acres compared to the 2,013 acres noted in this section. This discrepancy in acreage exists because the landuse layer classifies all open water as such rather than as a wetland. Based on the Walworth County wetland data set, there are currently 2,013 acres of wetlands in the watershed, or 7.65% of the total watershed area (Table 12). Lower Jackson Creek (17%) and Delavan Lake (10%) contain the greatest percentage of wetland area.

Table 12. Existing Wetlands

Sub-watershed Name	Watershed Area (Acres)	Wetlands (Acres)	Percent Wetlands
Brown's Channel	6,393	362	5.67%
Delavan Lake	5,598	533	9.51%
Lower Jackson Creek	3,107	528	16.98%
Unnamed Tributary	705	16	2.28%
Upper Jackson Creek	10,512	575	5.47%
Grand Total	**26,315**	**2,013**	**7.65%**

A comparison of existing wetland area (2,013 acres) to the extent of hydric soils (7,068 acres), or those soils that can support wetland development (see Section 2.3), indicates that there may be significant opportunities to expand, create or restore additional wetland area within the watershed. The model used for this plan has identified several areas where the addition or restoration of specific wetlands can achieve effective nutrient load reductions. Locations that are not specifically identified as a specific BMP will require additional analysis to determine feasibility and cost effectiveness.

Figure 11 – Existing Wetlands



2.11 Drained or Degraded Wetlands

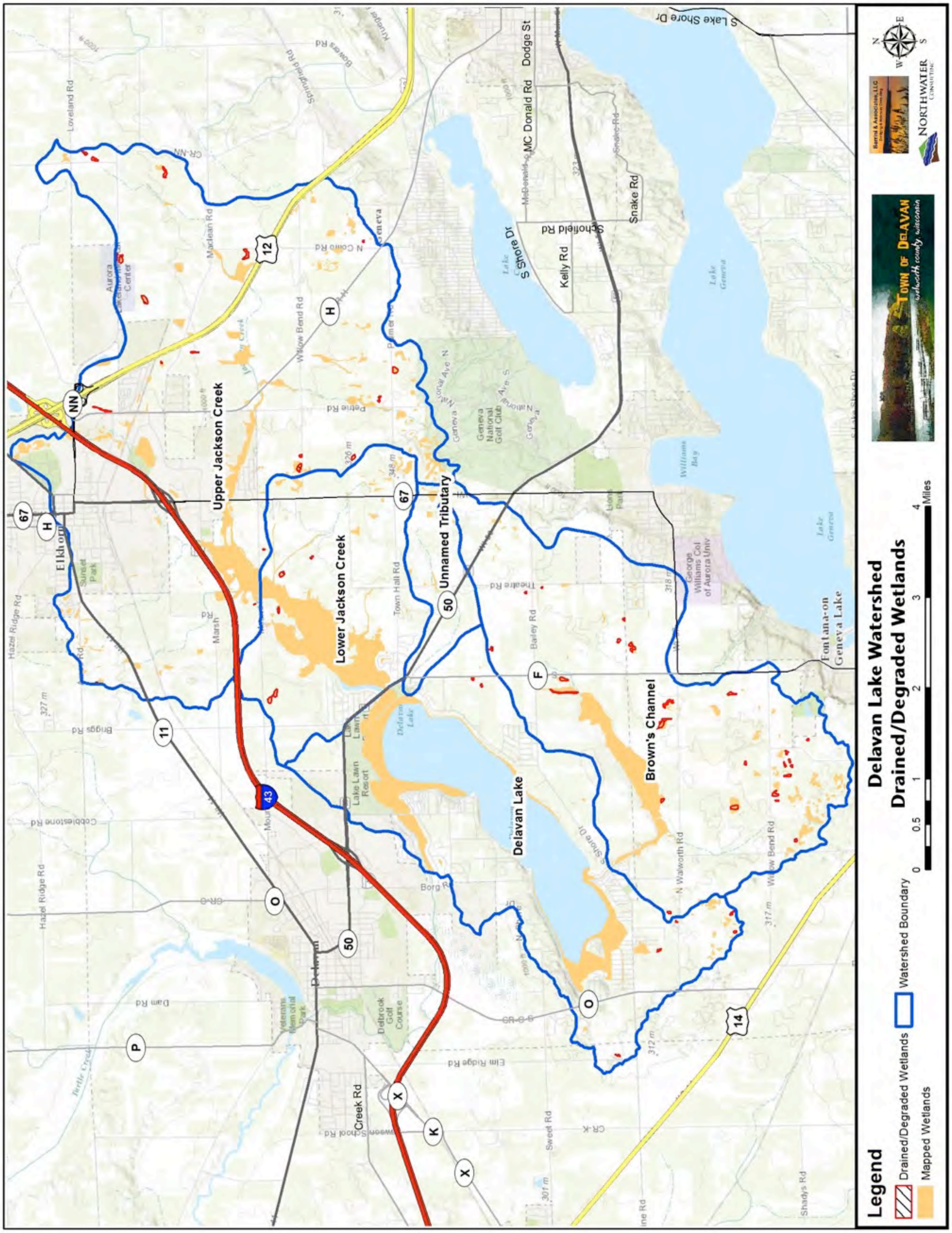
Mapped wetlands were evaluated by visually interpreting recent aerial imagery to determine the extent to which these wetlands have been modified or removed. Of the 2,013 acres of mapped wetlands in the watershed, 51 acres (3%) have either been drained or eliminated and could potentially benefit from restoration efforts, with the highest percentage and acreage within the Brown's Channel Sub-watershed (see Figure 12 and Table 13).

Table 13. Drained or Degraded Wetlands

Sub-watershed Name	Mapped Wetlands (Acres)	Drained or Degraded Wetlands (Acres)	Percent of Mapped Wetlands
Brown's Channel	362	23	6%
Delavan Lake	533	3	0.49%
Lower Jackson Creek	528	6	1%
Unnamed Tributary	16	0	0%
Upper Jackson Creek	575	19	3%
Grand Total	**2,013**	**51**	**3%**

Existing Wetland

Figure 12 – Drained or Degraded Wetlands



2.12 Threatened or Endangered Species

The Wisconsin Department of Natural Resources (WDNR) describes state endangered species as any species whose continued existence as a viable component of this state's wild animals or wild plants is determined by the department to be in jeopardy on the basis of scientific evidence. A threatened species is defined as any species of wild animals or wild plants, which appears likely, within the foreseeable future, on the basis of scientific evidence, to become endangered.

A request was made to WDNR to obtain information on the Threatened and Endangered (T&E), or rare species, within the Delavan Lake watershed. There are 28 known T&E Species within the watershed. The list of individual species includes 15 plants, 1 mussel, 4 fish, 2 snakes, 1 turtle, 1 bird, and 4 communities. The plants present include Swamp Agrimony, Purple and Prairie Milkweed, Hemlock Parsley, Few-flowered Spike-rush, Beaked Spike-rush, Azure Bluets, Soft-leaf Muhly, Yellow Water Lily, Wafer-ash, Hairy Wild-petunia, Low Nutrush, Waxleaf Meadowrue, Purple Meadow-parsnip and Sticky False-asphodel. The one mussel present is the Elktoe. The four fish include the Gravel Chub, Least Darter, Ozark Minnow and the Slender Madtom. The two snakes are the Queensnake and the Plains Gartersnake. The one turtle is the Blanding's Turtle and the one bird is the Black-crowned Night-Heron. The communities present in the watershed include a Calcareous Fen, Ephemeral Pond, Shrub-carr, and a Southern Sedge Meadow.

The presence of rare species or communities can be explained several different ways. All of these species are remnant of high quality natural communities and their presence and diversity is indicative of conservation efforts in the watershed.

There are several things that can be done to assist the survival of rare species occurring in the watershed:

- Preserve areas considered to be high quality natural habitats;
- Implement efforts to identify and control invasive species;
- If a restoration effort is planned, restoring an area that will favor recruitment of the rare species that are in the area will help maintain the diversity within the watershed.

Blanding's Turtle

2.13 Urbanization & Growth

The Town of Delavan, the City of Delavan, the City of Elkhorn and the Town of Walworth are the major urban areas within the watershed; the Town of Delavan surrounds most of the lake and lies wholly within the Delavan Lake watershed, whereas small portions of the City of Delavan, Elkhorn and Walworth lie within the watershed. The Town of Delavan (2000 population of 4,559), and portions of the City of Elkhorn (2010 population of 10,084), the City of Delavan (2010 population of 8,463) and the Village of Walworth lie within the limits of the Delavan Lake watershed. The population of Delavan Lake, which directly surrounds the lake and is a Census Designated Place (CDP), was approximately 2,649 according to the 2010 U.S. Census, which represents an increase of 12.6% from 2,352 in 2000. According to the U.S. Census County Quick Facts, the 2014 Walworth County population estimate is 103,527; a 10.3% increase from 2000. Although population growth can result in increased runoff due to more impervious surfaces, conversion of cropland to residential areas can have positive water quality impacts, if developed with conservation buffering and on-site detention.

Aerial View of Delavan Lake and Surrounding Area (6-18-15)

2.14 Sewered Areas and Septic Systems

The Delavan Lake Watershed is serviced by two Wastewater Treatment Plants (WWTPs); the Walworth County Metropolitan Sewerage District (Walcomet) and the Fontana-Walworth Water Pollution Control Commission. A total of 12,653 acres, or 48% of the watershed, is served by a WWTP (Table 14). The remainder of the watershed is on septic (based on available data).

Table 14. Sewered Areas by Sub-Watershed

Sub-watershed Name	Watershed Area (Acres)	Sewered Area (Acres)	Percent of Sub-watershed
Brown's Channel	6,393	2,144	34%
Delavan Lake	5,598	4,992	89%
Lower Jackson Creek	3,107	1,383	44%
Unnamed Tributary	705	399	57%
Upper Jackson Creek	10,512	3,735	36%
Grand Total	**26,315**	**12,653**	**48%**

Of the 2,015 acres of residential area in the watershed, 1,786 acres are served by a WWTP, or 87%. There are 228 acres of residential area in the watershed on septic systems. Assuming a conservative average rural lot size of 0.5 acres, this could translate into roughly 114 individual homes. Additionally, of the 228 residential acres on septic in the watershed, 153, or 67%, are found on soils that are potentially limiting to septic (Table 15).

Table 15. Percent of Unsewered Area in Watershed

Sub-watershed Name	Total Area (Acres) Unsewered	Acres Unsewered Residential	Percent of Unsewered Area	Acres Unsewered Residential on Limiting Soils	Percent of Unsewered on Limiting Soils
Brown's Channel	4,249	63	1%	53	1%
Delavan Lake	606	37	6%	32	5%
Lower Jackson Creek	1,724	31	2%	6	0.36%
Unnamed Tributary	306	7	2%	0.37	0.12%
Upper Jackson Creek	6,777	91	1%	61	0.90%
Total	**13,662**	**228**	**2%**	**153**	**1%**

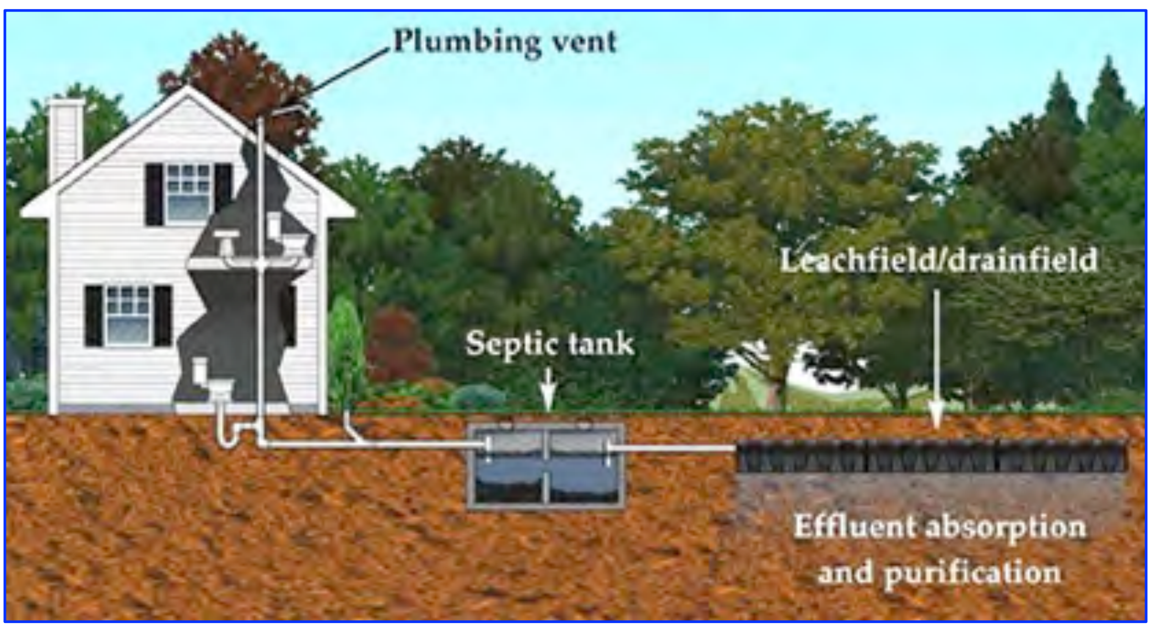
Septic systems provide treatment of wastewater from individual properties. Failing septic systems are typically an active source of pollutants. Faulty or leaking septic systems are sources of bacteria, nitrogen, and phosphorus. Typical national septic system failure rates are 10-20% and no failure rates are reported specifically for Wisconsin (U.S. EPA 2002). However, reported failure rates vary widely depending on the local definition of failure (U.S. EPA 2002).

Areas identified as residential and not within a sewered area were assumed to be served by onsite septic systems at a rate of one system per 0.5 acres. A 15% failure rate was used. Actual locations of failing systems are unknown, so an analysis of available GIS data was conducted to identify the potential for water quality impacts from septic systems. Data layers used included residential (urban and farm) boundaries, areas within a waste treatment district, and soils limited for septic fields. These layers were combined to determine the location and acreage of those residential areas with the highest likelihood of failing septic systems.

Out of a total of 228 acres of residential area believed to be on septic, 153 acres (67%) are located on limiting soils (Figure 13). The potential for phosphorus loading from failing septic systems focused on those residential areas are approximately 114 homes. It is possible that those septic systems on limiting soils will have the greatest chance for failing.

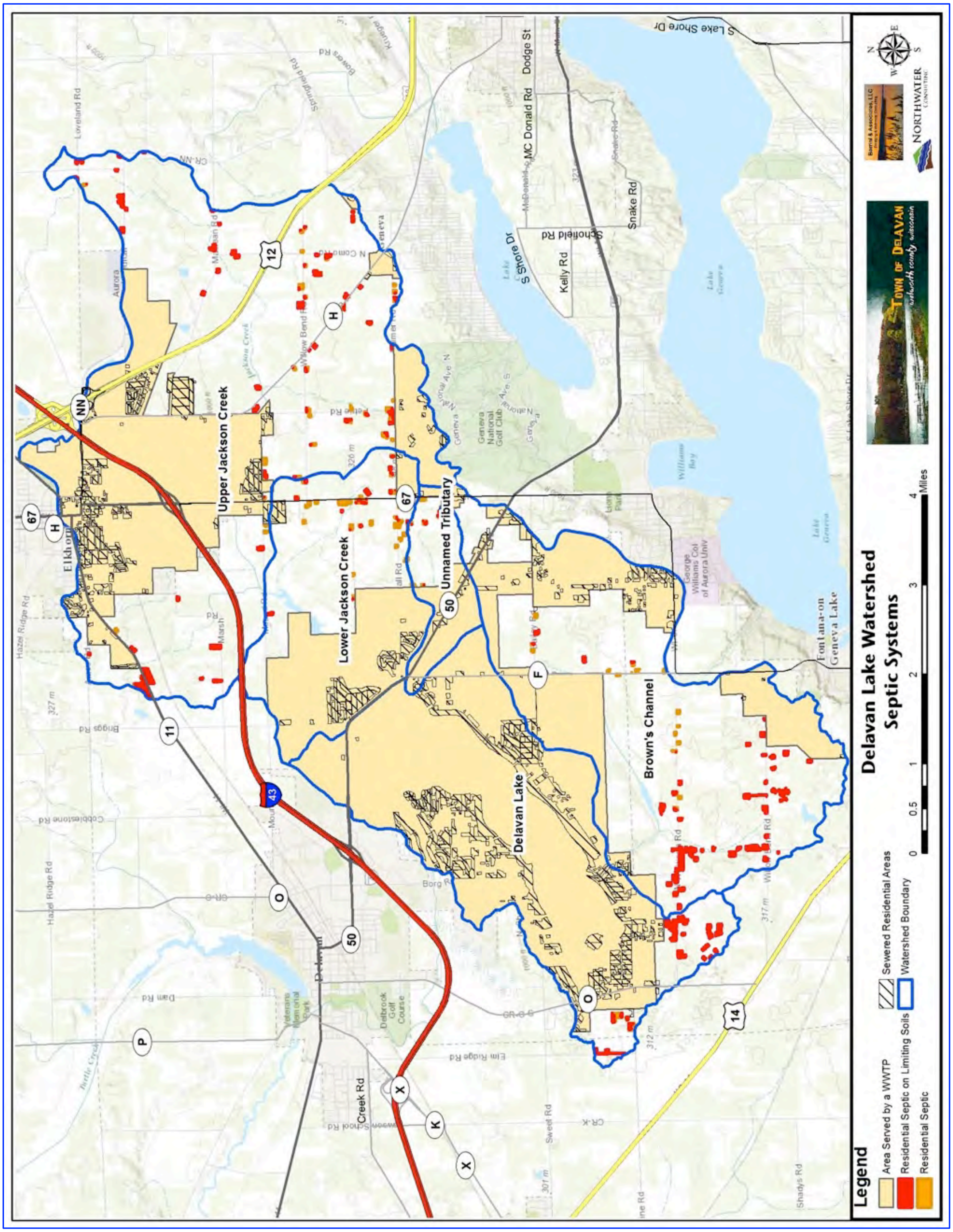
Number of Septic Systems	Population per Septic System	Septic System Failure Rate	Population on Failing Septic	Phosphorus Load (lbs/yr
114	2.43	15	41.6	208.21

Using a 15% failure rate for those septic systems only on limiting soils, phosphorus loading is estimated at approximately 140 lbs/yr.



Typical Domestic Septic System

Figure 13 – Existing Septic Systems



3.0 Causes & Sources of Watershed Impairments

A significant focus of this plan includes identifying causes and sources of sediment and phosphorus loading to the lake, as well as BMP recommendations for future implementation. A detailed review of previous and current planning efforts was completed; a detailed GIS analysis was conducted and a custom landuse layer was developed; a watershed-wide field assessment or windshield survey was completed; all available information was developed into a GIS map-based model, or *SWAMM*. Using information on soils, landuse and precipitation, this geospatial model has the ability to identify and quantify sources of pollutant loads at the field or parcel level. Based on model output results, a series of maps were generated that not only identify the sources of sediment and phosphorus loadings, but estimate and display annual loading by landuse and by location. Model results, combined with an analysis of available map data, indicated that the primary causes and sources of sediment and nutrient loading in the watershed are:

- Agriculture and cropped HEL soils
- Urban runoff
- Septic systems
- Lack of Detention

Although the 2011 Rock River Basin TMDL Plan did not specifically address Delavan Lake, Turtle Creek is located downstream of Delavan Lake and was addressed as being impaired for phosphorus and dissolved oxygen. For the purposes of this plan, Turtle Creek is not a direct drainage to Delavan Lake and is not included in the overall watershed implementation plan. However, improvements to the water quality of Delavan Lake will also reduce loadings to downstream locations. Impairments addressed will focus on Delavan Lake, but reductions in pollutant loadings and subsequent improvements in water quality in Jackson Creek and Delavan Lake will ultimately benefit Turtle Creek located downstream.

3.1 Analysis of Pollutant Loading Sources

The following section provides pollutant source descriptions identified at the significant subcategory level along with estimates to the extent they are present in the watershed.

3.1.1 Suspended Sediment & Phosphorus

Based on the results of the *SWAMM* and direct observations made during the watershed field assessment, it was determined that external sources of suspended sediment and phosphorus are originating primarily from cropped soils in the watershed and, to a lesser degree, from urban areas, such as residential areas surrounding the lake, paved roads, parking areas, commercial areas and pasture operations. Urban areas contribute nutrients primarily as a function of greater rates of runoff and less infiltration; the application of lawn fertilizers will also contribute to nutrient loading from urban areas. However, since only no-phosphate fertilizers are permitted in the Delavan Lake Watershed, phosphorus loading from lawns is generally low. With the exception of a small, localized portion of Jackson Creek upstream of the Mound Road Ponds, stream bank erosion does not appear to be a significant source of sediment loading based on direct field observations, available photographs and aerial imagery.

The Delavan Lake Watershed NPS *SWAMM* incorporates landuse data, soils and precipitation to calculate annual runoff using the Curve Number approach; literature-based Event Mean Concentrations (EMCs) and the Universal Soil Loss Equation (USLE) are incorporated to calculate loading. The model assumes uniform rainfall over the study area and uses a delivery ratio based on distance to a receiving waterbody (Delavan Lake). The Delavan Lake *SWAMM* was calibrated using existing water quality data and, as a result, calibrated model values were determined to be within acceptable ranges. The model does not specifically account for stream bank or gully erosion (see section 4.3 for estimates of gully erosion). Appendix A includes a complete model methodology.

Modeled NPS loadings of phosphorus and sediment by sub-watershed are presented in Table 16. Results indicated that on an annual basis, 3,340 pounds of phosphorus and 7,209 tons of sediment are delivered to the lake. This represents annual per acre loadings of 0.13 pounds for phosphorus and 0.27 tons of sediment. The greatest overall load of phosphorus and sediment is likely occurring from the upper Jackson creek sub-watershed and Browns Channel. Per-acre phosphorus loading is highest in the Delavan Lake sub-watershed, and the highest per-acre sediment load is originating from Lower Jackson Creek, although both Browns Channel and the Unnamed Tributary sub-watersheds export a relatively high per-acre sediment load.

Table 16. Sources of Nutrient Loads by Sub-Watershed

Sub-watershed Name	Watershed Area (Acres)	Annual Runoff (acre-feet)	Phosphorus Load (lbs/yr)	Per acre	Sediment Load (tons/yr)	Per acre
Brown's Channel	6,393	3,399	697	0.11	2,146	0.34
Delavan Lake	5,598	6,858	936	0.17	975	0.17
Lower Jackson Creek	3,107	2,356	404	0.13	1,520	0.49
Unnamed Tributary	705	415	90	0.13	288	0.41
Upper Jackson Creek	10,512	7,561	1,213	0.12	2,281	0.22
Grand Total	**26,315**	**20,589**	**3,340**	**0.13**	**7,209**	**0.27**

3.1.2 Critical Pollutant Loading Areas

Critical areas are those locations throughout the watershed where implementation activities should be focused with the intent of achieving the greatest "bang-for-the-buck." Critical areas for the Delavan Lake Watershed include Highly Erodible Soils (HEL), eroding gullies and agricultural tillage practices identified through a field assessment of the watershed. Actions addressing these critical areas will have the greatest value and benefit to the watershed.

3.1.3 Highly Erodible Land (HEL) Soils

According to the NRCS, Highly Erodible Land (HEL) is cropland, hayland or pasture that can erode at excessive rates, containing soils that have an erodibility index of eight or higher. If a producer has a field identified as highly erodible land and wishes to participate in a voluntary NRCS cost-share program, that producer is required to maintain a conservation system of practices that reduce erosion rates and soil loss. Fields that are determined not to be highly erodible land are not required to maintain a conservation system to reduce erosion (NRCS, 2014). Soils shown include both HEL and Predominantly HEL (PHEL) soils. PHEL are soils that can be either HEL or non-HEL depending on site specifics. Numerous counties were given special approval in 1997 to allow planning on PHEL soils for a conservation planning Alternative Cropping System (ACS). These soils, when HEL, could be planned for up to two times the tolerable soil loss and meet the ACS. Two to four times the tolerable soil loss could be used for planning with an ACS, if approved by the State Conservationist. Slope lengths can vary widely within a specific soil type and, therefore, special provisions were made to allow PHEL soil map units to use minimal tillage after soybeans, and still meet the ACS level of treatment (Agricultural Watershed Institute, 2014).

There are 10,759 acres (41%) of HEL and PHEL soils throughout the watershed; of this, 3,063 acres (12%) are classified as HEL and 7,696 (29%) as PHEL. Table 17 provides a breakdown of HEL and PHEL soils for Delavan Lake Watershed and Figure 13 shows the distribution in the basin. Comparing the distribution of HEL and PHEL soils in the watershed, Brown's Channel and the Unnamed Tributary sub-watersheds have the highest total percent of HEL and PHEL soils. Additionally, HEL soils within the Delavan Lake direct drainage are, on average, within 2,134 feet from the lake compared to a watershed-wide average of 9,510 feet and an average distance of 8,035 feet for Brown's Channel.

Table 17. Highly Erodible Land (HEL) by Sub-Watershed

Sub-watershed Name	Watershed Area (Acres)	HEL	Percent HEL	PHEL	Percent PHEL	Total	Percent Total	Average Distance to Lake (ft)
Brown's Channel	6,393	1,195	18.69%	2,684	41.99%	3,879	60.68%	8,035
Delavan Lake	5,598	898	16.05%	1,603	28.64%	2,501	44.68%	2,134
Lower Jackson Creek	3,107	465	14.97%	977	31.43%	1,442	46.40%	7,423
Unnamed Tributary	705	94	13.26%	428	60.72%	522	73.99%	5,944
Upper Jackson Creek	10,512	411	3.91%	2,004	19.07%	2,416	22.98%	18,476
Grand Total	**26,315**	**3,063**	**11.64%**	**7,696**	**29.25%**	**10,759**	**40.89%**	**9,510 (avg.)**

3.1.4 Cropped HEL Soils

Crop ground within the watershed was overlaid on map layers representing HEL and PHEL soils to determine the extent to which these soils are currently being cropped. Crop ground that is also considered HEL is likely to have some form of conservation practice or tillage practice in place that limits soil erosion. However, HEL soils can potentially erode at a higher rate and should be considered as potential project locations for reducing suspended sediment delivered to the lake. There are 5,561 acres (21%) of HEL and PHEL soils throughout the watershed currently being farmed, or approximately one-half of all the HEL and PHEL soils in the watershed; of this, 1,368 acres (5%) are classified as HEL and 4,193 (16%) as PHEL. The Unnamed Tributary drainage has the highest percentage of cropped HEL soils (42%), followed closely by Browns Channel (37%). Additionally, HEL soils within the Delavan Lake direct drainage are on average within 2,886 feet from the lake compared to a watershed wide average of 9,958 feet and an average distance of 6,611 feet for the Unnamed Tributary and 8,011 feet for Brown's Channel. Table 18 provides a breakdown of cropped HEL and PHEL soils for Delavan Lake and Figure 14 shows the distribution in the basin.

Table 18. Cropped HEL Soils by Sub-Watershed

Sub-watershed Name	Watershed Area (Acres)	Cropped HEL	Percent Cropped HEL	Cropped PHEL	Percent Cropped PHEL	Total	Percent Total	Average Distance to Lake (ft)
Brown's Channel	6,393	673	10.53%	1,680	26.27%	2,353	36.80%	8,011
Delavan Lake	5,598	179	3.20%	442	7.89%	621	11.09%	2,886
Low. Jackson Ck.	3,107	254	8.18%	637	20.50%	891	28.67%	8,274
Unnamed Trib.	705	55	7.81%	240	34.08%	295	41.89%	6,611
Up. Jackson Ck.	10,512	207	1.96%	1,195	11.37%	1,402	13.33%	18,986
Grand Total	**26,315**	**1,368**	**5.20%**	**4,193**	**15.94%**	**5,561**	**21.13%**	**9,958 (avg.)**

Table 19 summarizes the tillage practices observed during the 2015 windshield survey. Approximately 10 percent of the cropped area was using Conventional Tillage, 40% of the cropped area was using Mulch-Till, 24% was using Spring-Till, and 21 percent of the cropped area was in No-Till (see Figure 15).

Table 19 – Summary of Tillage Practices by Sub-Watershed

Sub-watershed Name	Total Crop Land Area (acres)	Acres Conventional Tillage	%	Acres Mulch-Till	%	Acres Spring-Till	%	Acres No-Till	%
Brown's Channel	3,928	207	5%	1,919	49%	252	6%	1,160	30%
Delavan Lake	1,166	46	4%	381	33%	387	33%	342	29%
Lower Jackson Creek	1,689	330	20%	883	52%	437	26%	35	2%
Unnamed Tributary	381	4	1%	242	63%	122	32%	0	0%
Upper Jackson Creek	6,186	737	12%	1,951	32%	1,983	32%	1,288	21%
Total	**13,351**	**1,324**	**10%**	**5,376**	**40%**	**3,181**	**24%**	**2,825**	**21%**

Figure 14 – Highly Erodible Land (HEL) Soils

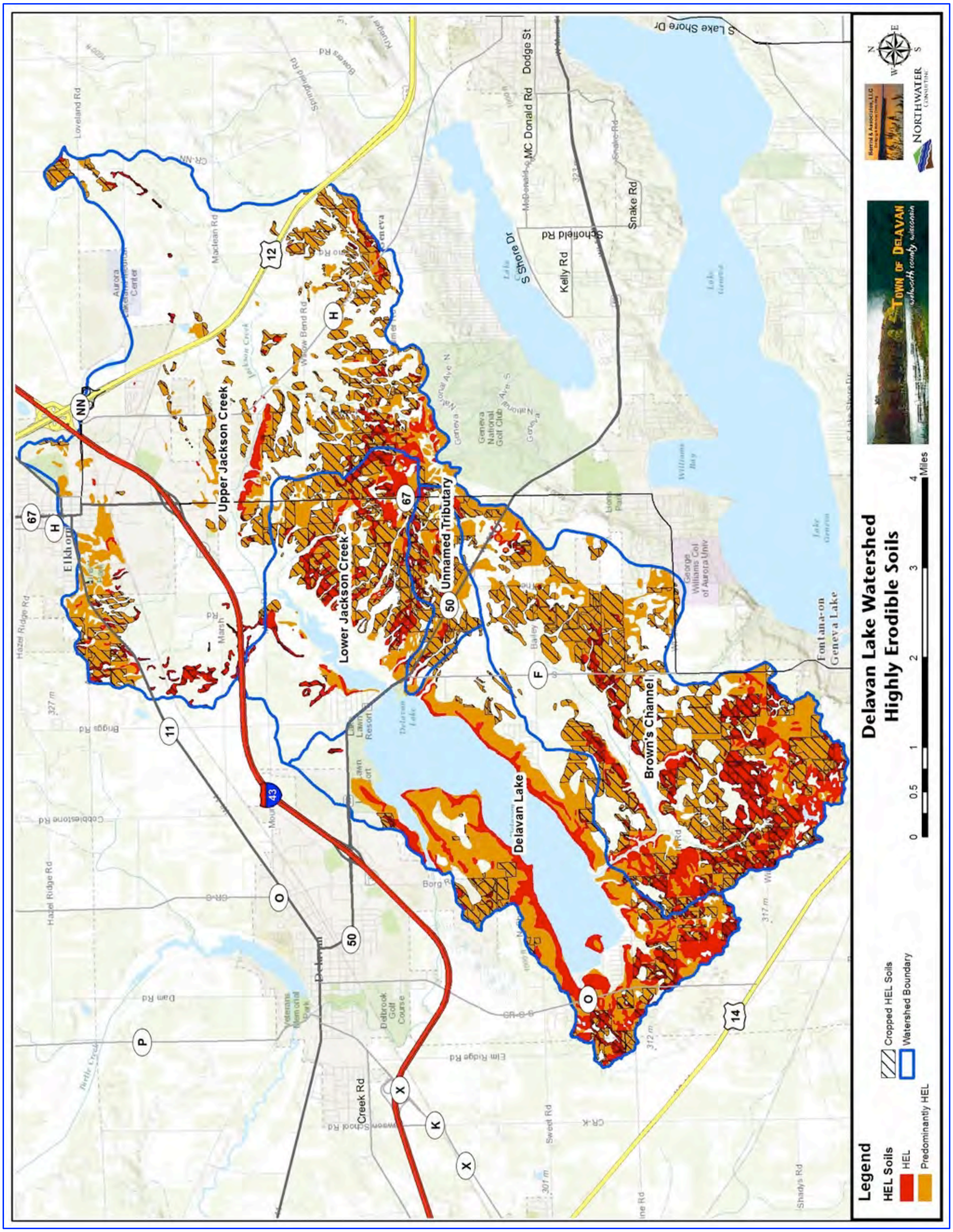
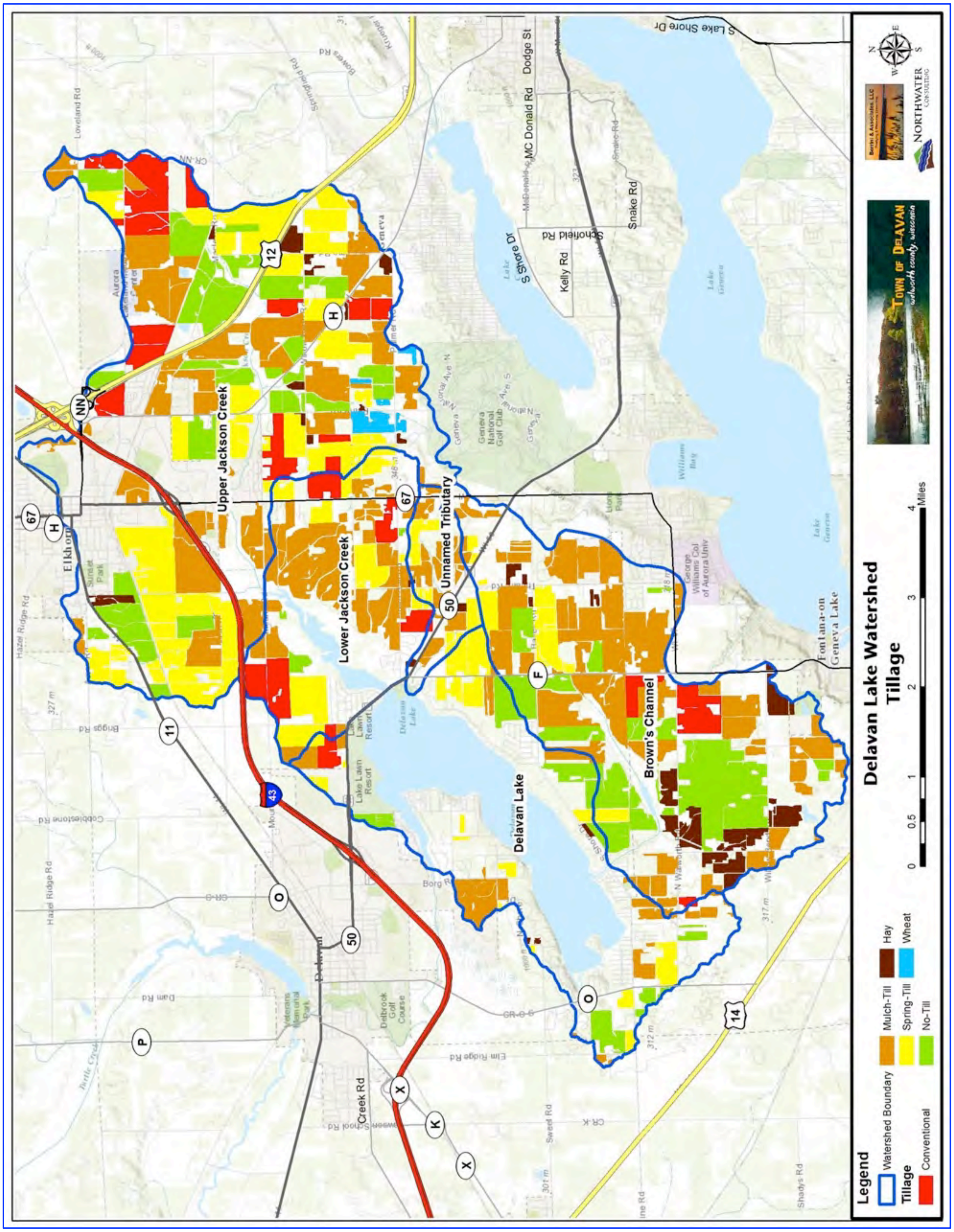


Figure 15 – Current Tillage Practices



3.1.5 Septic Limiting Soils

Outside of regional and municipal wastewater districts, residents within the Delavan Lake Watershed use septic systems to manage and treat wastewater. Just over 48% of the watershed (12,653 acres) is outside of a wastewater or sewer district.

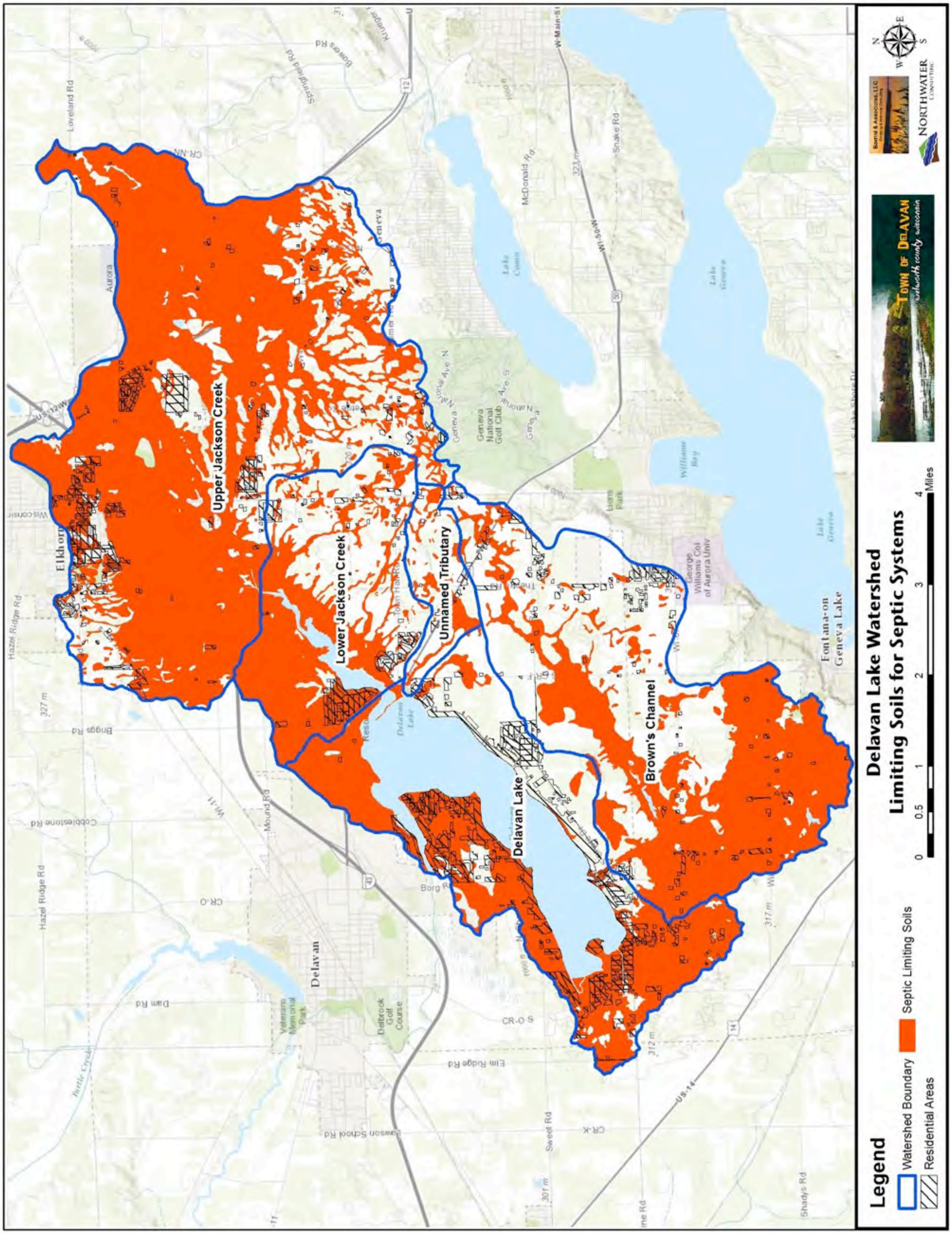
Not all soil types support septic systems; improperly constructed systems can lead to failure and allow leaching of wastewater into groundwater and surrounding waterways (Northwater, 2014). The NRCS provides generalized soil suitability for septic drain field maps. The suitability ranking is based on several factors: depth to water table, permeability rate, flooding potential and topography (Northwater, 2015). An analysis of soil suitability data indicates that 58%, or 15,274 acres (Table 20), of soils within the watershed are classified as "very limited" with respect to septic suitability.

Table 20. Septic Limiting Soils by Sub-watershed

Sub-watershed Name	Sub-Watershed Area (Acres)	Septic Limiting Soils (Acres)	Septic Limiting Soils (Percent)
Brown's Channel	6,393	3,192	50%
Delavan Lake	5,598	2,527	45%
Lower Jackson Creek	3,107	1,572	51%
Unnamed Tributary	705	195	28%
Upper Jackson Creek	10,512	7,789	74%
Grand Total	**26,315**	**15,274**	**58%**

The highest percentage falls within the Upper Jackson Creek sub-watershed. This does not necessarily mean that all of these soils are unsuitable for septic but caution should be taken when establishing systems in these areas. Figure 16 illustrates the extent of limiting soils for septic fields, along with the location of residential areas within the watershed. A map of areas in the watershed that have existing septic systems and areas that are served by a Wastewater Treatment Plant can be found in Figure 15. The data used to generate this map is based on available County data and there may be minor differences in locations as shown.

Figure 16 – Limiting Soils for Septic Systems



3.16 Eroding Gullies

Gully erosion is the removal of soil along drainage lines by surface water runoff. Once started, gullies will continue to move by headward erosion or by slumping of the sidewalls, unless steps are taken to stabilize the disturbance. Gully erosion occurs when water is channeled across unprotected land and washes away the soil along the drainage lines (see Figure 17). Under natural conditions, runoff is moderated by vegetation, which generally holds the soil together, protecting it from excessive runoff and direct rainfall. To repair gullies, the objective is to divert and modify the flow of water moving into and through the gully so that scouring is reduced, sediment accumulates and vegetation can establish. Stabilizing the gully head is important to prevent damaging water flow and headward erosion. In most cases, gullies can be prevented by good land management practices (Water Resources Solutions, 2014).

Gully erosion in the Delavan Lake Watershed was evaluated during a watershed windshield survey in 2015 and by historical aerial photo analysis. Gully dimensions were observed and recorded in the field using GPS and transferred to GIS to estimate sediment and nutrient loading. A total of 30 eroding gullies were observed in the field and confirmed via aerial imagery. Total net loading in tons/year and estimates of phosphorus loading were calculated using GIS and equations derived from the USEPA worksheet for “Estimating Load Reductions for Agricultural and Urban BMPs” that uses the “Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual (Michigan DEQ, 1999). A distance-based delivery ratio was applied to account for a gully’s distance from a receiving water body.

Eroding Gully

Figure 17 – Examples of Eroding Gullies

4.0 Pollutant Loading, Nonpoint Source Management Measures & Load Reductions

4.1 Introduction & Methodology

In March of 2015, a watershed windshield survey was completed to gain an understanding of watershed conditions and features, collect field-specific data, and identify management measures to be implemented with willing landowners. Data collected in the field included:

- Tillage practices
- Cover types
- Project (BMP) locations and site suitability
- Sources of sediment and gully erosion

Land parcels with high-priority BMP locations were identified during the watershed windshield survey and through interpretation of aerial imagery that resulted in the identification of a series of site-specific BMP locations. Drainage areas were then delineated for each site.

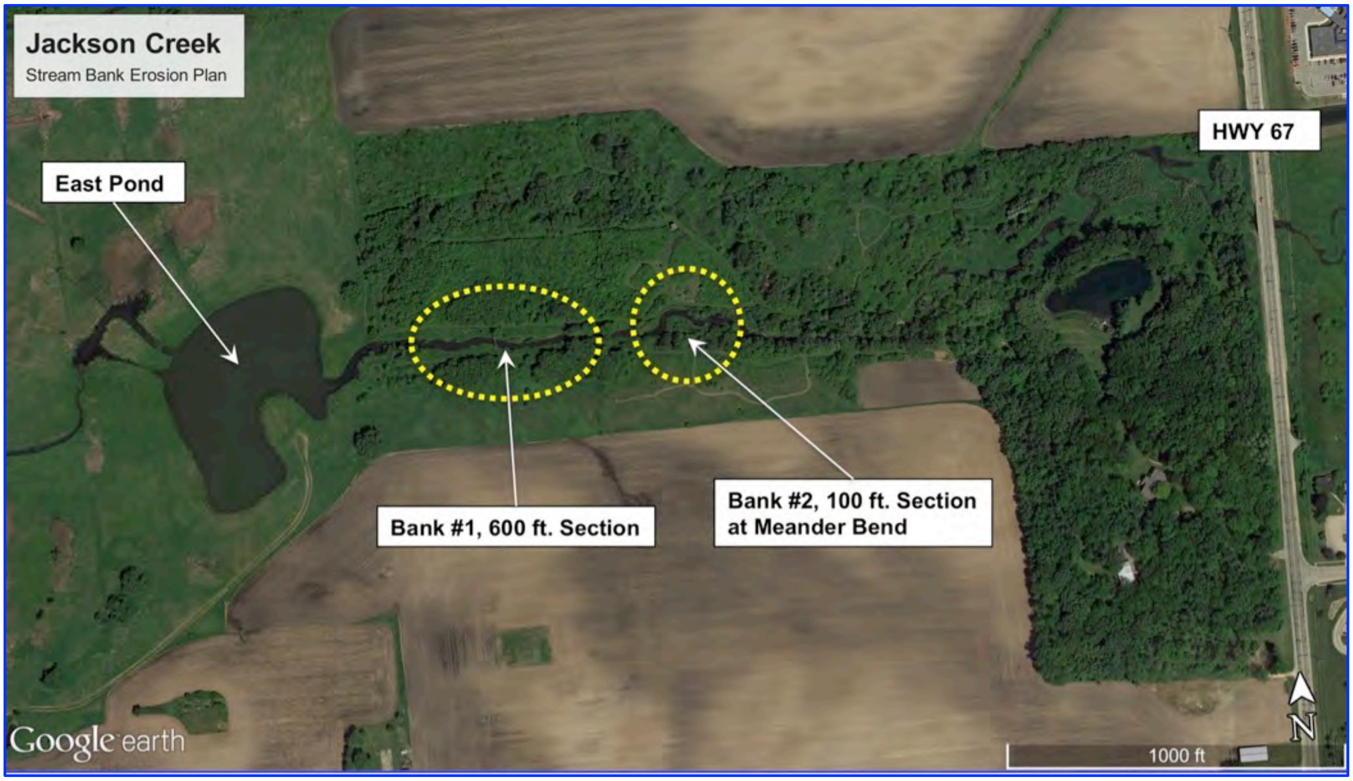
A spatially explicit and field-specific GIS-based pollutant loading model was then developed for the Delavan Lake Watershed. A model methodology is provided in Appendix A. In addition, information collected in the field was incorporated into the model, such as tillage practices, gully erosion and existing conservation practices.

4.2 Pollutant Loading

Overall, Nonpoint Source (NPS) pollutant load estimates in the Delavan Lake Watershed are presented in this section. Estimates are provided for loading resulting from direct runoff, observed conditions, and modeled land use categories. Gully erosion was observed in the field to the extent it was visible and erosion calculations and loading estimates are summarized below. Stream bank erosion was not directly assessed since watershed-wide observations indicated that stream bank erosion was not a significant problem within the Delavan Lake Watershed. General estimates were made using GIS, an average bank height and an average lateral recession rate. Major streams received an average eroding bank height of 3.0 ft. and an average lateral recession rate of 0.1 ft./yr., or moderate, for estimation purposes. All other tributary streams received an average eroding bank height of 1.5 ft. and a lateral recession rate of 0.05 ft./yr.

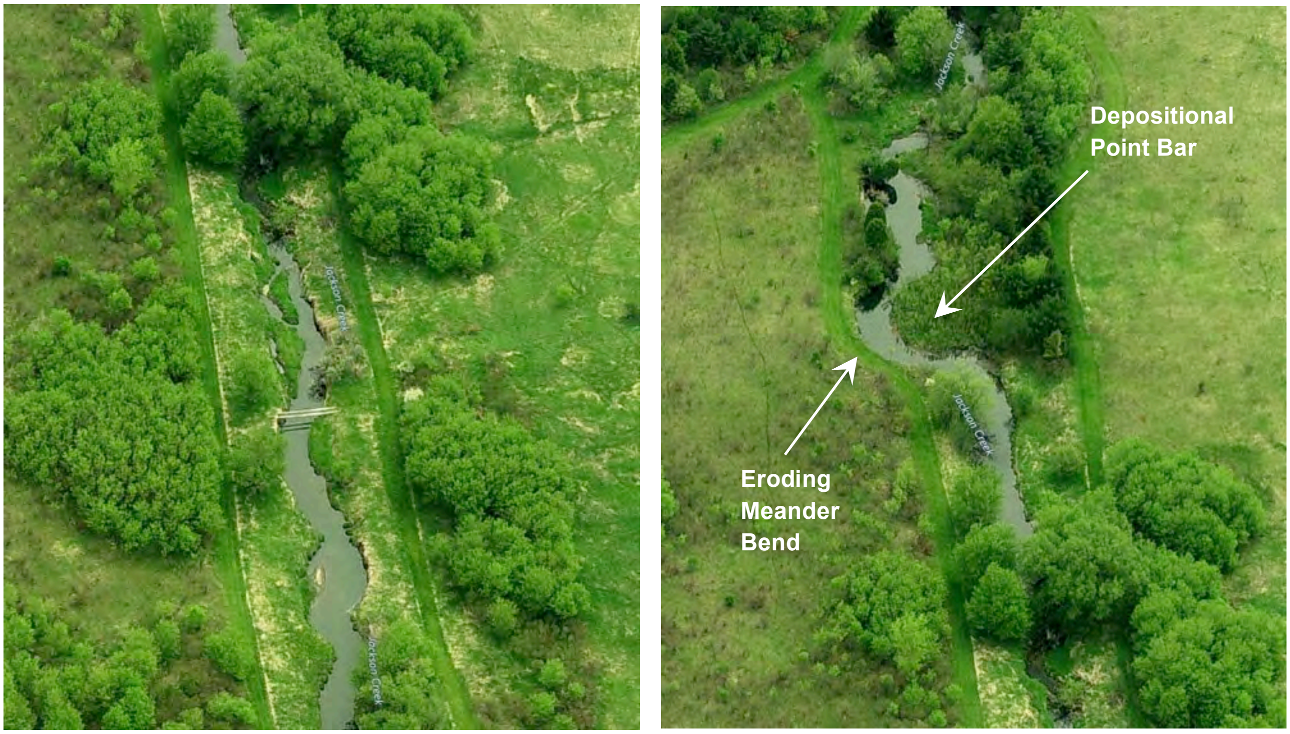
However, various portions of Jackson Creek located between East Pond and Hwy 67 generally exhibited higher bank heights than the remainder of Jackson Creek and were assessed using estimates based on ground level observations, available site photographs and historical aerial imagery (see Figures 18 and 19 below). Lateral recession rates were based on estimates obtained from overlapping historical aerial imagery. The more linear stream reach located directly upstream of East Pond was assigned a lateral recession rate of 0.5 ft. per year for the approximate 600 ft.-long section with observed erosion; and the eroding meander bend located closer to Hwy 67 was assigned a 1.0 ft. per year lateral recession rate based on historical aerial image measurements for the approximately 100 ft.-long outside meander bend. An average eroding bank height of 6.0 ft. was used for estimating purposes. The loading calculations shown below are based on the USEPA worksheet for "Estimating Load Reductions for Agricultural and Urban BMPs" that uses the "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual (Michigan DEQ, 1999). The loading estimate for eroding sections of Jackson Creek is: Bank #1 = 600 feet, sediment load = 26 tons per year and phosphorus load = 26 pounds per year; and Bank #2 = 100 feet, sediment load = 77 tons per year and phosphorus load = 77 pounds per year.

Figure 18 – Jackson Creek Stream Bank Erosion Location Map



Based on direct observations and historical aerial image analysis, it appears that although stream bank erosion is occurring along the channelized portion of Bank #1, this section of Jackson Creek is relatively stable and re-establishes bank stability after periodic storm event occurrences. The eroding bank at the outside meander bend (Bank #2) can benefit from stone toe protection and stream barbs or selective riffles to divert erosive energy away from the eroding bank.

Figure 19. Oblique Aerial Views of Eroding Stream Banks



The following equations were used to estimate pollutant loadings from observed gully erosion:

Sediment (tons/yr.) = Length (ft.) * Height (ft.) * Lateral Recession Rate (ft./yr.) * Soil Weight Dry Density (tons/ft3)

Phosphorus (lbs./yr.) = Sediment (tons/yr.) * N concentration in soil (0.0005 lbs./lb.) X 2,000 (lbs./ton) * Corr. Factor

Delivery Ratio = Gully Distance from Stream $^{\wedge}{}_{-0.2069}$

The 30 actively eroding gullies observed within the Delavan Lake Watershed deliver an estimated annual sediment load of 388 tons, and an annual phosphorus load of 388 pounds. Total observed gully length is estimated to be 31,175 feet, or approximately 5.9 miles. Additional gully erosion has been observed through historical aerial imagery analysis but has not been delineated and quantified for this report.

Table 21 provides modeled loading estimates by land use category. Cropland delivers the greatest total quantity of sediment and phosphorus to the lake. On a per-acre basis, cropland delivers the highest load of sediment. However, row crops are not responsible for the greatest per-acre loading of phosphorus.

Results from the GIS-based pollutant load model are illustrated in Figures 20 and 21. Aerial photos taken by DLSD after a significant 2008 rain event are included for informational purposes.

Table 21. Modeled Loading Estimates by Land Use Category

Landuse Category	Acres	Annual Runoff (acre-feet)	Phosphorus Load (lbs/yr)	Per Acre (lbs/yr)	Sediment Load (tons/yr)	Per Acre (tons/yr)
Cropland; Row Crops	13,351	8,656	2,090	0.16	7,016	0.53
Open Water - Pond	2,053	5,380	332	0.16	10	0.005
Residential Single-Family Low Density	1,141	528	138	0.12	27	0.02
Freeway	294	606	101	0.34	23	0.08
Local Street	267	553	94	0.35	21	0.08
Residential Single-Family Medium Density	707	481	92	0.13	27	0.04
Pasture	959	383	83	0.09	9	0.01
Parking	210	330	49	0.24	11	0.05
Forest	2,053	548	46	0.02	9	0.004
Urban Open Space	1,145	453	40	0.03	3	0.003
Retail	119	152	38	0.32	9	0.07
Wholesaling and Storage	139	172	24	0.18	6	0.04
Farm Building	226	146	23	0.10	6	0.02
Golf Course	124	54	19	0.15	3	0.02
Rural Open Space	1,182	294	18	0.02	1	0.001
Arterial Road	78	129	18	0.23	4	0.05
Government and Institutional	94	117	18	0.19	4	0.05
Multi-Family Low Rise	96	97	17	0.17	5	0.06
Recreation - Park	200	68	13	0.07	1	0.005
Orchards and Nursery	220	68	13	0.06	2	0.01
Open Space - Road	73	45	10	0.13	1	0.01
Sod Farm	61	35	9	0.15	1	0.01
Wetland	1,187	942	8	0.01	0.35	0.0003
Manufacturing	52	73	8	0.15	3	0.05
Feed Area	12	11	8	0.65	1	0.05
Recreation - Cultural	67	73	7	0.11	2	0.03
Residential Two-Family	40	34	3	0.08	1	0.02
Communication and Utilities	20	21	3	0.13	0.50	0.03
Mobile Homes	21	16	2	0.12	0.44	0.02
Railroad Right-of-Way	30	19	2	0.08	1	0.03
Air Field	6	11	2	0.34	0.48	0.08
Composting	11	6	2	0.19	0.35	0.03
Resource Extraction	19	17	2	0.10	0.30	0.02
Bus Terminal	6	13	2	0.25	1	0.09
Air Terminal and Hangar	7	8	2	0.24	1	0.08
Open Water - Stream	10	27	1	0.11	0.02	0.002
Confinement	4	5	1	0.27	0.13	0.04
Truck Terminal	5	7	1	0.14	0.24	0.04
Residential Single-Family Suburban Density	8	4	1	0.06	0	0.01
Landfill	5	5	1	0.10	0.19	0.04
Cemeteries	4	2	0.34	0.08	0.06	0.01
Local Street - Permeable	6	1	0.22	0.04	0.05	0.01
Freeway Wetland	3	1	0.08	0.03	0.00	0.001
Arterial Road Wetland	0.25	0.07	0.01	0.03	0.0003	0.001

Figure 20 - Modeled Annual Phosphorus Loading Map

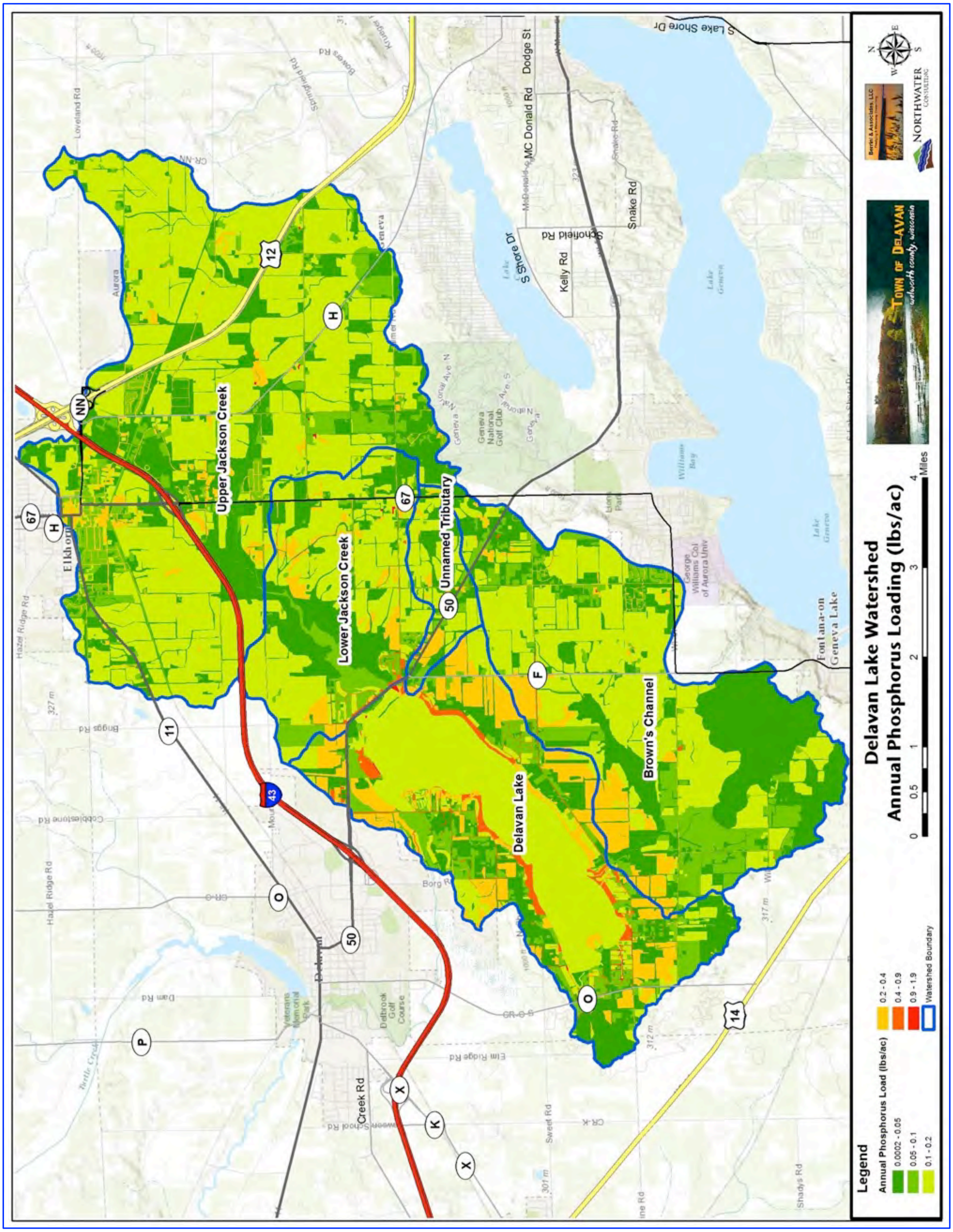


Figure 21 - Modeled Annual Sediment Loading Map

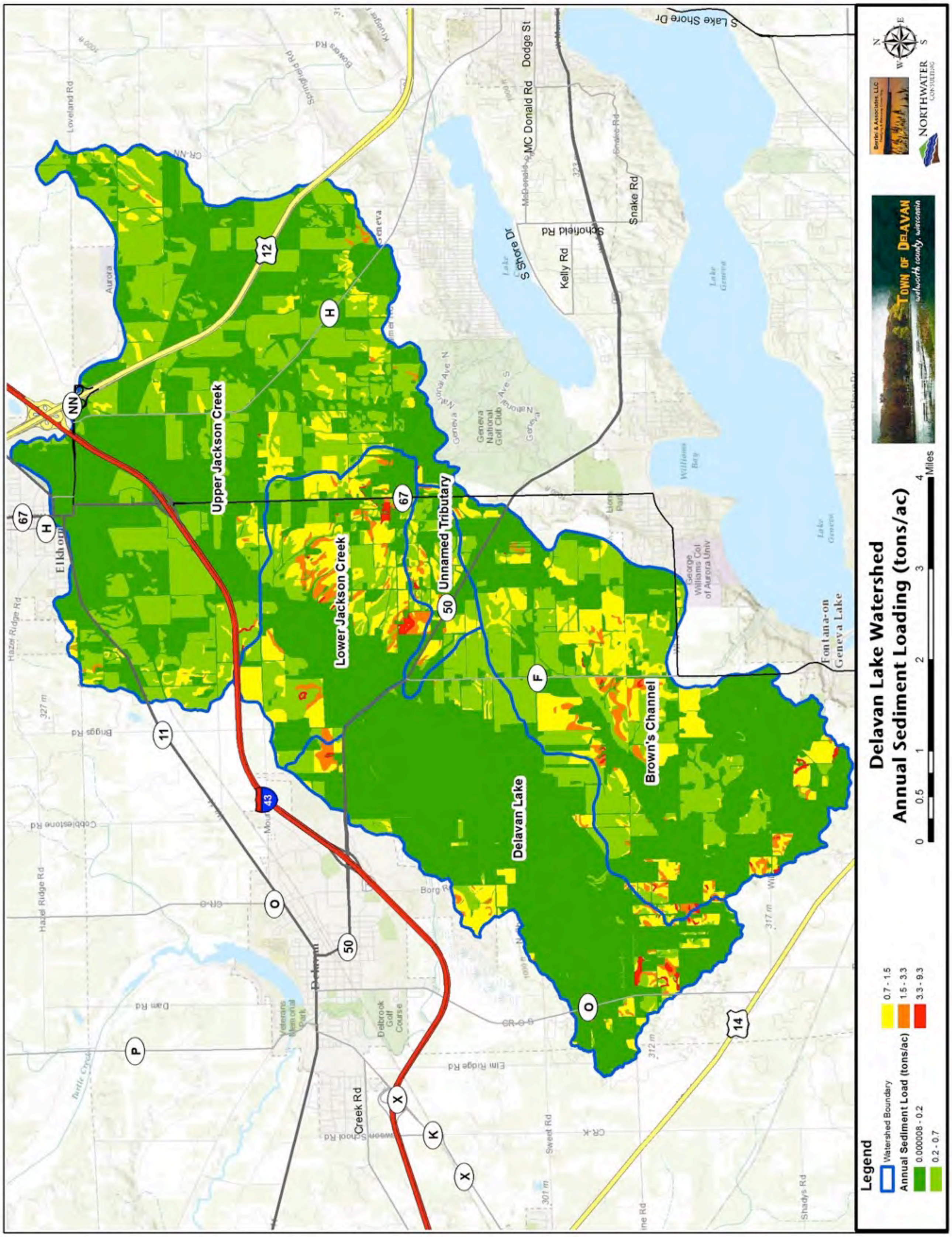


Figure 22. Aerial Photos Taken after Significant 2008 Rain Event

4.3 Best Management Practices & Expected Load Reductions

A watershed windshield survey was completed In March of 2015 to gain an understanding of watershed conditions and features and to collect field-specific data. High-priority BMP locations were identified in the field and mapped using GIS. These BMPs, combined with an interpretation of aerial imagery and land use information, resulted in the identification of a series of site-specific BMP locations. Project boundaries or drainage areas were then delineated for each site.

Identified BMP projects were run through the GIS-based pollution loading model and expected annual load reductions were calculated using literature-based pollution removal efficiencies for phosphorus and sediment, as well as by professional judgment.

This section describes the BMPs recommended for the Delavan Lake Watershed, their applicable quantities and expected annual pollutant load reductions.

Best Management Practices (BMPs) can be described as a practice or procedure to prevent or reduce water pollution and address stakeholder concerns. BMPs typically include treatment requirements, operating procedures, and practices to control runoff and abate the discharge of pollutants. This section of the plan will describe both site-specific BMPs, as well as those that can be applied to a field as a whole or basin-wide to achieve measurable load reductions in phosphorus and sediment. Average pollutant reduction percentages that are based on existing literature, and local expertise, can be found in Table 22.

Table 22 - Average Pollutant Reduction Percentages for Recommended BMPs

BMP	Reduction % Phosphorus	Reduction % Sediment
WASCB[1]	60%	65%
Grade Control/Riffle[1]	40-45%	45-50%
Detention Basin/Pond	30-50%	40-70%
Livestock Management System	50%	60%
Feed Area Waste System	70%	75%
Blind Inlet	50%	70%
Grassed Waterway[1]	5-35%	10-45%
Filter Strip	40-55%	45-65%
Field Border	45%	55%
Porous Pavement	55%	70%
Rain Garden, Rain Barrel, Rock Infiltration	50-65%	65%
Wetland	35-60%	45-75%
No-Till	30%	40%
Cover Crop	30%	40%

[1] – Controls 100% of gully erosion

Berrini & Associates, LLC Dredging & Waterway Consulting

Town of Delavan walworth county, wisconsin

Northwater Consulting

4.3.1 Best Management Practice Summary

This section provides a brief description of each BMP recommended in the plan, both basin-wide and site-specific.

Blind Inlet

A blind inlet is defined as an excavated earthen box with perforated collector tubing placed in the bottom and filled to the surface with rock or gravel. The rock is the inlet for surface water. Two (2) blind inlet systems are recommended for Delavan Lake to treat 22 acres. The approximate load reductions expected if two blind inlets are implemented are approximately 1.2 lbs./year of phosphorus, and 10 tons/yr of sediment.

Cover Crops

A cover crop is a temporary vegetative cover that is grown to provide protection for the soil and improve soil conditions. Cover crops can be applied over a broad area in the watershed, primarily where no-till, strip-till or conservation tillage is occurring. Cover crops are recommended for all fields where no-till is currently being practiced. Cover crops are recommended on 2,824 acres of crop ground currently practicing no-till. If fully implemented, this practice will result in phosphorus reductions of 132 pounds and 282 tons of sediment annually.

No-Till

No-till can be defined as farming where the soil is left relatively undisturbed from harvest to planting. During the planting operation, a narrow seedbed is prepared or holes are drilled in which seeds are planted. A switch from conventional tillage to no-till is often a prerequisite for the installation of cover crops and, therefore, is recommended for all fields in the watershed where conventional, mulch or spring tillage is occurring. Approximately 9,886 acres of no-till are recommended throughout the watershed. Although an estimated 21% of the watershed is currently farmed using no-till practices, additional no-till acreage is highly recommended. If fully implemented, phosphorus loading can be reduced by 485 pounds annually and sediment loading can be reduced by 2,507 tons annually.

Water and Sediment Control Basins (WASCB)

A WASCB is an earth embankment and/or channel constructed across a slope to intercept runoff water and trap soil. WASCBs are often constructed to mitigate gully erosion where concentrated flow is occurring and where drainage areas are relatively small. Terraces, similar to a WASCB in design, are placed in areas where concentrated flow paths are less defined, such as long, wide-sloping fields. A total of nine (9) individual WASCBs are recommended. If implemented, these practices will result in phosphorus load reductions of 39 pounds and sediment reductions of 51 tons annually.

Field Borders

A field border is a type of conservation buffer consisting of a grassy border along one or more edges of a field. In addition to the soil and water protection provided by the perennial vegetation, field borders can be designed to provide other environmental and practical benefits. For example, field borders can straighten irregular field boundaries and provide space to turn and park tractors during field operations. Field borders can also harbor natural predators of crop pests and provide wildlife habitat. Field borders are recommended for two fields in the watershed to treat 36 acres. If implemented, these practices will result in phosphorus reductions of 4 pounds and sediment reductions of 38 tons annually.

Grassed Waterway

A grassed waterway is a grassed strip in a field that acts as an outlet for water to control silt, filter nutrients and limit gully formation. Grassed waterways are applicable in the watershed in areas with very large drainage areas and low-moderate slopes. A total of 27 grassed waterways are recommended in the watershed. These 27 waterways total approximately 55,150 feet or 76 acres. If fully implemented, these BMPs will result in annual phosphorus reductions of 408 pounds and 612 tons of sediment. It is important to note that significant load reductions can be achieved by the elimination of ongoing gully erosion at these specific locations and that additional nutrient removal can be achieved by vegetative filtration. However, the elimination and prevention of gully erosion is the primary purpose of these grassed waterways.

Constructed Wetland

A constructed wetland is a shallow water area constructed by creating an earth embankment or excavation area. Constructed wetlands can include a water control structure and are designed to mimic natural wetland hydrology, store sediment and filter nutrients. Constructed wetlands have been identified throughout the watershed and, in most cases, represent an area that was once a functioning wetland. Wetlands are recommended at 22 sites throughout the watershed totaling 33 acres. If implemented, these wetlands will achieve phosphorus reductions of 73 pounds and sediment reductions of 251 tons of sediment annually.

Filter Strip

A filter strip is a narrow band of grass or other permanent vegetation used to reduce sediment, nutrients, pesticides and other contaminants. Only those areas directly adjacent to an openly flowing ditch or stream where existing buffer areas are either inadequate or nonexistent were selected for the placement of filter strips. Filter strips are recommended at 8 sites and total 15,074 ft. or 11.7 acres. If fully implemented, these filter strips will result in phosphorus reductions of 10 pounds and sediment reductions of 16 tons annually.

Grade Control Structure/Rock Riffle

A grade control structure or rock riffle is a rock structure constructed in a stream channel or gully to stabilize grade. In the Delavan Lake Watershed, grade control structures are recommended at locations where slopes are very steep and gully erosion is considered very severe; areas where WASCBs, terraces or grassed waterways are just not feasible. Eight (8) individual grade control structures or riffles are recommended in the watershed at two locations in combination with detention. If implemented, these BMPs will result in phosphorus reductions of 4.4 pounds and 20 tons of sediment annually.

Detention Basin/Pond

A detention basin or pond is a sediment or water impoundment made by constructing an earthen dam. Detention basins are recommended for both urban and agricultural areas and, in many cases, can be combined with other BMPs, such as wetlands or grade control practices, to maximize pollutant removal. In the Delavan Lake Watershed, basins are recommended to address the current lack of stormwater detention. For undetained developed areas, detention is recommended on 1,595 acres throughout the watershed. If detention is implemented to capture runoff from all 1,595 acres, phosphorus will be reduced by 123 pounds and sediment will be reduced by 41 tons annually. Nine (9) additional detention basins have been reccommended at specific BMP sites (Figure 27). If fully implemented, these additional sites will achieve phosphorus reductions of approximately 33 pounds and sediment reductions of approximately 91 tons annually.

Livestock Feed Area Waste System

Once a site has been identified in the watershed, an integrated system can be constructed to manage livestock waste. The feed area system includes three individual practices working in series; a settling basin to capture solids, a rock spreader and vegetated swale for initial waste treatment and, finally, a treatment wetland to capture and treat the remaining waste. A feed area waste system is recommended at six (6) sites for a total treatment area of 3.5 acres. If implemented, this practice will reduce phosphorus loads by 3 pounds and sediment by 0.24 tons annually. One additional site, identified during the windshield survey, is recommended. At this location, a diversion and a roof gutter system is also recommended in addition to the waste system proposed below; if implemented, this project will treat six (6) acres and will result in phosphorus reductions of approximately one (1) pound annually and sediment reductions of 0.24 tons annually.

Pasture Management System

Once a site has been identified, an integrated pasture management system is designed to control runoff. This system typically includes a diversion to route contributing drainage (clean water) around the pasture, WASCBs or other sediment trapping practices placed in the pasture to control erosion and trap solids within the pasture, wetlands constructed to treat any contaminated runoff draining to the stream, and stream fencing and alternative water supplies, if needed. A pasture management system is recommended on 12 pasture sites, totaling 55 acres. If implemented, this practice will reduce phosphorus loading by 7 pounds and sediment by 1.1 tons annually.

Rain Barrels, Rain Gardens, Rock Infiltration or Permeable Pavement

A combination of rain barrels, rock infiltration, rain gardens (or bio-swales), and porous pavement are recommended, primarily in the urban areas of the watershed within close proximity to the lake. A rain barrel is a barrel used as a cistern to hold rainwater from residential roof runoff.

Rock infiltration consists of an excavated pit or trench filled with rock that stores runoff underground, in order to divert, clean and infiltrate runoff water. A rain garden is a planted depression that allows rainwater runoff from impervious urban areas, including roofs, driveways, walkways, parking lots, and compacted lawn areas, the opportunity to be filtered and absorbed.

Porous/Permeable Pavement is a method of paving that allows stormwater to seep into the ground as it falls, rather than running off into storm drains and waterways. Permeable pavements function similarly to sand filters, in that they filter the water by forcing it to pass through different aggregate sizes and typically some sort of filter fabric. Therefore, most of the treatment is through physical processes. As precipitation falls on the pavement, it infiltrates down into the storage basin and is slowly released into the surrounding soil.

A combination of rain barrels, rock infiltration and rain gardens are recommended for 443 acres of developed residential areas. If implemented, these practices will result in reductions of 76 pounds of phosphorus and 21.5 tons of sediment annually. Permeable/porous pavement is recommended on 133 acres of parking lots and arterial/residential roads. If implemented, this practice will result in reductions of 43 pounds of phosphorus and 12 tons of sediment annually.

4.3.2 Basin-Wide Best Management Practices

In the Delavan Lake Watershed, basin-wide practices include Cover Crops, No-Till, Wetlands, Grassed Waterways, Filter Strips, Detention Basins/Ponds, Rain Gardens, Rain Barrels, Rock Infiltration Basins and Porous Pavement, and can be applied to the majority of urban and agricultural areas within the watershed. BMP quantities, expected load reductions (phosphorus and sediment) and locations are presented in this section. The information is broken out for the Delavan Lake Watershed as a whole. Individual tables in Appendix C provide annual load reductions by Basin-Wide BMP and Figures 23 to 27 show the distribution of each recommended BMP location within the watershed.

Both a change in tillage to No-Till and the widespread adoption of cover crops will have the greatest benefit on water quality and achieve the highest total load reductions. Installing filter strips and ponds upstream of Delavan Lake will also achieve large reductions in phosphorus and sediment. In the urban areas of the watershed, detention basins are the most effective practice and will result in the greatest load reductions, in addition to providing flood reduction benefits. A total of 9,886 acres have been identified and recommended for a gradual future shift to No-Till farming practices. If all recommended acreage implements No-Till practices, annual load reductions of approximately 485 pounds of phosphorus and 2,507 tons of suspended sediment will occur. If 50 percent of the recommended acreage implements No-Till practices, annual load reductions of approximately 242.3 pounds of phosphorus and 1,254 tons of suspended sediment will occur. This represents per-acre load reductions of approximately 0.05 pounds of phosphorus and 0.25 tons of sediment annually.

Approximately 2,824 acres currently farming with No-Till practices have been recommended as candidates for cover crops. If cover crops are implemented in all recommended locations, an estimated annual load reduction of 132 pounds of phosphorus and 282 tons of sediment would occur. This represents an average per-acre load reduction of 0.05 pounds of phosphorus and 0.10 tons of sediment. If any recommended locations for No-Till are implemented, then cover crops would be recommended for those locations, as well and similar per-acre load reductions would be expected.

It should be noted that although No-Till farming with cover crops incorporated reduces soil erosion and nutrient loading most effectively, there may be cases where switching to No-Till is not accepted by a particular landowner and the use of minimum or conservation tillage methods should be considered, particularly when maximum crop residue is maintained and applicable site-specific practices, such as grass waterways and suitable buffers and detention, can be cooperatively implemented. Cover crops can still be implemented effectively in conservation tillage systems with adequate planning assistance from NRCS, LURM or UW Extension.

Cover crops are about more than just holding soil in place. They are a beneficial part of an entire soil health system. By providing continuous living roots, minimizing disturbance, maximizing soil cover, and maximizing biodiversity within a field, improved soil health is compounded each year cover crops are in place. Cover crops can provide many benefits to corn and soybean cropping systems. By growing living roots throughout the year, soils can support increased microbe activity, plant nutrients, and the biodiversity and biomass of organisms in the soil. Year-round living roots also gather and hold onto nutrients and improve the physical, chemical, and biological properties of soils, increasing nutrient-rich organic matter that is readily available for the following year’s crop. Additional benefits include weed and erosion control.

Cover crops can fit into any cropping system and can work if crops are early or late, or if the weather is unpredictable. The most common methods of seeding cover crops are drills and broadcast seeding for after harvest and aerial seeding or high-clearance methods for early seeding before harvest. The most effective way to implement a new cover crop system is to start out simple; select one field or a few acres and, as experience is gained, they can be expanded into additional acres. As with any change in farming practices, benefits can take time to realize and it takes managing a complete soil health system over several years to begin to notice improvement in soil quality and function.

Figure 23 – Recommended No-Till Locations

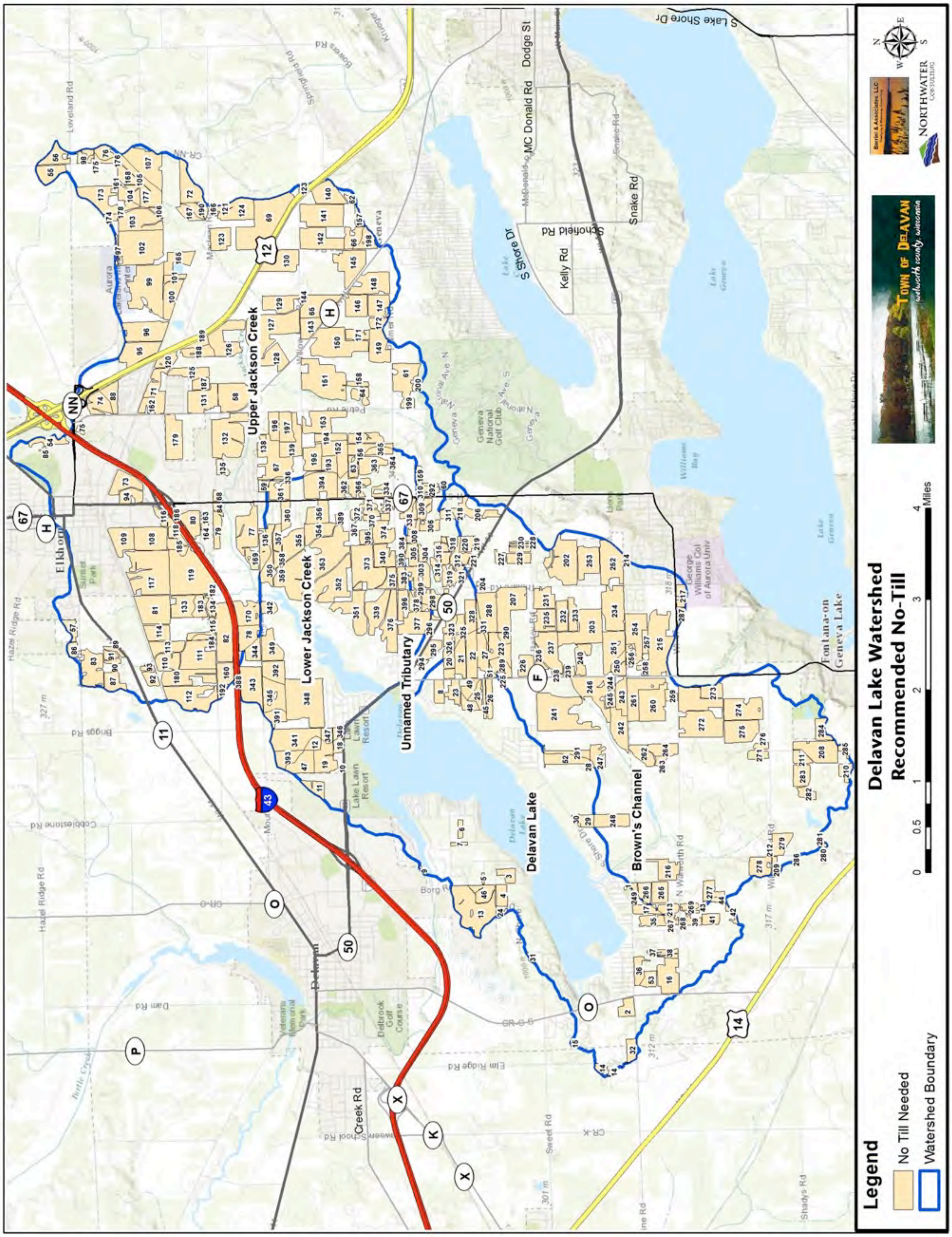


Figure 24 – Recommended Cover Crop Locations

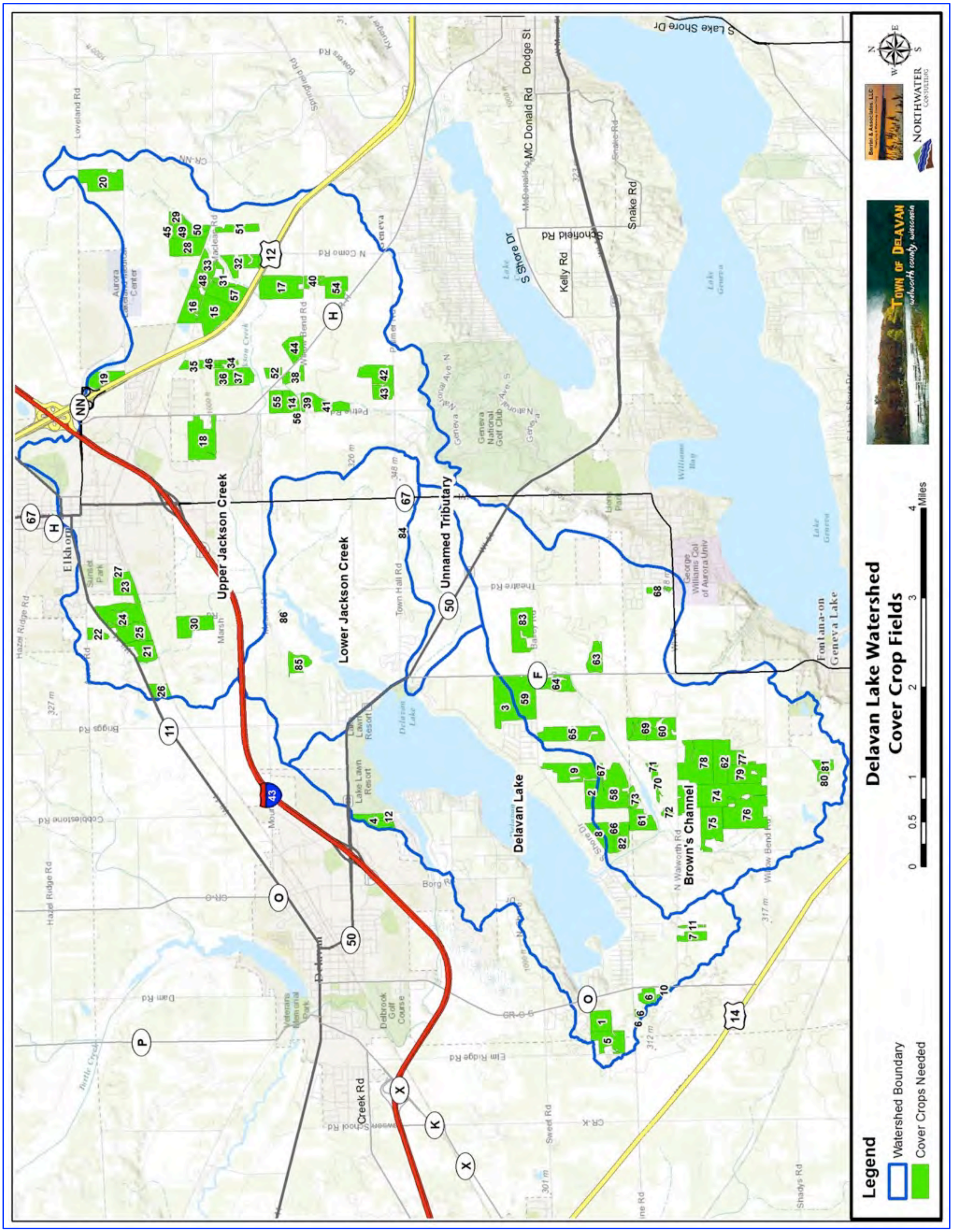
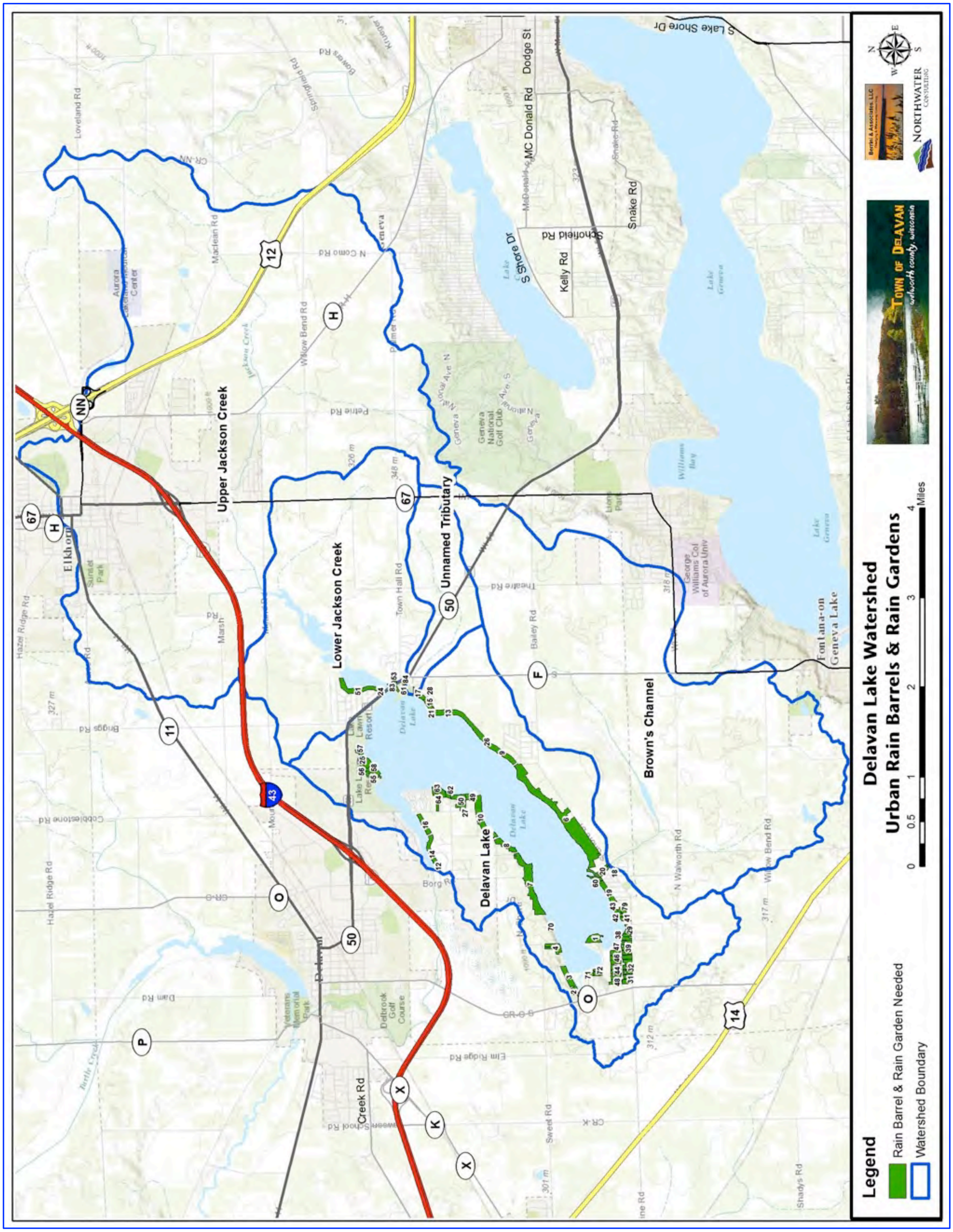


Figure 25 – Recommended Rain Barrel & Rain Garden Locations



For detention basins in urban areas, consideration should be given to less traditional and more naturalized designs; for both new construction and retrofitting existing basins. The concept of naturalized detention basins is gaining popularity. In a naturalized basin, the lawn on the basin slopes and bottom is replaced with a variety of meadow plants that simulates a wetland system. These plants have deeper roots that are more efficient at aiding rainwater infiltration and pollution removal than turf grass. There are many benefits to this naturalized approach and this concept should be actively pursued in in the Delavan Lake Watershed. If all recommended detention areas are implemented, an annual load reduction of 123 pounds of phosphorus and 41 tons of sediment would be expected. This represents an average per-acre load reduction of 0.08 pounds of phosphorus and 0.03 tons of sediment for the implementation of recommended detention areas.

As noted above, implementing BMPs, such as permeable pavement, detention, rain barrels, rock infiltration and rain gardens, will provide beneficial nutrient load reductions, but to a lesser extent than for the implementation of No-Till and Cover Crops. If all of the recommended rain barrels/rock infiltration basins and rain gardens are implemented, an annual load reduction of 76 pounds of phosphorus and 21 tons of sediment would be expected to occur. This represents an average per-acre load reduction of 0.17 pounds of phosphorus and 0.05 tons of sediment for rain barrel/rock infiltration basin and rain garden implementation. With the implementation of all permeable pavement locations, an annual load reduction of 43 pounds of phosphorus and 12 tons of sediment would occur. This represents an average per-acre load reduction of 0.08 pounds of phosphorus and 0.03 tons of sediment for the implementation of detention areas, where recommended.

Permeable Pavement

Figure 26 – Recommended Detention Locations

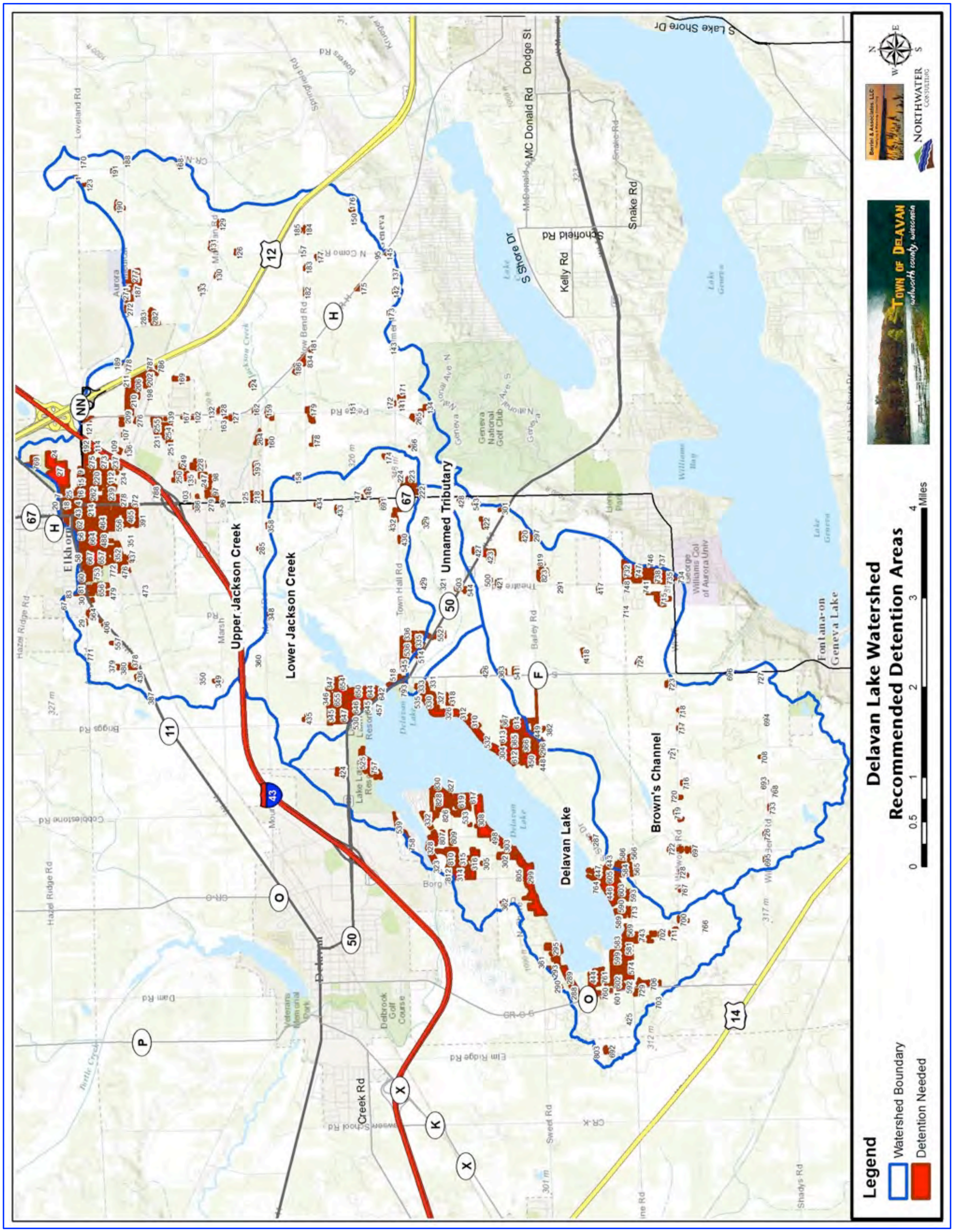
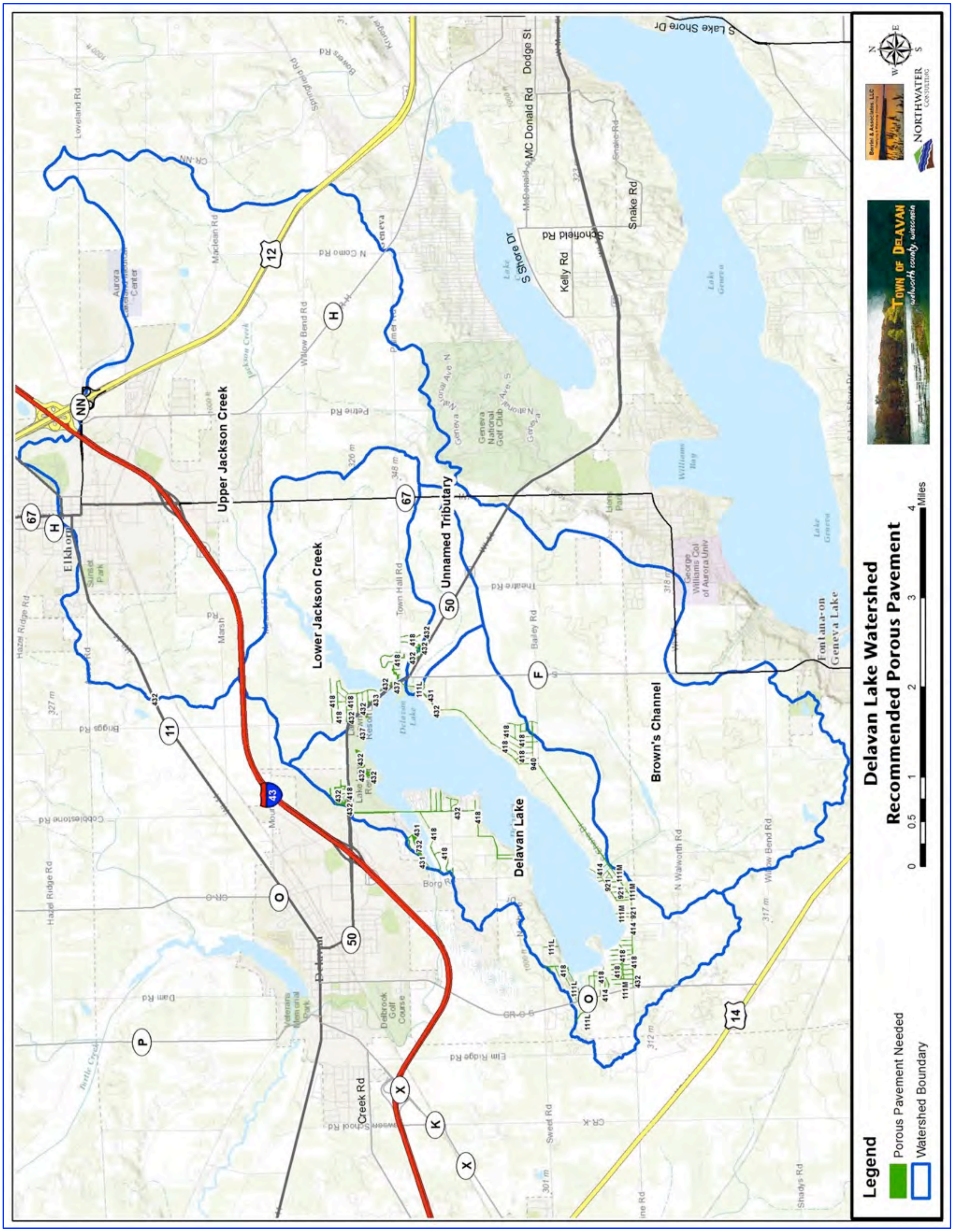


Figure 27 – Recommended Porous Pavement Locations



4.3.3 Site-Specific Best Management Practices

Site-specific BMPs are those practices where a field visit, combined with the identification of specific parcels or landowners, has resulted in the identification of a feasible project at a specific location. Each practice presented in this section will need to be approved by the landowner and submitted concurrently with this plan as part of an implementation grant application. Site-specific practices are located throughout the watershed, upstream of Delavan Lake and include WASCBs/Sediment Basins, a Terrace, Grassed Waterways, a Pond, Grade Control/Riffles, a Feed Area Waste System, and a Pasture Management System. Load reductions and BMP quantities are included in Table 23 and Figure 28 illustrates their location within the watershed. Once implemented, these practices will reduce pollutant loads delivered to Delavan Lake annually by approximately 616 lbs. for phosphorus and 1,207.3 tons for sediment. A summary table of estimated costs for site-specific BMPs is included in Table 25.

This conservative estimate represents an 18.4% reduction in total phosphorus load and a 16.7% reduction in total sediment load delivered to the lake annually. It is important to note that these model nutrient loading estimates have been derived by calibrating the model using recent USGS loading data for the Mound Road gaging station and, when available, the Rt. 50 gaging station. The USGS data clearly demonstrates that the Mound Road Ponds and the Jackson Creek Wetland, combined with the North Inlet area, have provided sediment and nutrient trapping and filtering benefits. Without these highly beneficial natural and constructed BMPs in place, annual sediment and phosphorus loads delivered to Delavan Lake would be significantly higher than the modeled estimates shown in Table 14. Additional discussion is provided in Section 5.3.4 (Supplemental Nonpoint Source Management Measures).

Figure 28 – Recommended Site-Specific BMP Locations

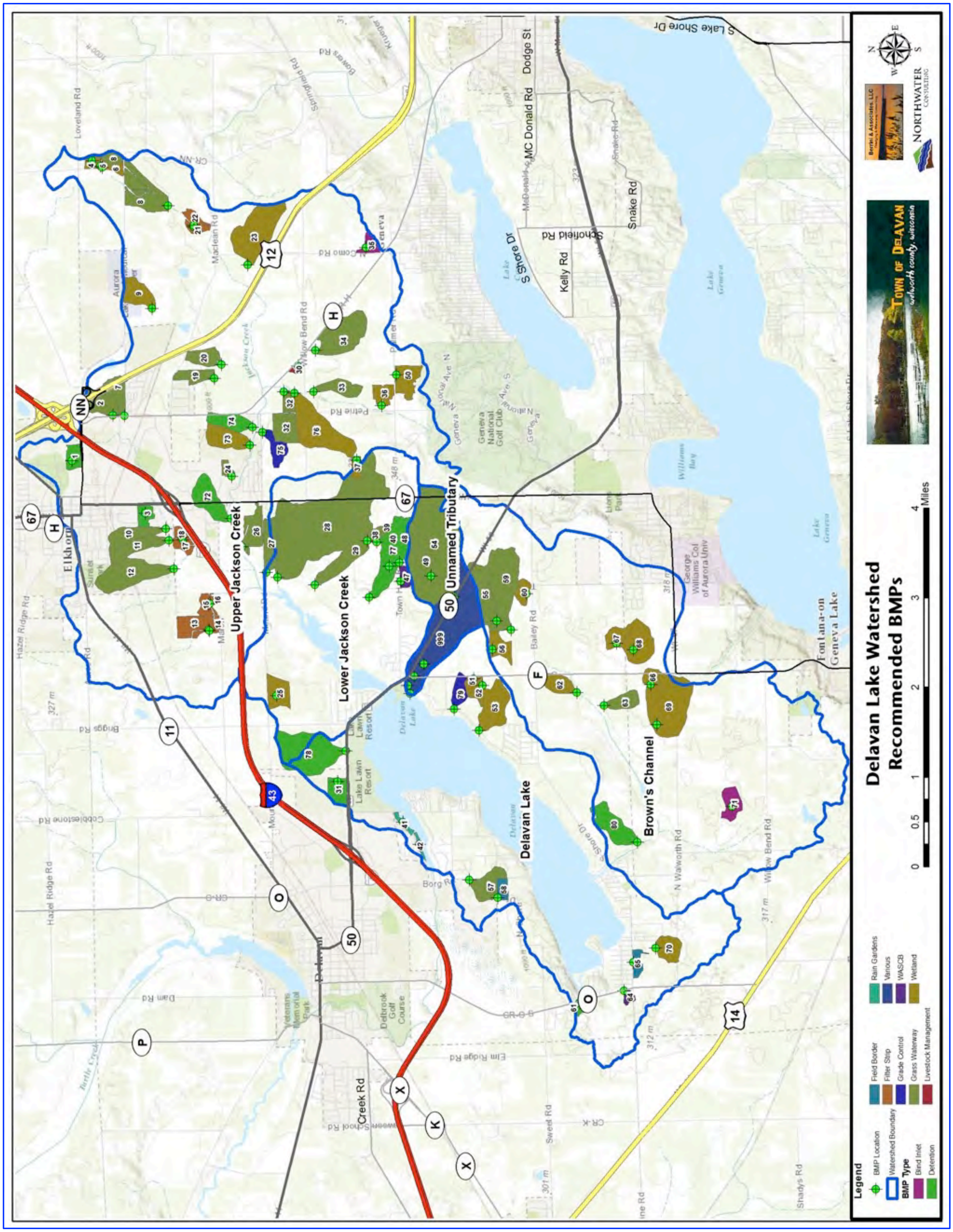


Table 23 - Site-Specific BMPs; Quantities & Load Reductions

BMP Number	BMP Code	BMP Type	Description	Number, Type, Structures	Acres Treated	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
1	1	Detention	Rain Gardens, Runoff Control	2 Basins, 5 Rain Gardens	28.7	1.47	0.51
2	1	Grass Waterway	Wetland	2,200 LF, 3.0 and 1.6 ac.	55.8	17.32	20.97
3	2	Detention	Rain Gardens, Runoff Control	1 Basin, 2 Rain Gardens I Bioswale	24.1	0.80	0.26
4	1	Wetland	0.9 ac.	1	12.3	0.70	6.07
5	2	Wetland	0.6 ac.	1	3.0	0.18	0.90
6	3	Wetland	0.5 ac.	1	14.0	0.73	3.88
7	2	Grass Waterway	2,000 LF	2.8 ac.	42.2	12.02	5.23
8	3	Grass Waterway	3,550 LF	4.9 ac.	121.5	19.06	43.44
9	4	Wetland	2.3 ac.	1	55.0	3.04	3.80
10	4	Grass Waterway	2,100 LF	2.9 ac.	60.0	10.74	13.44
11	5	Grass Waterway	2,400 LF	3.3 ac.	55.6	11.70	13.48
12	6	Grass Waterway	4,800 LF	6.6 ac.	122.8	26.13	27.01
13	1	Filter Strip	2,650 LF	3.0 ac.	50.2	3.21	2.76
14	2	Filter Strip	2,650 LF	1.8 ac.	12.3	1.00	2.58
15	3	Filter Strip	1,400 LF	1.0 ac.	18.2	1.44	2.39
16	4	Filter Strip	1,400 LF	1.0 ac.	4.16	0.37	0.50
17	5	Filter Strip	1,600 LF	1.1 ac.	16.7	1.26	2.97
18	6	Filter Strip	1,900 LF	1.3 ac.	12.8	0.96	2.15
19	7	Filter Strip	1,300 LF	1.8 ac.	35.8	1.43	3.11
20	9	Grass Waterway	1,600 LF	2.2 ac.	40.1	9.68	10.99
21	7	Grass Waterway	1,650 LF	1.1 ac.	13.9	17.16	17.13
22	8	Filter Strip	2,000 LF	1.4 ac.	17.1	1.15	1.85
23	4	Wetland	2.3 ac.	1	148.4	7.52	12.73
24	10	Grass Waterway	750 LF	1.0 ac.	12.3	6.14	6.44
25	5	Wetland	Blind Inlet	3.2 ac.	51.2	4.28	22.1
26	11	Grass Waterway	2,500 LF	3.4 ac.	60.7	9.06	19.09
27	12	Grass Waterway	2,100 LF	2.9 ac.	24.4	19.61	26.04
28	13	Grass Waterway	8.575 LF	12.0 ac.	31.9	49.84	92.57
29	14	Grass Waterway	2,200 LF	3.0 ac.	520.3	29.23	41.80
30	1	Livestock Mgmt.	Feed Area Diversion, Gutters	1 Waste System 1 Diversion 1 Gutter System,	1.2	1.19	0.24
31	3	Detention	Wetland	2 Basins,	97.8	3.60	1.04

BMP Number	BMP Code	BMP Type	Description	Number, Type, Structures	Acres Treated	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
				1 Wetland			
32	15	Grass Waterway	1,300 LF	1.8 ac.	5.59	11.31	20.72
33	16	Grass Waterway	800 LF	1.1 ac.	37.7	5.61	8.88
34	17	Grass Waterway	3,000 LF	4.1 ac.	71.5	22.25	29.64
35	1	Blind Inlet	1 Inlet	1	42.4	1.18	9.75
36	6	Wetland	0.6 ac.	1	120.9	1.81	4.46
37	7	Wetland	0.9 ac.	1	21.5	1.03	4.10
38	18	Grass Waterway	550 LF	0.8 ac.	29.5	3.23	8.96
39	19	Grass Waterway	275 LF	0.4 ac.	7.5	1.51	4.03
40	20	Grass Waterway	600 LF	0.8 ac.	7.9	8.39	13.46
41	1	Detention	Rain Gardens	20	13.5	1.57	0.58
42	2	Detention	Rain Gardens	18	4.8	0.61	0.23
43	999	Bioswale, Wetland	Saturated Buffer	1 Bioswale 2 Riffles 1 Sat. Buffer	705.5	36.22*	110.20*
44	999	Riffles	Grade Control, Wetlands	4 Riffles, 4 Wetlands			
45	999	Detention	Wetlands	1 Det. Basin or 4 Wetlands			
46	999	Grass Waterway	600 LF	0.8 ac.			
47	1	WASCB	Grass Waterway	6 WASCOBs 1,000 LF 1.4 ac.	9.33	33.57	41.75
48	21	Grass Waterway	1,000 LF	1.4 ac.	36.3	5.52	7.03
49	22	Grass Waterway	900 LF	1.2 ac.	14.38	4.65	9.70
50	8	Wetland	2.0 ac.	1	51.34	3.32	15.25
51	9	Wetland	Blind Inlet	0.4 ac.	15.44	1.53	3.56
52	10	Wetland	Blind Inlet	0.3 ac.	15.58	1.88	4.97
53	11	Wetland	Bioswale, Tree Thin	4 0.1 ac. Wetlands 500 ft. 0.7 ac. Bioswale	87.18	9.31	15.97
54	23	Grass Waterway	800 LF	1.1 ac.	387.19	17.58	33.75
55	24	Grass Waterway	2,000 LF	2.8 ac.	77.57	11.96	16.83
56	12	Wetland	0.6 ac.	1	37.03	3.26	11.31
57	25	Grass Waterway	2,800 LF	3.9 ac.	66.29	50.01	64.03
58	1	Field Border	1,900 LF	2.6 ac.	17.95	1.97	12.36
59	26	Grass Waterway	3,200 LF	4.4 ac.	152.13	24.15	33.56
60	13	Wetland	0.3 ac.	1	21.96	1.26	5.40
61	4	Detention	Rain Garden	1 Basin	12.95	0.52	0.14

BMP Number	BMP Code	BMP Type	Description	Number, Type, Structures	Acres Treated	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
				8 Rain Gardens			
62	5	Wetland	3.8 ac.	2	38.20	3.15	3.10
63	27	Grass Waterway	1,250 LF	1.7 ac.	35.46	5.76	17.77
64	2	WASCB	Bioswale	3 x 200 LF 0.2 ac.	10.43	5.54	9.48
65	2	Field Border	2,000 LF	2.3 ac.	18.53	2.20	25.16
66	13	Wetland	0.3 ac.	1	20.12	1.69	12.10
67	14	Wetland	Blind Inlet	0.7 ac.	32.50	2.38	13.83
68	15	Wetland	2.0 ac.	1	80.36	5.56	21.55
69	16	Wetland	3.0 ac.	1	170.31	6.17	32.75
70	17	Wetland	0.5 ac.	1	43.49	2.64	21.18
71	2	Blind Inlet	Wetland	1 Inlet 2.0 ac. Wetland	41.14	0.34	0.37
72	5	Detention	Wetland	1 Basin 3.0 ac. Wetland	75.87	2.83	2.65
73	18	Wetland	Detention WASCB	3.0 ac. Wetland 1 Basin 1 WASCB	63.67	5.29	11.15
74	6	Detention	Wetland	3.0 ac.	47.78	2.83	2.65
75	1	Grade Control	Detention Riffles	4 Structures 1 Basin	35.99	2.15	15.25
76	19	Wetland	Detention	4.0 ac. Wetland 1 Basin	150.99	6.68	27.99
77	7	Detention	Wetland	3.0 ac. Wetland 1 Basin	129.82	5.81	28.18
78	8	Detention	Wetland	6.0 ac. Wetland 1 Basin	164.90	8.43	39.34
79	2	Grade Control	Detention Riffles	4 Structures 1 Basin	30.72	2.26	4.75
80	9	Detention	Detention Riffles	1 Basin 2 Riffles	2.57	0.22	0.71
		Grand Total		**189**	**5,152.5**	**615.6**	**1,207.3**

* For recommended BMPs within Town Park and upstream of South Shore Drive and Route F South (#43 - #46), load reduction estimates are based on a complete installation of all BMPs. Varying percentages of load reductions will be achieved for partial BMP installations. For example, the Town Park BMPs and the bank stabilization work (riffles) upstream of South Shore Drive will be more effective when combined with upstream detention. Therefore, we recommend including BMP installations upstream of Town Park to complement any BMPs to be installed within the park itself.

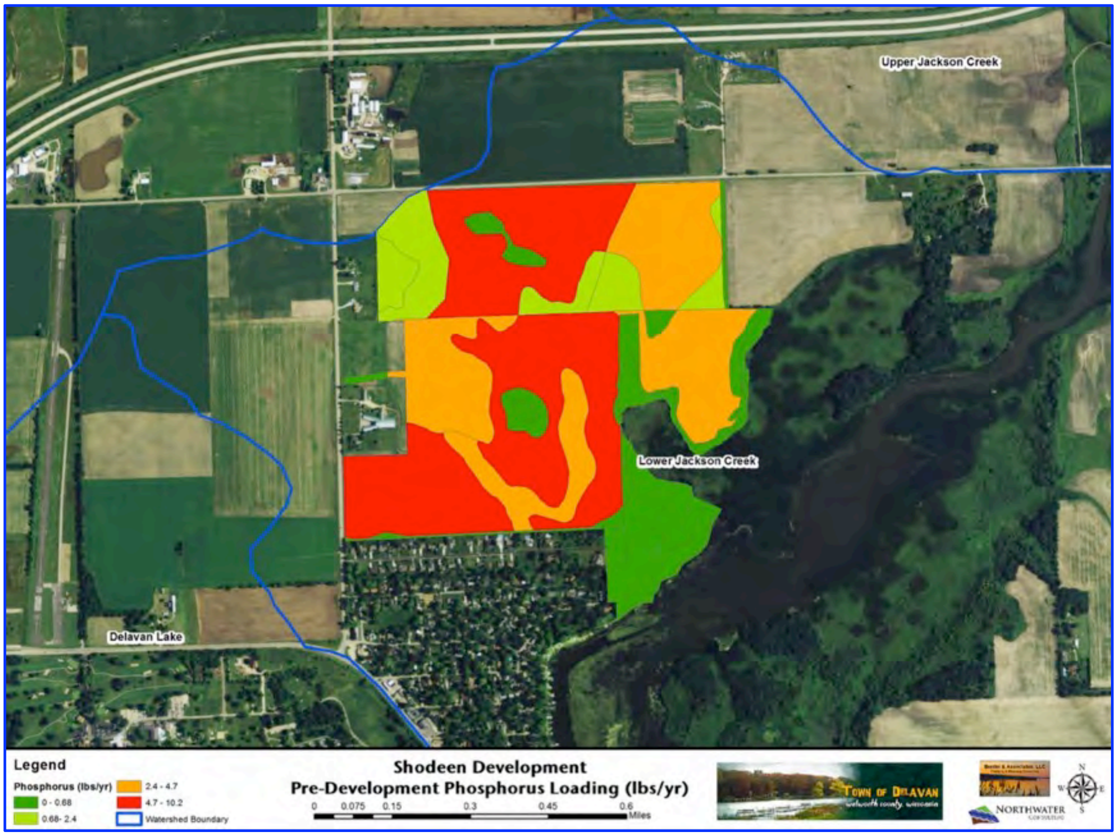
Recommended High-Priority BMPs

One high-priority site identified as a Site-Specific BMP is located at the Town Park along the northeastern corner of Delavan Lake at the outlet of the Unnamed Tributary sub-watershed. At this site, and upstream, a combination of BMPs are recommended: a bioswale and a saturated buffer, one large detention basin or up to 4 wetlands, 2 grade control structures or riffles, and 600 feet or 0.8 acres of grassed waterway. If completely implemented, this system is expected to achieve annual nutrient load reductions of 39 pounds of phosphorus and 110 tons of sediment (see Figure 29).

Figure 29 – Recommended Town Park BMPs

Another very high-priority site that was identified and evaluated is located west of the Delavan Inlet within the Lower Jackson Creek Sub-Watershed. At this site, there is a proposed conservation subdivision development referred to as the "Shores of Delavan Lake." The Town of Delavan requested that the proposed development be evaluated to determine if nutrient loadings would change and whether there would be a benefit to Delavan Lake water quality. The proposed development would change the existing landuse from cropped agriculture to a residential development with conservation buffers and on-site detention. If completely implemented according to preliminary design plans, this system will achieve annual nutrient load reductions of 32 pounds of phosphorus and 175 tons of sediment (see Figures 30 and 31). Onsite detention would also provide flood control benefits. Construction and maintenance costs would be the responsibility of the developer and owner. Regardless of whether the Shores of Delavan Lake is constructed, this site includes Basin-Wide BMP recommendations such as No-Till and Cover Crops.

Figure 30 – Pre- and Post-Development Phosphorus Loading for “Shores of Delavan Lake”



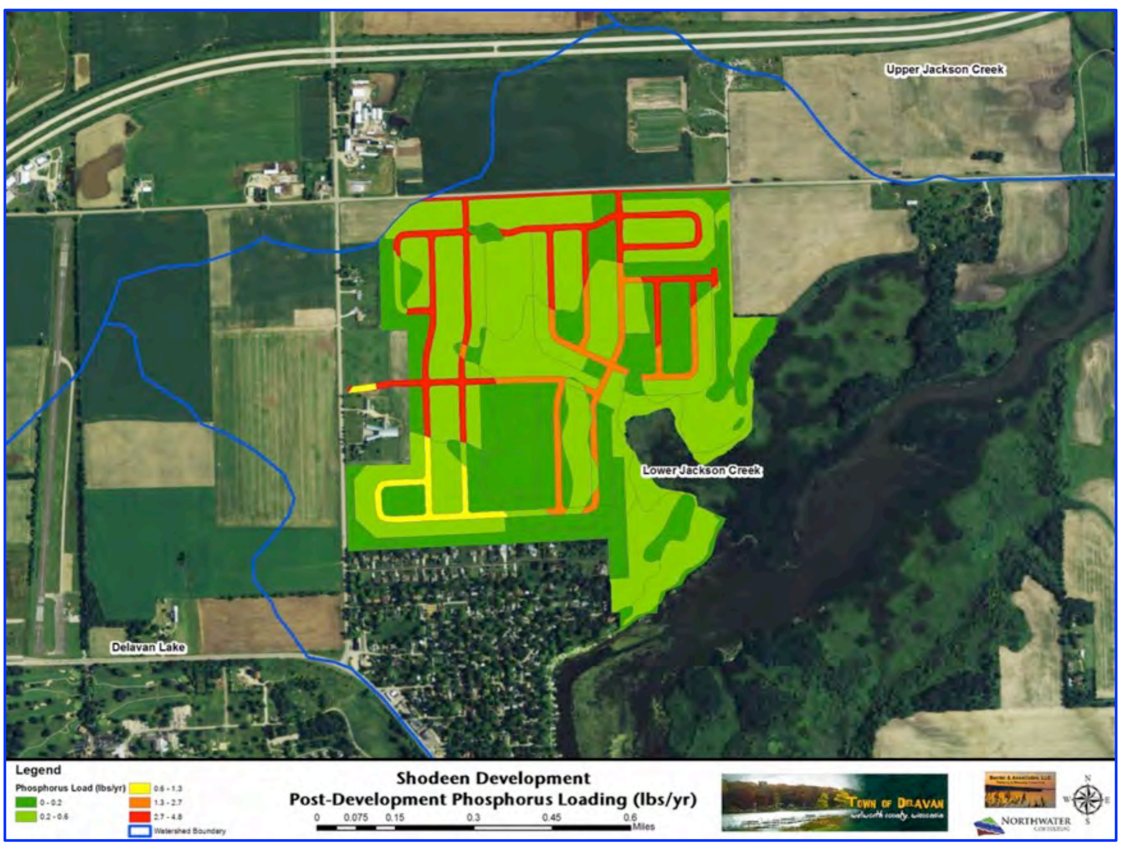
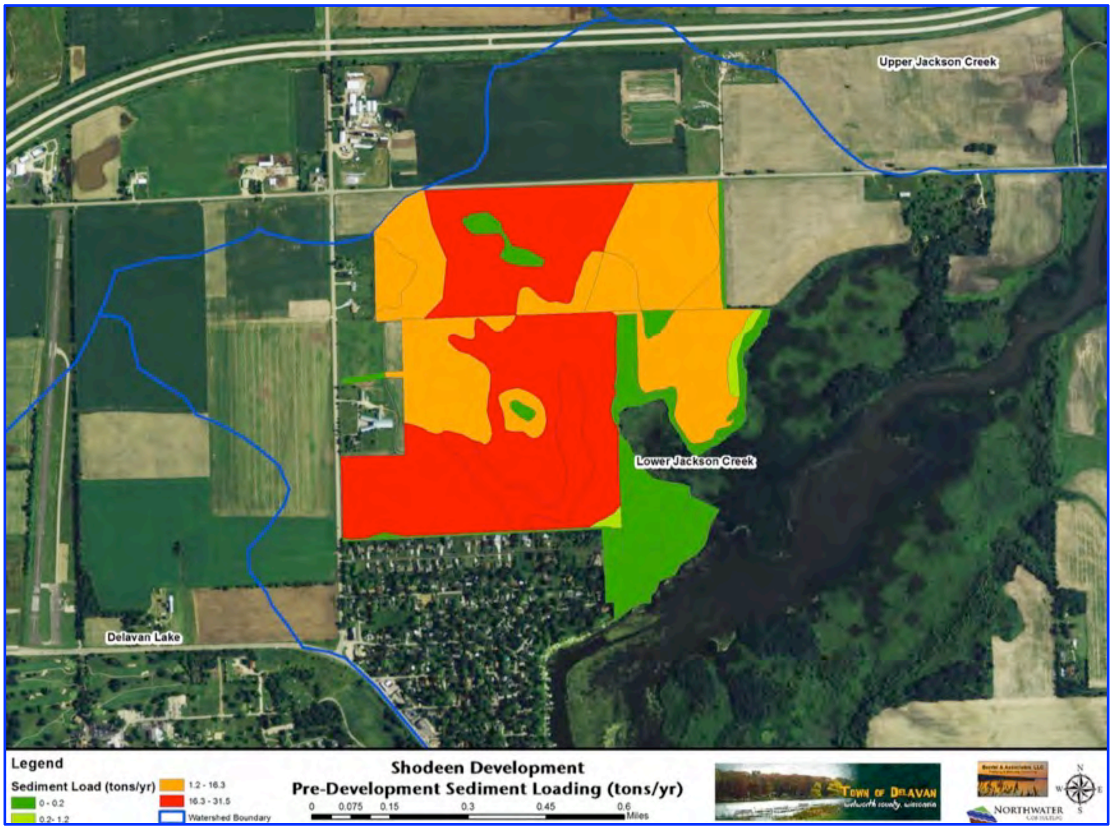
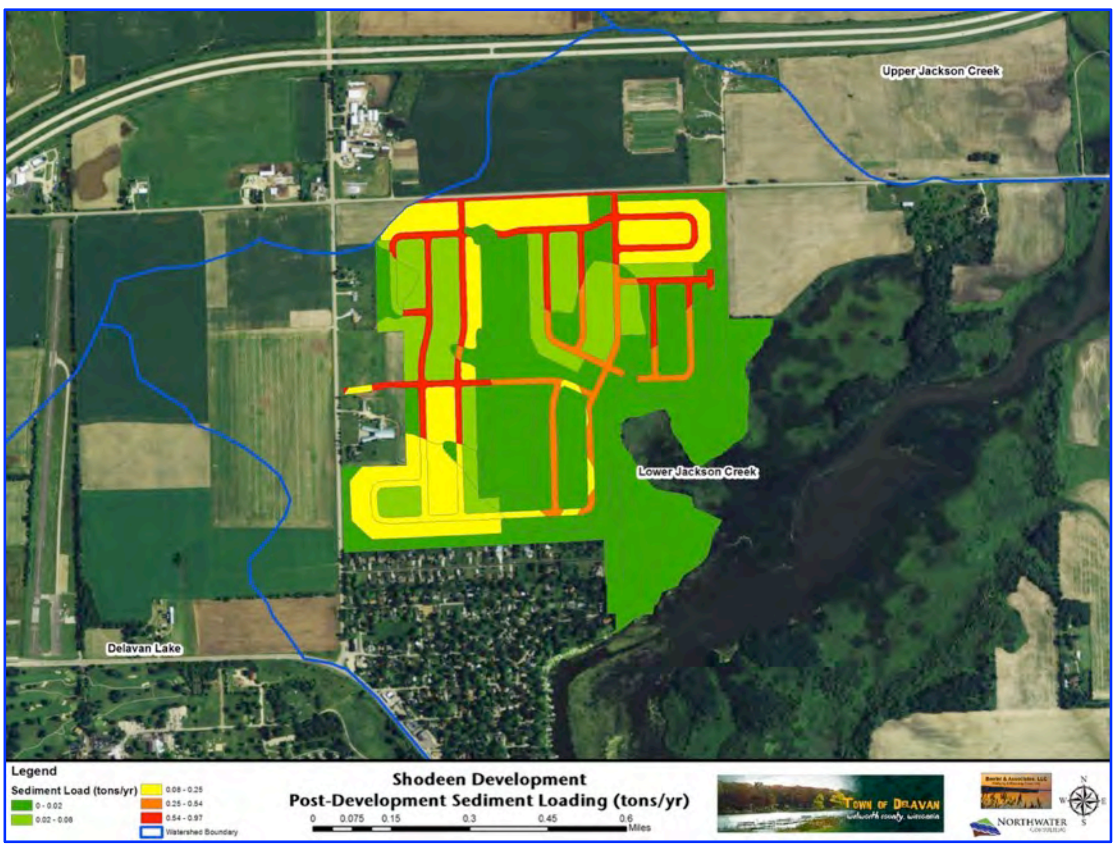


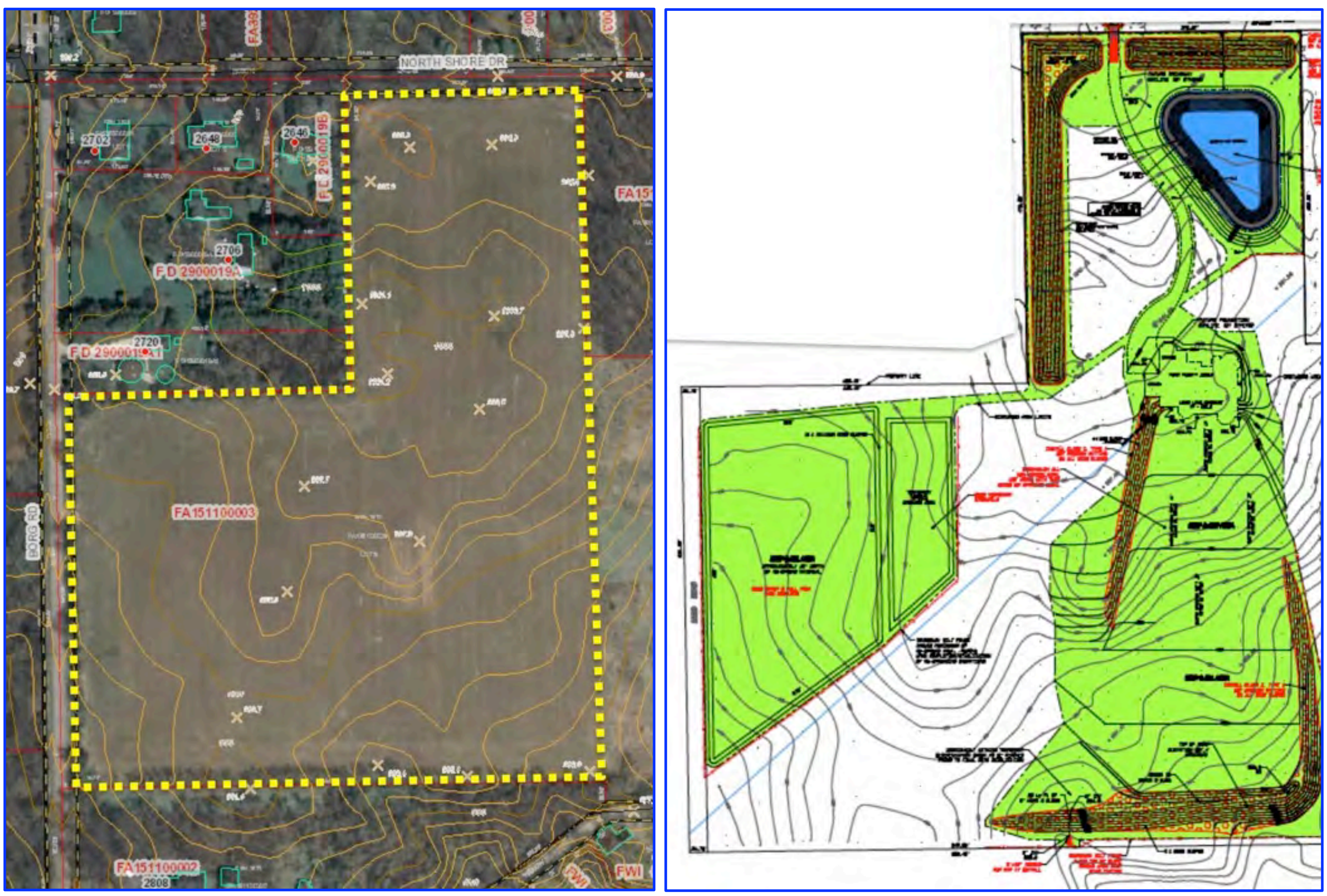
Figure 31 – Pre- and Post-Development Sediment Loading for "Shores of Delavan Lake"





The Town of Delavan and Combs & Associates made a recent request to evaluate a proposed land use change for a single-family residential development just west of Delavan Lake (see Figure 32). The proposed 16-acre parcel development is located at the corner of North Lake Shore Drive and Borg Road and is currently being farmed. The proposed plan contains detention at the sloping southeast corner of the site; it appears to provide positive benefits with respect to lake protection. A small portion (approx. 6 acres) of the total 16-acre parcel will be either prairie grass or alfalfa, although prairie grass is preferred, as it is more efficient than alfalfa at sediment and nutrient removal. The proposed pond onsite is approximately 0.5 acres in size with a maximum water depth of 8 to 10 ft., and is shown to be located in the northeastern corner of the site and will be supplemented with high-quality ground water from an existing well located on site and within close proximity. According to model estimates, this plan will reduce sediment and phosphorus loadings to the lake by at least 80 percent, which translates into annual load reductions of approximately 13 tons of sediment and 4 pounds of phosphorus. Construction and maintenance costs would be the responsibility of the developer and owner.

Figure 32 – Proposed Baker Parcel Development Location & Plan



4.3.4 Supplemental Nonpoint Source Management Measures

Several additional management measures are proposed or likely needed to achieve water quality benefits. These management measures will require additional data collection and, therefore, expected load reductions cannot be estimated accurately at this time. Once the appropriate information is collected, this Watershed Implementation Plan will be updated to include additional BMP locations, expected load reductions, estimated costs and responsible entities.

1. Conduct additional landowner outreach, site visits and the identification/treatment of additional gully erosion in locations not visually observed during field reconnaissance efforts.
2. Hire a qualified Watershed Plan Coordinator part-time to assist the Town with implementation of the plan. The estimated cost is $30,000 to $40,000 per year and assumes a natural resources background and experience with watershed planning and BMP implementation. The Plan Coordinator would also assist with development of an informational brochure, education and outreach to landowners, assist with grant applications, and would monitor and report on Plan progress to the Town Lake Committee.
3. Complete selective stream bank stabilization at the eroding meander bend on Jackson Creek located approx. 1,000 ft. upstream of East Pond.
4. Continue with implementation of in-lake controls, such as maintenance dredging, shoreline and bank stabilization, aquatic plant management and excessive carp removal.
5. Conduct maintenance of existing BMPs and nutrient trapping structures.

Gully Erosion Assessment

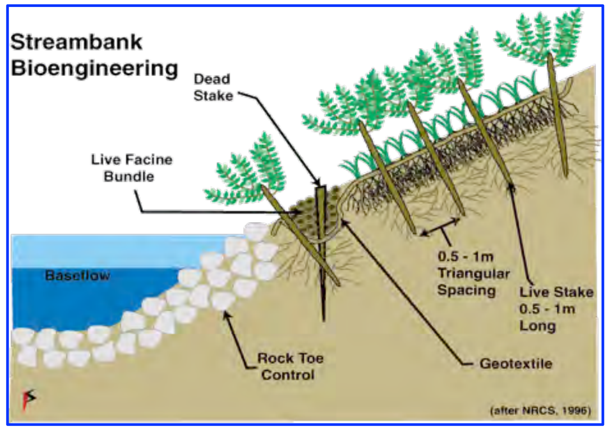
Gully erosion in the watershed was evaluated to the extent that it was visible. Many observed locations are addressed with site-specific BMPs in Section 4.3.3. Additional gully erosion is likely occurring in the watershed and any effective management measures will require additional knowledge of location, extent and severity. It is recommended that a program be initiated to survey all potential gully erosion in the watershed. A gully survey should be targeted to all crop fields not previously assessed with slopes greater than 2%. Data should be recoded using GPS and should include:

- Gully length, width and depth
- An estimate of the number of years eroding
- Applicable management measure or BMP

Section 4.2 provides field-verified estimates of annual loading from 27 gullies that represent approximately 53,300 linear feet (~ 61 acres); an annual load reduction of 598 tons of sediment and 401 lbs. of phosphorus are estimated. It is likely that a more extensive survey will result in the identification of additional eroding gullies that are tilled over annually and, therefore, it is reasonable to assume that any future load reductions achieved will total those loading figures presented above. The estimated cost of a gully erosion survey is $6,000 to $8,000.

Stream Bank Stabilization

The eroding meander bend shown in Figures 17 and 18 (Bank #2) of Section 4.2 is the one location we recommend further consideration for stabilization. This approximate 100 ft.-long section of stream bank is actively eroding and historical aerial imagery confirms that the lateral recession rate has been approximately one foot per year. The annual nutrient load for this eroding meander bend is estimated to be 77 tons per year for sediment and 77 lbs. per year for phosphorus. According to the 2015 EQIP cost data, stabilizing this 100 ft. section of stream bank with riprap armoring and up to three stream barbs will cost approximately $35,000, including design and permitting.



In-Lake Management Measures

There is a continued need for in-lake management measures, such as selective maintenance dredging, shoreline and bank stabilization, aquatic plant management, excessive carp removal, etc. More information is required to determine the feasibility of these measures. Recommendations include:

1. Complete maintenance dredging within the upstream end of Brown's Channel beginning approximately 500 feet from East Lake Shore Drive. Approximately 1,100 cubic yards of accumulated sediment was surveyed in late 2011 and recommended for removal at an estimated cost of $80,000 to $100,000, including engineering and permitting. This sediment contains phosphorus, some of which is likely to be re-mobilized into Delavan Lake as a future loading. Although the channel was effectively dredged in 2007, several very rainy years with significant storm events were likely the cause of rapid sediment deposition following the dredging effort. Based on data collected during the North Inlet Dredging Project in 2011, approximately one pound of phosphorus was removed for every ton of sediment dredged. A significant amount of nitrogen was also removed during the dredging effort. The lake sediment is saturated with water and has a dry bulk density of about 50 lbs/cu ft., or 0.675 tons/cubic yard. Therefore, removing approximately 1,100 cubic yards of sediment from Brown's Channel would effectively remove 742 tons of sediment and 809 pounds of phosphorus from the channel portion of the lake and would reduce mobilization and transport to the lake.

2. Complete a post-dredge survey of the North Inlet dredging area completed in 2011 for future planning purposes. If the survey is scheduled in 2016, an approximate five-year period would have elapsed since the project was completed. The cost of the survey is estimated to be $6,000 to $8,000.

3. Complete a shoreline assessment of the entire perimeter of Delavan Lake to identify any locations that are eroding and could benefit from shoreline protection and stabilization. The cost of this shoreline survey is estimated to be $8,000 to $10,000.

4. Continue with aquatic plant management activities by DLSD that include harvesting rooted aquatic plants and to consider methods of removing excessive filamentous algae and duckweed rather than allowing this growth to die and decompose in the lake. An evaluation and analysis of harvested aquatic plants from a nearby Wisconsin lake indicated that there was approximately 0.15 pounds of phosphorus per harvested cubic yard. Based on recent statistics, the DLSD typically harvests roughly 3,000 cubic yards annually, resulting in approximately 450 pounds of phosphorus removed from the lake each year. It is recommended that these harvesting efforts continue and that consideration is given to evaluating methods of removing excessive floating algae and duckweed, when possible, to remove additional phosphorus and nitrogen from the lake.

5. Since the North Inlet has functioned very well as a nutrient filter for trapping incoming sediment and phosphorus, it is critical to maintain the dense rooted aquatic plant population throughout the North Inlet. Increased carp numbers observed in recent years that congregate in shallow areas of the lake to spawn in late spring can negatively impact the aquatic plant density due to increased turbidity from the bottom feeding action of the carp. In addition to potential impacts to the ecologically import aquatic plant population in the North Inlet that has provided nutrient trapping and filtering, the common carp can re-suspend phosphorus-rich bottom sediment into the water column. A study completed by Lamarra (1975) documented that carp can internally load a lake with 1.07mg/sq. meter/day to 2.18mg/sq. meter/day. It was estimated that a small lake area with 1,000 adult carp could produce internal nutrient loads ranging from 131 to 266 lbs. per year. Therefore, strategically removing carp on an annual basis is highly recommended, particularly throughout the North Inlet area. Commercial carp fisherman will likely be required to effectively harvest carp from the Inlet due to limited accessibility. The timing of the harvest and the appropriate methodology should likely coincide with the annual spring spawn when carp tend to congregate in shallow upstream areas in dense numbers.

6. In past reports completed by USGS, it has been noted that internal nutrient loading from anoxic bottom sediments can be a significant component of the overall nutrient load to the lake. Recent monitoring data suggests that high concentrations of phosphorus are present in the near-bottom water samples when the lake becomes thermally stratified in the summer and the hypolimnion becomes anoxic. Consulting with USGS to complete an updated internal nutrient loading analysis and to determine if any remedial measures are warranted, such as alum treatments, flushing after lake turnover or hypolimnetic aeration, etc., is recommended. The approximate cost is estimated to be $8,000 to $10,000.

Maintenance of Existing BMPs

Based on recent USGS monitoring data obtained at Mound Road and at Highway 50, it is evident that existing BMPs, such as the Mound Road Ponds and adjacent wetlands, the perennially vegetated Delavan North Inlet, and the Brown's Channel system have functioned effectively at trapping and filtering suspended sediment and phosphorus prior to being delivered to the lake. The model developed for this watershed plan was calibrated using available USGS data collected on Jackson Creek to reflect load reduction estimates. As these BMPs become fulfilled to effective capacity or otherwise impacted, they will become less effective and must be maintained or enhanced in order to achieve the annual loading estimates stated in this report. Additional detail on recommended BMP maintenance is provided below.

Mound Road Ponds: A 2013 survey of the Mound Road Ponds indicated that approximately 31 to 33 percent of the available storage volume has been lost to sediment deposition. An updated survey just completed in September 2015 indicated that the 4.4-acre East Pond, the 1.2-acre North Pond and the 1.1-acre West Pond have trapped an additional 0.13 feet (923 cy), 0.46 feet (891 cy) and 0.34 feet (603 cy) of additional sediment, respectively, in the past two years (Lake and Pond Solutions, 2015). The total available pond capacities have been reduced by 2 to 7 percent as a result of additional sediment deposition, and the total volume of sediment in each pond is now estimated to be 11,287 cy for East Pond, 4,704 cy for North Pond and 3,514 cy for West Pond. The pond cross sections also indicate that sediment deposition has been variable and that some internal remobilization and subsequent sediment transport has likely occurred as water depths have become shallower near the inflow points and relative sediment trapping efficiencies have decreased. It is recommended that maintenance and/or enhancement of the Mound Road Pond system is planned and implemented as soon as possible, rather than waiting until they are no longer effective. However, in order to determine the most cost effective approach and design, more data gathering is recommended.

As a supplement to the updated pond survey measurements (completed by Lake and Pond Solutions, 2015), we recommend collecting one sediment core from each of the three ponds to evaluate physical and chemical characteristics of the deposited sediment. Physical characteristics will include water content, bulk density with depth and re-mobilization potential at the sediment/water interface. Chemical characteristics of specific interest for planning include organic content and phosphorus. In addition to sediment analysis, we recommend obtaining two to three separate storm event samples at the inflow and outflow points of each pond. Since automatic samplers would not be feasible, we recommend that for each storm event with observable runoff, three separate grab samples will be obtained with at least one hour between each sample. The samples would then be analyzed for total phosphorus and suspended sediment to observe current pond trapping efficiency. We recommend that the proposed sediment analysis and selective monitoring of the inflow and outflow of the ponds be completed in 2016. Once this data is gathered and analyzed along with the recently completed sediment survey measurements (Lake and Pond Solutions, 2015), maintenance and enhancement options for the ponds can be determined and recommended for implementation in 2017. This proposed pond evaluation is estimated to cost approximately $8,000 to $10,000 and includes laboratory analyses of sediment and water samples.

Selectively removing soft, nutrient-rich sediment from the three ponds to restore lost capacity should be an important component of the overall restoration and maintenance effort. The nutrient trapping effectiveness of the ponds has been demonstrated by monitoring (USGS, 1995) and by actual survey measurements. Brune's Curve suggests that the sediment-trapping efficiency of a pond with a given drainage area will trap a higher percentage of suspended sediment if the pond volume or capacity is increased (Brune, 1953). In an effort to minimize physical disturbance to the adjacent Jackson Creek Wetland, we recommend evaluating low-impact hydraulic suction dredging as an alternative to mechanical excavation. Sediment would be pumped through a small flexible pipeline to geotextile tubes located in the previously permitted upland location on the southwest side of the complex. We believe that excessive physical disturbance by excavators and trucks may be detrimental to the adjacent wetland by allowing re-establishment by invasive plants such as Phragmites.

Since dredging is expensive and no grant assistance can be accessed for that purpose, it is critical that any sediment removal effort is carefully planned and completed to optimize effectiveness while minimizing environmental impact and total cost. The estimated cost of selectively dredging sediment from the ponds may be in excess of $350,000, including engineering and permitting. Therefore, it appears necessary to control the total dredging quantity and to strategically target the most cost-effective dredging depths and limits in order to effectively manage cost. Although grant assistance is not possible for dredging, it may be possible to include additional BMPs that could enhance the overall effectiveness of the Mound Road Pond Complex and Jackson Creek Wetland System and to potentially utilize dollars spent on pond maintenance dredging as matching funds to access grant funds for additional approved BMPs. There may also be an opportunity to collaborate with the Jackson Creek Protection Plan for complimentary BMP planning and implementation. Completion of this planning study by SEWRPC and Kettle Moraine Land Trust is pending.

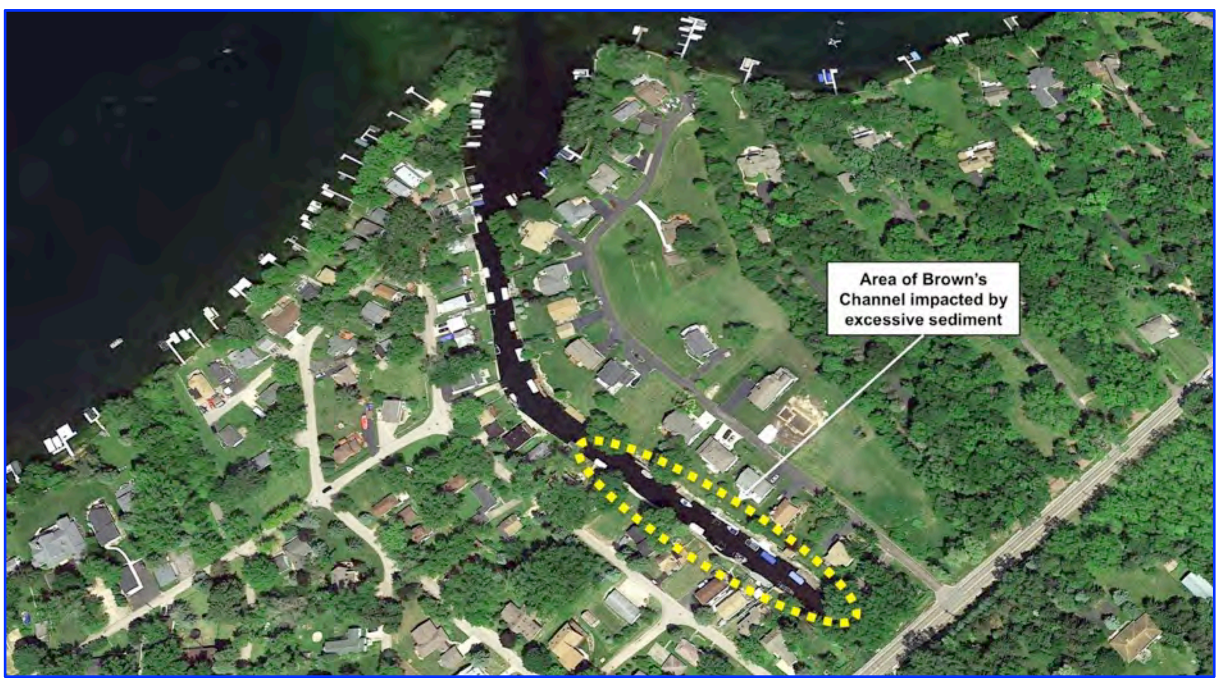
Mound Road Ponds

The Delavan North Inlet has been perennially vegetated with rooted aquatic plant growth through most of the Inlet and is a protected WDNR Aquatic Sensitive Area. Recent USGS monitoring data obtained while the Rt. 50 gage station was active has shown that the North Inlet area has been very effective at trapping sediment and phosphorus. A channel deepening project was completed in 2011 at the lower southwest end of the Inlet that included the removal of approximately 45,330 cubic yards of nutrient-rich sediment while providing needed navigational access and capacity. The rooted aquatic vegetation that develops throughout the summer provides additional nutrient trapping and filtering benefits and should be protected. There have been recent reports and sightings of increased common carp activity in shallow areas of the lake, particularly in upstream areas of the North Inlet during spring spawning periods. Increased carp populations can contribute to nutrient loading by re-suspending bottom sediments and phosphorus and can reduce aquatic plant density, which is critical for filtering incoming nutrients. The weekend of June 20-22, 2014, saw many bow and arrow fishermen participating in the first annual rough fish derby, sponsored by Lakeside Bait & Tackle. When the results were tallied, a total of 185 carp were taken out of Delavan Lake with a total weight of 1,828 pounds and composted by a local farmer. The largest fish weighed 26 pounds and the average weight was 9.9 pounds per fish. This is a commendable effort that should be continued and expanded upon to remove larger numbers of carp each year. It is recommended to budget approximately $5,000 to $10,000 per year for enhanced carp removal efforts within the North Inlet and Mound Road area of Jackson Creek.

Delavan North Inlet

Brown's Channel has been noted above in the In-Lake Management Measures section as requiring maintenance to remove excessive sediment accumulations from the upper end of the channel. It is also an existing BMP due to its ability to function as a sediment and nutrient trap prior to being transported into the main body of the lake. Completed field surveys have documented excessive sediment deposition within the upper 500 ft. of Brown's Channel directly downstream (lake side) of Lake Shore Drive. In addition, sediment deposition and woody debris have been observed within the channel directly upstream of the South Shore Drive bridge and concrete weir for a distance of approximately 140 feet (HDR, 2011). The existing concrete weir was installed in 1983 by the USGS for monitoring purposes to measure inflow and to estimate sediment and nutrient loadings. The low elevation weir has retained small amounts of sediment and woody debris in the widened channel area directly upstream but was never intended to be a sediment trapping structure. The unstable, phosphorus-rich sediment has periodically become remobilized and transported into the lake.

Potential Brown's Channel enhancement alternatives and preliminary estimated costs include: 1) The removal of approximately 1,100 cubic yards of accumulated sediment from the upper 500 feet of the lake-side portion of Brown's Channel; including engineering and permitting, the cost is estimated to be \$80,000 to \$100,000 (described above); 2) Removing the existing concrete weir and stabilizing 140 feet of stream bank and channel upstream of South Shore Drive. The work would include selective tree removal and/or thinning to allow more light penetration, debris removal, grading, turf reinforcement mat, rock riffles, native plantings, etc.; the estimated cost, including engineering and permitting, would range from \$60,000 to \$80,000; and 3) Potential upstream Wetland Pond Enhancement that would require landowner cooperation and a survey to determine the sediment removal quantity, and road and outlet culvert enhancement. Engineering design, permitting and construction costs are estimated to range from \$50,000 to \$60,000.



Brown's Channel

5.0 Costs, Priorities, Technical Assistance & Responsible Parties

BMP costs were calculated based on professional judgment and expertise; unit costs derived from NRCS EQIP rates and other similar watershed plans. Cost estimates should be considered as estimates of probable cost for planning only and revisited during implementation. The following cost assumptions have been used to develop estimates of probable cost for BMP Implementation.

1. Residential rain barrels, rain gardens, rock infiltration pits and urban detention are estimated at four times the treatment area, or four per acre. Each acre assumes eight 60-gallon rain barrels or four rain gardens and detention systems. Assumed costs are $80 for rain barrels and $3,500 for each rain garden and detention system. Additional planning and financial assistance may be required. The DLIA and DLSD has partnered with the Wisconsin Healthy Lakes Implementation Plan and offers potential assistance for certain lake-side practices. See Delavan Lake Improvement Association website (www.delavan-lake.org) or (http://tinyurl.com/healthylakes) for more information.
2. Cost estimates for blind inlets are based on NRCS - EQIP cost-share rates and assume construction and material costs of $3,000/inlet. Each inlet assumes treatment of 50 acres. Additional design and permitting assistance may be required.
3. Costs for filter strips and field borders assume a 10-year minimum lifespan and are calculated at $700/ac., assuming a minimum width of 50 feet and are based on NRCS cost-share rates and include land preparation, materials and seeding.
4. Costs for cover crops and No-Till are assumed to be $15/ac. annually for No-Till and $45/ac. annually for cover crops, on average, and typical NRCS - EQIP cost-share rates should apply for an assumed minimum 10-year period.
5. Costs for riffles and grade control structures are based on professional judgment and field experience, and total $8,000 per individual structure, including engineering and design.
6. Costs for stream bank stabilization are based on the maximum cost-share rate of $60/ft. (80% of actual cost), plus engineering, permitting and design.
7. Wetland creation and/or restoration assumes a cost of $2,000 per water control structure and engineering and dirt work or excavation costs up to $3,000 per acre. The maximum cost-share rate for wetland development and improvement should apply. Additional design and permitting assistance will be required.
8. Grassed waterways assume a 10-year minimum lifespan and an installed cost of $7.50/ft. and should include any engineering, permitting or design that may be required.
9. Water and sediment control basin costs are based on maximum cost-share rates of and are estimated at $2,040/basin. Additional design assistance will be required.
10. Pasture/feed area management includes a combination of costs for multiple practices. Heavy use area protection is based on maximum cost-share rates of $1,800/facility. Diversions are based on maximum cost-share rates of $4.50/ft. A pond or waste containment system is based on maximum cost-share rates of $20,000/facility. Additional design assistance will be required.
11. Estimates of Probable Costs for detention basins or ponds at locations receiving in excess of 10 acres of runoff are based on site conditions and professional judgment/experience, and are estimated at $40,000 each, including engineering, permitting and design costs.

5.1 Estimates of Probable Cost and Recommended Priorities

Tables 24 through 27 provide a detailed breakdown of estimates of probable cost and relative implementation priorities for all basin-wide, site-specific BMPs, and supplemental NPS management measures. The total cost of implementing all watershed-wide BMPs is $20,468,640; the total cost of implementing all site-specific BMPs is $1,526,659. A significant percentage of the estimated cost for these Basin-Wide BMPs is attributed to the installation of 132 acres of porous or permeable pavement at an estimated cost of $100,000 per acre, which may be unrealistic due to the high cost of installation and the relatively low nutrient load reductions. The cost to implement all supplemental management measures ranges from $1,257,000 to $1,615,000. Periodic maintenance is anticipated every eight to ten years depending on rainfall patterns and nutrient loads resulting from runoff. The order of each BMP is also listed by relative implementation priority. This numerical priority order is based on the average amount of phosphorus and sediment load reductions that may be achieved for the estimated cost associated with each BMP. Therefore, the BMPs that reduce sediment and phosphorus loadings by the greatest amount for the dollars spent have been assigned a higher priority rating.

In addition to the costs presented in this section for BMP implementation, there will be costs associated with technical assistance provided by various state and local agencies (described in Section 6.3.1), as well as consultants. It is estimated that costs for technical assistance from engineers and consultants could range from $200,000 to $400,000 over the course of ten years or more. In order to efficiently and effectively facilitate the implementation of this Plan, we recommended that a part-time Watershed Plan Coordinator position be included. The estimated cost is $30,000 to $40,000 per year and assumes a natural resources background and experience with watershed planning and BMP implementation. While these costs may seem challenging, we feel that having a local coordinator included in the overall implementation effort will optimize the long-term success of the Plan.

Table 24 – Estimates of Probable Cost and Relative Priorities: Basin - Wide BMPs

BMP Description (and relative priority)	Number of Units	Unit Cost	Estimated Cost (assume 10 Years)
1. No-Till Farming	9,886 acres	$15/ac/yr/10 yrs	$1,482,900/10 yr.
2. Cover Crops	2,824 acres	$45/ac/yr/10 yrs	$1,270,800/10 yr.
3. Rain Gardens, Bioswales	221 acres	$3,500 ea/4/ac	$773,500
4. Rain Barrels /Rock Infiltration	221 acres	$80 ea/8 per acre	$141,440
5. Detention	1,595 acres	Det. Pond if >5 ac.	$3,600,000
6. Permeable Pavement	132 acres	$100,000/acre	$13,200,000
Total Basin-Wide BMP Costs			**$20,468,640**

Table 25 - Estimates of Probable Cost: Site-Specific BMPs

BMP Number	BMP Type	Description	Units and Quantities	Acres Treated	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)	Estimated Cost
1	Detention	Runoff Control	2 Basins, 5 Rain Gardens	28.7	1.47	0.51	$97,500
2	Grass Waterway	Wetland	2,200 LF, 3.0 and 1.6 ac.	55.8	17.32	20.97	$16,500
3	Detention	Runoff Control	1 Basin, 2 Rain Gardens I Bioswale	24.1	0.80	0.26	$50,500
4	Wetland	0.9 ac.	1	12.3	0.70	6.07	$4,700
5	Wetland	0.6 ac.	1	3.0	0.18	0.90	$3,800
6	Wetland	0.5 ac.	1	14.0	0.73	3.88	$3,500
7	Grass Waterway	2,000 LF	2.8 ac.	42.2	12.02	5.23	$15,000
8	Grass Waterway	3,550 LF	4.9 ac.	121.5	19.06	43.44	$26,625
9	Wetland	2.3 ac.	1	55.0	3.04	3.80	$8,900
10	Grass Waterway	2,100 LF	2.9 ac.	60.0	10.74	13.44	$15,750
11	Grass Waterway	2,400 LF	3.3 ac.	55.6	11.70	13.48	$18,000
12	Grass Waterway	4,800 LF	6.6 ac.	122.8	26.13	27.01	$36,000
13	Filter Strip	2,650 LF	3.0 ac.	50.2	3.21	2.76	$2,100
14	Filter Strip	2,650 LF	1.8 ac.	12.3	1.00	2.58	$1,260
15	Filter Strip	1,400 LF	1.0 ac.	18.2	1.44	2.39	$700
16	Filter Strip	1,400 LF	1.0 ac.	4.16	0.37	0.50	$700
17	Filter Strip	1,600 LF	1.1 ac.	16.7	1.26	2.97	$770
18	Filter Strip	1,900 LF	1.3 ac.	12.8	0.96	2.15	$910
19	Filter Strip	1,300 LF	1.8 ac.	35.8	1.43	3.11	$1,260
20	Grass Waterway	1,600 LF	2.2 ac.	40.1	9.68	10.99	$12,000
21	Grass Waterway	1,650 LF	1.1 ac.	13.9	17.16	17.13	$12,375
22	Filter Strip	2,000 LF	1.4 ac.	17.1	1.15	1.85	$980
23	Wetland	2.3 ac.	1	148.4	7.52	12.73	$8,900
24	Grass Waterway	750 LF	1.0 ac.	12.3	6.14	6.44	$5,625
25	Wetland	Blind Inlet	3.2 ac.	51.2	4.28	22.1	$3,000
26	Grass Waterway	2,500 LF	3.4 ac.	60.7	9.06	19.09	$18,750
27	Grass Waterway	2,100 LF	2.9 ac.	24.4	19.61	26.04	$15,750
28	Grass Waterway	8,575 LF	12.0 ac.	31.9	49.84	92.57	$64,312
29	Grass Waterway	2,200 LF	3.0 ac.	520.3	29.23	41.80	$16,500
30	Livestock Mgmt.	Feed Area Diversion,	Waste/Diversion/ Gutter System,	1.2	1.19	0.24	$8,500
31	Detention	Wetland	2 Basins, 1 Wetland	97.8	3.60	1.04	$85,000
32	Grass Waterway	1,300 LF	1.8 ac.	5.59	11.31	20.72	$9,750

BMP Number	BMP Type	Description	Units and Quantities	Acres Treated	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)	Estimated Cost
33	Grass Waterway	800 LF	1.1 ac.	37.7	5.61	8.88	$6,000
34	Grass Waterway	3,000 LF	4.1 ac.	71.5	22.25	29.64	$22,500
35	Blind Inlet	1 Inlet	1	42.4	1.18	9.75	$3,000
36	Wetland	0.6 ac.	1	120.9	1.81	4.46	$3,800
37	Wetland	0.9 ac.	1	21.5	1.03	4.10	$4,700
38	Grass Waterway	550 LF	0.8 ac.	29.5	3.23	8.96	$4,125
39	Grass Waterway	275 LF	0.4 ac.	7.5	1.51	4.03	$2,062
40	Grass Waterway	600 LF	0.8 ac.	7.9	8.39	13.46	$4,500
41	Detention	Rain Gardens	20	13.5	1.57	0.58	$70,000
42	Detention	Rain Gardens	18	4.8	0.61	0.23	$63,000
43	Bioswale, Wetland	Saturated Buffer	1 Bioswale 1 Sat. Buffer	705.5	36.22	110.20	$15,000
44	Riffles	Grade Control	4 Riffles, 4 Wetlands				$52,000
45	Detention	Wetlands	1 Det. Basin, or 4 Wetlands				$60,000
46	Grass Waterway	600 LF	0.8 ac.				$4,500
47	WASCB	Grass Waterway	6 WASCOBs 1,000 LF, 1.4 ac.	9.33	33.57	41.75	$19,500
48	Grass Waterway	1,000 LF	1.4 ac.	36.3	5.52	7.03	$7,500
49	Grass Waterway	900 LF	1.2 ac.	14.38	4.65	9.70	$6,750
50	Wetland	2.0 ac.	1	51.34	3.32	15.25	$8,000
51	Wetland	Blind Inlet	0.4 ac.	15.44	1.53	3.56	$3,000
52	Wetland	Blind Inlet	0.3 ac.	15.58	1.88	4.97	$3,000
53	Wetland	Bioswale, Tree Thin	4 0.1 ac. Wetlands 500 ft. Bioswale	87.18	9.31	15.97	$19,500
54	Grass Waterway	800 LF	1.1 ac.	387.19	17.58	33.75	$6,000
55	Grass Waterway	2,000 LF	2.8 ac.	77.57	11.96	16.83	$15,000
56	Wetland	0.6 ac.	1	37.03	3.26	11.31	$3,800
57	Grass Waterway	2,800 LF	3.9 ac.	66.29	50.01	64.03	$21,000
58	Field Border	1,900 LF	2.6 ac.	17.95	1.97	12.36	$1,820
59	Grass Waterway	3,200 LF	4.4 ac.	152.13	24.15	33.56	$24,000
60	Wetland	0.3 ac.	1	21.96	1.26	5.40	$2,900
61	Detention	Rain Garden	1 Basin 8 Rain Gardens	12.95	0.52	0.14	$68,000
62	Wetland	3.8 ac.	2	38.20	3.15	3.10	$15,400
63	Grass Waterway	1,250 LF	1.7 ac.	35.46	5.76	17.77	$9,375
64	WASCB	Bioswale	3 x 200 LF	10.43	5.54	9.48	$9,000

BMP Number	BMP Type	Description	Units and Quantities	Acres Treated	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)	Estimated Cost
			0.2 ac.				
65	Field Border	2,000 LF	2.3 ac.	18.53	2.20	25.16	$1,610
66	Wetland	0.3 ac.	1	20.12	1.69	12.10	$2,900
67	Wetland	Blind Inlet	0.7 ac.	32.50	2.38	13.83	$3,000
68	Wetland	2.0 ac.	1	80.36	5.56	21.55	$8,000
69	Wetland	3.0 ac.	1	170.31	6.17	32.75	$11,000
70	Wetland	0.5 ac.	1	43.49	2.64	21.18	$3,500
71	Blind Inlet	Wetland	1 Inlet 2.0 ac. Wetland	41.14	0.34	0.37	$11,000
72	Detention	Wetland	1 Basin 3.0 ac. Wetland	75.87	2.83	2.65	$51,000
73	Wetland	Detention WASCB	3.0 ac. Wetland 1 Basin, 1 WASCB	63.67	5.29	11.15	$54,000
74	Detention	Wetland	3.0 ac.	47.78	2.83	2.65	$11,000
75	Grade Control	Detention Riffles	4 Structures 1 Basin	35.99	2.15	15.25	$72,000
76	Wetland	Detention	4.0 ac. Wetland 1 Basin	150.99	6.68	27.99	$14,000
77	Detention	Wetland	3.0 ac. Wetland 1 Basin	129.82	5.81	28.18	$11,000
78	Detention	Wetland	6.0 ac. Wetland 1 Basin	164.90	8.43	39.34	$20,000
79	Grade Control	Detention Riffles	4 Structures 1 Basin	30.72	2.26	4.75	$72,000
80	Detention	Detention Riffles	1 Basin 2 Riffles	2.57	0.22	0.71	$56,000
	Grand Total		**189**	**5,152.5**	**615.6**	**1,207.3**	**$1,526,659**

Table 26 below is arranged in a numerical priority order that is based on the average annual amount of phosphorus and sediment load reductions that can be achieved compared to the estimated cost associated with implementation of each BMP. The BMP that can reduce the greatest annual nutrient load for the least cost is listed as the higher priority for purposes of this report. BMP #'s 43 to 46 can reduce a substantial amount of the estimated annual sediment loadings from the Unnamed Tributary sub-watershed and are separately noted as high-priority BMPs elsewhere in this report. This BMP system is located on land primarily owned by the Town and is also an excellent candidate for potential grant assistance.

Table 26 – Summary of Site-Specific BMPs Prioritized by Load Reduction Cost

BMP Priority	BMP Number	BMP Type	Total Estimated Cost	Phos. Reduction Cost (per lb./year for 10 years)	Sedim. Reduction Cost (per ton/year for 10 years)	Avg Phos. and Sedim. Reduction Cost (per year for 10 yrs)
1	54	Grass Waterway	$6,000	$34.13	$17.78	$25.95
2	57	Grass Waterway	$21,000	$41.99	$32.80	$37.39
3	15	Filter Strip	$700	$48.61	$29.29	$38.95
4	65	Field Border	$1,610	$73.18	$6.40	$39.79
5	25	Wetland	$3,000	$70.09	$13.57	$41.83
6	17	Filter Strip	$770	$61.11	$25.93	$43.52
7	40	Grass Waterway	$4,500	$53.64	$33.43	$43.53
8	29	Grass Waterway	$16,500	$56.45	$39.47	$47.96
9	47	WASCB	$19,500	$58.09	$46.71	$52.40
10	58	Field Border	$1,820	$92.39	$14.72	$53.56
11	19	Filter Strip	$1,260	$88.11	$40.51	$64.31
12	32	Grass Waterway	$9,750	$86.21	$47.06	$66.63
13	18	Filter Strip	$910	$94.79	$42.33	$68.56
14	22	Filter Strip	$980	$85.22	$52.97	$69.10
15	27	Grass Waterway	$15,750	$80.32	$60.48	$70.40
16	13	Filter Strip	$2,100	$65.42	$76.09	$70.75
17	21	Grass Waterway	$12,375	$72.12	$72.24	$72.18
18	67	Wetland	$3,000	$126.05	$21.69	$73.87
19	70	Wetland	$3,500	$132.58	$16.53	$74.55
20	56	Wetland	$3,800	$116.56	$33.60	$75.08
21	59	Grass Waterway	$24,000	$99.38	$71.51	$85.45
22	38	Grass Waterway	$4,125	$127.71	$46.04	$86.87
23	2	Grass Waterway	$16,500	$95.27	$78.68	$86.97
24	33	Grass Waterway	$6,000	$106.95	$67.57	$87.26
25	14	Filter Strip	$1,260	$126.00	$48.84	$87.42
26	34	Grass Waterway	$22,500	$101.12	$75.91	$88.52
27	24	Grass Waterway	$5,625	$91.61	$87.34	$89.48
28	68	Wetland	$8,000	$143.88	$37.12	$90.50
29	39	Grass Waterway	$2,062	$136.56	$51.17	$93.86
30	23	Wetland	$8,900	$118.35	$69.91	$94.13
31	66	Wetland	$2,900	$171.60	$23.97	$97.78
32	28	Grass Waterway	$64,312	$129.04	$69.47	$99.26
33	8	Grass Waterway	$26,625	$139.69	$61.29	$100.49
34	69	Wetland	$11,000	$178.28	$33.59	$105.93
35	55	Grass Waterway	$15,000	$125.42	$89.13	$107.27
36	49	Grass Waterway	$6,750	$145.16	$69.59	$107.37
37	63	Grass Waterway	$9,375	$162.76	$52.76	$107.76
38	52	Wetland	$3,000	$159.57	$60.36	$109.97
39	77	Detention	$11,000	$189.33	$39.03	$114.18
40	20	Grass Waterway	$12,000	$123.97	$109.19	$116.58
41	48	Grass Waterway	$7,500	$135.87	$106.69	$121.28
42	64	WASCB	$9,000	$162.45	$94.94	$128.70

BMP Priority	BMP Number	BMP Type	Total Estimated Cost	Phos. Reduction Cost (per lb./year for 10 years)	Sedim. Reduction Cost (per ton/year for 10 years)	Avg Phos. and Sedim. Reduction Cost (per year for 10 yrs)
43	76	Wetland	$14,000	$209.58	$50.02	$129.80
44	10	Grass Waterway	$15,750	$146.65	$117.19	$131.92
45	12	Grass Waterway	$36,000	$137.77	$133.28	$135.53
46	51	Wetland	$3,000	$196.08	$84.27	$140.17
47	60	Wetland	$2,900	$230.16	$53.70	$141.93
48	35	Blind Inlet	$3,000	$254.24	$30.77	$142.50
49	11	Grass Waterway	$18,000	$153.85	$133.53	$143.69
50	78	Detention	$20,000	$237.25	$50.84	$144.04
51	50	Wetland	$8,000	$240.96	$52.46	$146.71
52	36	Wetland	$3,800	$209.94	$85.20	$147.57
53	26	Grass Waterway	$18,750	$206.95	$98.22	$152.59
54	16	Filter Strip	$700	$189.19	$140.00	$164.59
55	53	Wetland	$19,500	$209.45	$122.10	$165.78
56	7	Grass Waterway	$15,000	$124.79	$286.81	$205.80
57*	**43 to 46**	**Multiple BMPs at Town Park**	**$141,500**	**$390.67**	**$128.40**	**$259.54**
58	9	Wetland	$8,900	$292.76	$234.21	$263.49
59	6	Wetland	$3,500	$479.45	$90.21	$284.83
60	37	Wetland	$4,700	$456.31	$114.63	$285.47
61	4	Wetland	$4,700	$671.43	$77.43	$374.43
62	74	Detention	$11,000	$388.69	$415.09	$401.89
63	62	Wetland	$15,400	$488.89	$496.77	$492.83
64	73	Wetland	$54,000	$1,020.79	$484.30	$752.55
65	5	Wetland	$3,800	$2,111.11	$422.22	$1,266.67
66	72	Detention	$51,000	$1,802.12	$1,924.53	$1,863.32
67	75	Grade Control	$72,000	$3,348.84	$472.13	$1,910.48
68	30	Livestock Mgmt.	$8,500	$714.29	$3,541.67	$2,127.98
69	79	Grade Control	$72,000	$3,185.84	$1,515.79	$2,350.82
70	71	Blind Inlet	$11,000	$3,235.29	$2,972.97	$3,104.13
71	31	Detention	$85,000	$2,361.11	$8,173.08	$5,267.09
72	41	Detention	$70,000	$4,458.60	$12,068.97	$8,263.78
73	3	Detention	$50,500	$6,312.50	$19,423.08	$12,867.79
74	1	Detention	$97,500	$6,632.65	$19,117.65	$12,875.15
75	80	Detention	$56,000	$25,454.55	$7,887.32	$16,670.93
76	42	Detention	$63,000	$10,327.87	$27,391.30	$18,859.59
77	61	Detention	$68,000	$13,076.92	$48,571.43	$30,824.18

* Note: Recommended Town Park BMP System located within the Unnamed Tributary sub-watershed is a high priority due to the total drainage area treated, the close proximity to the lake, and because the property is primarily located on Town property with the exception of the recommended upstream detention area.

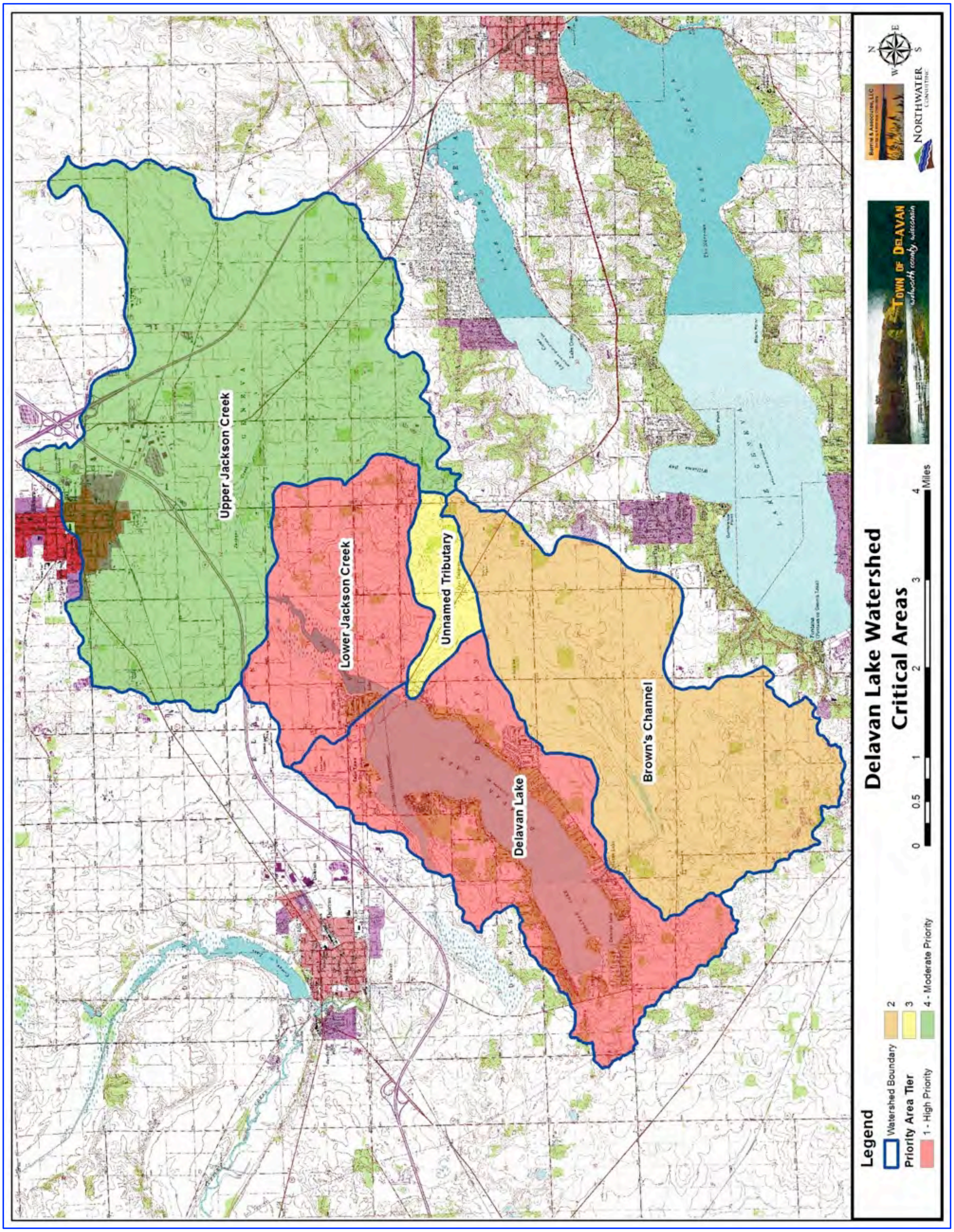
Table 27 - Estimates of Probable Cost and Relative Implementation Priority: Supplemental Nonpoint Source Management Measures

Relative Priority	Management Measure	Quantity	Total Cost
1	Mound Road Pond Assessment	1	$8,000 to $10,000
2	Mound Road Pond Maintenance (~ 8 to 10 yr. cycle)	1	$400,000 to $500,000
3	Brown's Chan. Sediment Removal (~8 to 10 yr. cycle)	1	$80,000 to $100,000
4	Brown's Chan. Stabilization (Upstream of Road)	1	$60,000 to $80,000
5	North Inlet Carp Removal (for 10 yrs at $5K-$10K/yr)	1	$50,000 to $100,000
6	Watershed Plan Coordinator (Part Time, ~ 10 years)	1	$300,000 to $400,000
7	Informational Brochure for Public Outreach	1	$4,000 to $6,000
8	Gully Erosion Assessment	1	$6,000 to $8,000
9	Brown's Chan. Wetland Pond Enhancement	1	$50,000 to $60,000
10	Stream Bank Stabilization	1	$30,000 to $40,000
11	Water Quality Monitoring (Annual, for 10 years)	1	$250,000 to $300,000
12	North Inlet Dredging Area Survey (every 5 years)	1	$6,000 to $8,000
13	Delavan Lake Shoreline Assessment	1	$6,000 to $8,000
	Grand Total		**$1,250,000 to $1,620,000**

The immediate and ongoing maintenance of existing BMPs, such as Brown's Channel, the Mound Road Ponds and Jackson Creek Wetland, and the North Inlet, can be completed because of land ownership and should be a top priority for immediate implementation. It was pointed out in this report that converting agricultural cropland into a conservation subdivision development with adequate onsite detention and buffers can provide substantial sediment and nutrient load reductions. These predicted load reductions were specifically noted for the proposed Shores of Delavan Lake subdivision and for the Baker Parcel, and would apply to other similar land use conversions that may arise, provided sufficient erosion control, detention and conservation buffering are included.

In addition to prioritizing BMPs by the amount of nutrient load reductions expected compared to the total implementation cost (as shown in Section 5.1, Estimates of Probable Cost and Recommended Priorities), an additional Tiered system is suggested for prioritizing focused efforts by sub-watershed, as implementation opportunities develop. This Tiered system is based on modeled loading estimates and proximity to the lake. The close proximity of Delavan Lake Sub-Watershed delivers a higher per-acre concentration of phosphorus than other areas of the watershed and was given an overall high priority of Tier 1. Lower Jackson Creek Sub-Watershed is also Tier 1 based on modeled sediment loads, followed by Tier 2 Brown's Channel sub-watershed, Tier 3 Unnamed Tributary and Tier 4 Upper Jackson Creek Sub-Watershed. (see Figure 33).

Figure 33 – Watershed Priority Areas



5.2 Responsible Parties

Farmer/Landowner In the Delavan Lake Watershed, there are varying business arrangements on who farms the land and makes important conservation decisions. If the farmer is the landowner, then the farmer/landowner is considered the primary responsible party. If the person/entity who owns the land is an absentee owner, then either the farmer/tenant or the absentee landowner is the responsible party. The tenant and landowner often make conservation practice decisions together in a collaborative fashion. Lease terms often determine who makes conservation decisions on the agricultural parcel.

Walworth County Land Use and Resource Management Dept. (LURM) The Walworth County LURM provides technical assistance to landowners, businesses and units of government to advance County conservation goals. It works in partnership with federal, state and local agencies to achieve conservation goals and compliance by:

1. Implementing practices to achieve sediment, nutrient & pollutant load reduction
2. Providing cost sharing assistance, when possible
3. Assisting with nutrient management and attaining urban conservation goals
4. Providing Erosion Control & Storm Water activities oversight (permitting & inspections)
5. Conducting Information & Education Activities

Natural Resources Conservation Service (NRCS) The United States Department of Agriculture has local offices in most Wisconsin counties, which include the NRCS. The Walworth County NRCS office is responsible for the Delavan Lake Watershed. The NRCS provides both conservation technical assistance and financial assistance to farmers and landowners. One of the programs frequently used for financial assistance is the Environmental Quality Incentive Program (EQIP). Most applicable to the Delavan Lake Watershed, the EQIP program provides cost sharing for implementation of approved conservation program practices. The farmer/landowner applies to the NRCS for conservation program funds and they are assisted by NRCS staff to complete the application process, certify the practices and make payments.

Farm Service Agency (FSA) Included in the USDA local offices are officials of the FSA who also provide some conservation-oriented programs; specifically, they provide the administrative structure for the federal Conservation Reserve Program and also support the state Conservation Reserve and Enhancement Program.

Town of Delavan (Town) The Town of Delavan has primary stewardship responsibility for the Lake along with the Delavan Lake Sanitary District (DLSD), which is responsible for aquatic plant management activities, protecting water quality and building alliances with select partners to implement successful lake and watershed management practices. It is recommended that a qualified Watershed Plan Coordinator be hired part-time to assist the Town with implementation of the plan. The estimated cost is $30,000 to $40,000 per year and assumes a natural resources background and experience with watershed planning and BMP implementation.

US Fish & Wildlife Service (USFWS) Provides technical assistance to local watershed protection groups. It also administers several grant and cost-share programs that fund habitat restoration. The USFWS also administers the federal Endangered Species Act and supports a program called Endangered Species

Program Partners, which features formal or informal partnerships for protecting endangered and threatened species and helping them to recover. These partnerships include federal partners, as well as states, tribes, local governments, nonprofit organizations, and individual landowners.

Kettle Moraine Land Trust Kettle Moraine Land Trust (KMLT) is an accredited, 501C(3) non-profit created "to preserve the natural heritage of the Kettle Moraine watersheds and nearby lands in Walworth County, Wisconsin through partnerships in land conservancy and resource management." It is currently in partnership with the Southeastern Wisconsin Regional Planning Commission (SEWRPC) to complete the Jackson Creek Protection Plan, which includes a portion of the Delavan Lake Watershed. The Jackson Creek Protection Plan is a unified approach to voluntarily addressing complex water quality problems, seeking funding, and a coordinated public outreach and education program to accomplish both. The plan recommends civic engagement, best management practices, information and education activities, and needed restoration to achieve habitat protection and improved water quality in the watershed. Estimated costs, potential funding sources, entities responsible for implementation, monitoring and measures to gauge success are also part of the plan. Although overlap exists with the overall Delavan Lake Watershed Implementation Plan, coordination is strongly recommended to enhance the overall success of both plans, which will result in long-term water quality improvements.

Delavan Lake Improvement Association (DLIA) Since the Delavan Lake Improvement Association's 1895 inception, the DLIA has taken a leadership role in the implementation of many significant lake projects. Over the past 100 years, the DLIA, in addition to promoting and supporting various beneficial projects, has served as a lake "watch dog" by identifying and alleviating problems. It is currently assisting WDNR with promoting and implementing the Healthy Lakes Program that can provide cost-share assistance for implementing lakeshore BMPs, such as native buffers, rain gardens and rock infiltration practices to protect Delavan Lake water quality.

United States Environmental Protection Agency (USEPA) The federal EPA has offices in some states to implement programs in those and other states. In Wisconsin, the WDNR provides program direction and financial assistance for water quality protection through the Clean Water Act Section 319 program.

United States Geological Survey (USGS) The Madison, WI office has been monitoring Jackson Creek inflows at the Mound Road gaging station and has also been monitoring in-water quality at Delavan Lake. This partnership has provided valuable water quality data and is strongly recommended to continue as the watershed plan is gradually implemented.

Wisconsin Department of Natural Resources (WDNR) WDNR provides education and information, technical guidance and selective financial assistance for lake, watershed and water quality initiatives. Although managing NPS pollution in Wisconsin involves a partnership of many programs, agencies, and stakeholders, the WDNR is the central unit of state government assigned to protect, maintain and improve the quality and management of the waters of the state.

Southeastern Wisconsin Regional Planning Commission (SEWRPC) SEWRPC works with local lake community organizations, including lake management associations and public inland lake protection and rehabilitation districts, to prepare lake management and watershed protection plans. These plans can be targeted issue-based plans, such as aquatic plant management plans; lake protection and/or recreational use plans designed to correct or manage current problems; or comprehensive management plans that address the full range of management issues. Comprehensive lake plan reports describe the existing chemical, biological, and physical water quality conditions in each lake in question; existing and proposed uses of the lake and attendant water quality objectives and standards; recommended pollution abatement measures required in each lake watershed to protect and enhance lake water quality; and recommended aquatic plant management and other appropriate in-lake measures needed to provide for a range of suitable recreational uses of the lake. SEWRPC is currently developing the Jackson Creek Protection Plan with assistance from the Kettle Moraine Land Trust (KMLT). Although overlap exists with the Delavan Lake Watershed Implementation Plan, coordination is recommended to enhance the overall success of both plans, which will result in long-term water quality improvements.

Wisconsin Department of Agriculture (WDOA) The WDOA's division of Trade and Consumer Protection (DATCP) administers the land and water resource management program, which includes farm conservation standards to implement nonpoint water pollution standards set by DNR (see Wisconsin Administrative Code chapter ATCP 50). These include standards for: 1) Soil erosion, 2) Manure storage facilities, 3) Clean water diversions, 4) Nutrient management, and 5) Manure management. Every county must have a land and water resource management plan in order to qualify for state funding. DATCP reviews and approves county plans at regular intervals, in consultation with the LWCB. Counties with approved plans are eligible for staffing grants and conservation cost-share funding from DATCP. DATCP funds county conservation staff and provides technical support to counties. DATCP and DNR may provide cost-share funding to counties and counties use cost-share funds to help farmers pay for needed farm conservation practices.

5.3 Technical & Financial Assistance

Section 5.3 will list and describe the technical assistance required to implement the plan, as well as the funding mechanisms/sources that should be explored to fund plan recommendations.

5.3.1 Technical Assistance

In addition to the programs of conservation technical assistance provided by the Walworth County LURM, USGS, NRCS and WDNR, there are conservation technical assistance resources provided through the University of Wisconsin Cooperative Extension (UWEX) and UW Discovery Farms, as well as by private professional consultants. Funding cuts have reduced the Cooperative Extension's ability to provide much direct technical assistance. Many producers rely upon private consultants: certified crop advisors (CCA) or Technical Service Providers (TSP) for technical expertise. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) and the Wisconsin Department of Natural Resources (WDNR) work with local lake community organizations, including lake management associations and public inland lake protection and rehabilitation districts, to prepare lake management and watershed protection plans, in addition to providing technical assistance.

5.3.2 Financial Assistance

Key sources of potential financial assistance for the Delavan Lake Watershed Implementation Plan are listed below:

Wisconsin Department of Natural Resources (WDNR) WDNR provides selective financial assistance opportunities for lake, watershed and water quality initiatives, such as the Surface Water, Targeted Runoff Management Grant Programs. Lake Protection Grants assist eligible applicants with implementation of lake protection and restoration projects that protect or improve water quality, habitat or the elements of lake ecosystems. The basic Lake Protection subprograms include: 1) Fee simple or Easement Land Acquisition, 2) Wetland and Shoreline Habitat Restoration, 3) Lake Classification and Local Ordinance Development, 4) Lake Plan implementation and 5) Healthy Lakes Initiative, which is currently active with assistance from the Delavan Lake Improvement Association. The Targeted Runoff Management (TRM) Grant Program offers competitive grants for local governments for controlling NPS pollution. Grants reimburse costs for agriculture or urban runoff management practices in targeted, critical geographic areas with surface water or groundwater quality concerns. Detailed application instructions, procedures and submittal deadlines can be accessed from the WDNR Website (http://dnr.wi.gov/aid/grants.html).

USDA NRCS EQIP Environmental Quality Incentives Program is a cost-share program for farmers and landowners to share the expenses of implementation and maintenance of approved soil and water conservation practices on farmland for qualified entities.

USDA FSA CRP Conservation Reserve Program (CRP) is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

USDA FSA CREP Conservation Reserve Enhancement Program (CREP) is an offshoot of the Conservation Reserve Program. Administered on the federal level by the FSA, CREP targets high-priority conservation issues identified by local, state, or tribal governments or non-governmental organizations. In exchange for removing environmentally sensitive land from production and introducing conservation practices, farmers and agricultural landowners are paid an annual rental rate. Participation is voluntary, and the contract period is typically 10–15 years, along with other federal and state incentives, as applicable, per each CREP agreement.

USFWS Partners Program restores, improves, and protects fish and wildlife habitat on private lands through alliances between the U.S. Fish and Wildlife Service, other organizations, and individuals, while leaving the land in private ownership.

Private Funds This category of financial assistance can come from private foundations, individual farmers, and landowners and can be used as cash match for grant funds or as private contributions to Delavan Lake Watershed conservation activity.

Town of Delavan The Town of Delavan may have resources it can selectively allocate to be used as match for WDNR or EQIP cost share, or as contributions to watershed or in-lake conservation practices to maximize water quality protection for Delavan Lake.

American Farmland Trust AFT may provide matching funds for Delavan Lake Watershed Outreach and Education from private foundation sources. It is also actively promoting cover crops and may be a potential resource for assistance requests.

Mississippi River Basin Healthy Watersheds Initiative To improve the health of the Mississippi River Basin, NRCS has established the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through this Initiative, NRCS and its partners will help producers in selected watersheds in the Mississippi River Basin voluntarily implement conservation practices that avoid, control, and trap nutrient runoff; improve wildlife habitat; and maintain agricultural productivity.

6.0 Information, Education and Outreach

An information and education component that will be used to enhance public understanding of a project and encourage the public's early and continued participation in selecting, designing and implementing the appropriate non-point source management measures is one of the Nine Elements of a Watershed Plan. Public and stakeholder support, education, and outreach are critical to maintaining healthy watersheds into the future. Local communities, landowners, businesses, and the public all have a role to play and a stake in services provided by healthy aquatic ecosystems and their supporting watersheds. Often, it is important to demonstrate the economic link to sustaining these resources. But ultimately, changing behavior to minimize impacts to the environment and living sustainably will be required to protect and maintain healthy watersheds (USEPA).

The Wisconsin Department of Natural Resources (WDNR), the Natural Resources Conservation Service (NRCS), the Walworth County Land Use and Resource Management (LURM) Dept., the Delavan Lake Improvement Association (DLIA), the Kettle Moraine Land Trust, the Southeastern Wisconsin Regional Planning Commission (SEWRPC), the Delavan Lake Sanitary District (DLSD) and others have conducted numerous informational and educational activities in recent years. An annual Lake Fest is conducted at Town Park that has recently included educational activities and invited speakers to talk about lake-related issues. Additional and continued outreach and education efforts are strongly recommended. Conserving valuable topsoil and preventing excessive off-site transport of sediment and nutrients, such as phosphorus and nitrogen, should be a concern for all landowners in the watershed.

A coordinated and targeted information and outreach effort is recommended that includes working with local, county and state natural resource agencies, developing and distributing informational brochures, conducting educational participatory workshops (i.e., Annual Lake Fest, etc.), posting website project highlights, conducting meetings with landowners, highlighting installed BMP examples for observation and discussion, etc. It will be critical to the success of the project for people to be interested and involved in the actions needed to restore or protect Delavan Lake, especially since it may mean making voluntary changes in their own actions.

The Watershed Plan Coordinator (recommended new part-time position) can assist with the implementation of many of these efforts that initially would include the development of targeted informational brochures for distribution, as well as initiating website postings to promote the progress of the Watershed Plan. The Delavan Lake Watershed outreach campaign may also consider additional avenues, such as surveying stakeholders to better understand their perceptions of the issues, how proposed solutions might affect them and how they relate to Delavan Lake.

7.0 Implementation Milestones & Schedule

Implementation milestones and goals are intended to be measured by NRCS EQIP contracts, WDNR, DLIA and Town of Delavan funded cost-share measures and initiated projects. The goals are meant to be both measurable and realistic, given that much of the construction work must be accomplished seasonally to avoid impacts to agricultural planting, growing and harvesting activities. Specific milestones and a schedule/timeframe are presented in Table 28. Direct outreach and communication one-on-one with landowners is vital to the success of future implementation activities and will be a component of every effort to secure the adoption of the BMPs listed below. This communication and outreach will also help to ensure practices are maintained over time.

A conservative implementation schedule is presented in Table 28 as an overall Project Planning Guide. Each initial milestone described in years 1 & 2 is intended to optimize both short- and long-term implementation opportunities. A targeted education and selective outreach program is anticipated to result in landowners willing to implement a substantial number of recommended best management practices (BMPs) over time. Promoting BMPs, such as rain gardens, rock infiltration pits, native plantings, diversions and shoreline stabilization to homeowners surrounding Delavan Lake, will yield direct and indirect water quality benefits. Willing participation, increased awareness and acceptance of the Plan by the Town and near-lake homeowners will translate positively to agricultural landowners further upstream in the watershed. Once initial planning, coordinating and BMP prioritization steps have been completed and implemented, mid-term and long-term BMP implementation efforts can be realistically targeted for potential grant assistance and gradually implemented. Implementation and maintenance of existing BMPs within Town-owned property, such as the Mound Road Ponds, Brown's Channel and Town Park, along with In-Lake Management Measures, should be immediate top priorities. Potential high-priority projects that would provide significant load reductions, such as those identified and described in Section 5.3, may move forward into construction and should be considered and noted, if implemented. As described in Section 5.1 above, potential BMP considerations can be evaluated by the sub-watershed location Tier system that considers proximity to the lake in addition to potential load reductions. Although we highly recommend designating a qualified watershed plan coordinator, we feel action should be taken towards maintenance of the existing BMPs, and that finding and hiring a qualified part-time watershed coordinator in a timely manner, and the long-term commitment of the Town of Delavan, the DLSD, the City of Delavan, the DLIA and other stakeholders, is critical to the short- and long- term success of this plan, which is focused on protecting the water quality of Delavan Lake.

Table 28 - Implementation Milestones & Timeframe

Timeframe	Milestone
Years 1 - 2	1. Complete Mound Road Pond Assessment 2. Plan and Begin Mound Road Pond Maintenance 3. Plan and Begin Brown's Channel Maintenance 4. Hire Part-Time Watershed Plan Coordinator 5. Begin Information, Education and Outreach Efforts 6. Promote Healthy Lakes Initiative and Install Rain Gardens, Buffers, etc. 7. Plan and Install Town Park BMPs 8. Complete Gully Erosion Assessment 9. Complete Delavan Lake Shoreline Assessment 10. Conduct one-on-one communication with willing Landowners. 11. Complete North Inlet Channel Survey 12. Plan and Conduct North Inlet Carp Removal (Annual) 13. Continue with Water Quality Monitoring
Years 3 - 5	1. Continue with Information, Education and Outreach Efforts 2. Install 25% of Site-Specific BMPs (Grass Waterways, Wetlands, Detention, etc.) 3. Install 25% of Basin-Wide BMPs (No-Till, Cover Crops, Detention, etc.) 4. Complete Mound Road Pond Maintenance 5. Complete Brown's Channel Maintenance 6. Continue with Water Quality Monitoring 7. Continue Healthy Lakes Initiative and Install Rain Gardens, Buffers, etc. 8. Conduct North Inlet Carp Removal Efforts (Annual) 9. Continue to conduct one-on-one communication with willing landowners
Years 6 - 10	1. Continue with Information, Education and Outreach Efforts 2. Install 50% of Site-Specific BMPs (Grass Waterways, Wetlands, Detention, etc.) 3. Install 50% (or more) of Basin-Wide BMPs (No-Till, Cover Crops, Detention, etc.) 4. Complete Mound Road Pond Surveys and Maintenance, as required 5. Complete Brown's Channel Surveys and Maintenance, as required 6. Continue with Water Quality Monitoring 7. Conduct North Inlet Carp Removal (Annual) 8. Continue Healthy Lakes Initiative and Install Rain Gardens, Buffers, etc. 9. Continue to conduct additional one-on-one outreach with landowners

Table 29 summarizes BMP milestones or objectives, responsible entities and the potential technical assistance and funding sources that may be available. The implementation milestones or objectives presented below are intended to be achievable and realistic over a 10-year period and follow the site-specific, basin-wide, and supplemental practices described in Section 5. Although these implementation milestones alone do not entirely meet water quality targets as presented in Section 8, they will result in substantial improvements to water quality and the future attainment of water quality standards in the watershed.

Table 29 - Implementation Objectives, Responsible Parties, Technical/Financial Assistance

BMP/Objective	Responsible Party	Potential Technical Assistance and Funding Sources
	Basin Wide BMPs	
BMP: Cover Crops **Objective*:*** Install 2,824 acres	Landowner/LURM/NRCS/ Town of Delavan	***Technical Assistance***: SWCD/NRCS/Consultants ***Funding Mechanism***: WDNR/Town of Delavan/NRCS /Private funds
BMP: No-Till **Objective**: Convert 9,886 acres	Landowner/LURM/NRCS/ Town of Delavan	***Technical Assistance:*** SWCD/NRCS/Consultants ***Funding Mechanism***: WDNR/Town of Delavan/NRCS / Private funds
BMP: Rain Gardens/Bioswales **Objective:** Install Rain Gardens and Bioswales to reduce loadings	Landowner/LURM/DLSD/ Town of Delavan	**Technical Assistance:** NRCS/SWCD /Consultants **Funding Mechanism:** WDNR/Town of Delavan/NRCS /Private funds
BMP: Rain Barrels/Rock infiltration/ Shoreline Buffers/Diversions **Objective:** Promote Healthy Lakes Program & reduce nutrient delivery to lake	Landowner/LURM/DLSD/ Town of Delavan	**Technical Assistance**: SWCD/NRCS/Consultants **Funding Mechanism**: WDNR/Town of Delavan/NRCS /Private funds
BMP: Detention **Objective:** Install detention ponds, bioswales to reduce nutrient loads	Landowner/LURM/DLSD/ Town of Delavan	**Technical Assistance:** SWCD/NRCS/Consultants **Funding Mechanism:** WDNR/Town of Delavan/NRCS /Private funds
BMP: Permeable Pavement **Objective:** Installing permeable pavement to reduce urban runoff and nutrient delivery	Landowner/LURM/DLSD/ Town of Delavan	**Technical Assistance:** SWCD/NRCS/Consultants **Funding Mechanism:** WDNR/Town of Delavan/NRCS/Private funds
	Site-Specific BMPs	
BMP: Grass Waterways **Objective:** Install grass waterways to prevent gully erosion & reduce nutrient delivery	Landowner/LURM/NRCS/ Town of Delavan	***Technical Assistance***: LURM/NRCS/Consultant ***Funding Mechanism***: WDNR/Town of Delavan/NRCS/Private funds
BMP: Wetlands **Objective:** Install wetlands to trap and filter nutrients	Landowner/LURM/NRCS/ Town of Delavan	***Technical Assistance***: LURM/NRCS/Consultant ***Funding Mechanism***: WDNR/Town of Delavan/NRCS/Private funds
BMP: Detention **Objective:** Install detention ponds, bioswales to reduce nutrient loads	Landowner/LURM/ Town of Delavan	**Technical Assistance**: LURM/NRCS/Consultant **Funding Mechanism**: WDNR/Town of Delavan/NRCS/Private funds
BMP: Filter Strips, Field Borders **Objective:** Install Filter Strips & Field Borders to reduce nutrient delivery	Landowner/LURM/NRCS/ Town of Delavan	***Technical Assistance***: LURM/NRCS/Consultant ***Funding Mechanism***: WDNR/Town of Delavan/NRCS/Private funds

BMP/Objective	Responsible Party	Potential Technical Assistance and Funding Sources
BMP: WASCOB, Blind Inlets **Objective:** Install WASCOBs and Blind Inlets to reduce nutrient delivery	Landowner/LURM/NRCS/ Town of Delavan	***Technical Assistance***: LURM/NRCS/Consultant ***Funding Mechanism***: WDNR/Town of Delavan/NRCS/Private funds
BMP: Grade Control/Riffles **Objective:** Install riffles to reduce erosion and nutrient delivery	Landowner/LURM/NRCS/ Town of Delavan	**Technical Assistance**: LURM/NRCS/Consultant **Funding Mechanism**: WDNR/Town of Delavan/NRCS/Private funds
	Supplemental Management Measures	
BMP: Maintain Existing BMPs **Objective:** Mound Rd. Pond Assessment and Maintenance	Town of Delavan/DLSD/DLIA	**Technical Assistance**: LURM/NRCS/Consultant **Funding Mechanism**: WDNR/Town of Delavan
BMP: Maintain Existing BMPs **Objective:** Brown's Channel Sediment Removal	Town of Delavan/DLSD/DLIA	**Technical Assistance**: LURM/NRCS/Consultant **Funding Mechanism**: WDNR/Town of Delavan
BMP: In-Lake Management **Objective:** Annual Carp Removal Efforts to reduce nutrient loading	Town of Delavan/DLSD/DLIA	**Technical Assistance:** WDNR/Consultant **Funding Mechanism:** WDNR/Town of Delavan
BMP: Watershed Plan Coordinator **Objective:** Hire qualified person to assist with plan implementation	Town of Delavan/DLSD	**Technical Assistance**: WDNR/LURM/Consultant **Funding Mechanism**: WDNR/Town of Delavan
BMP: Education and Outreach **Objective:** Provide information and initiate outreach to stakeholders in watershed	Town of Delavan/ LURM/WDNR/DLSD/DLIA	**Technical Assistance**: Town of Delavan/Consultant **Funding Mechanism**: WDNR/ Town of Delavan
BMP: Gully Erosion Survey **Objective:** Conduct study	Town of Delavan, LURM, NRCS	**Technical Assistance**: Consultant **Funding Mechanism**: Town of Delavan/WDNR
BMP: Stream Bank Stabilization **Objective:** Plan and Implement recommended stream bank stabilization to reduce erosion	Landowner/WDNR/NRCS/LURM/ Town of Delavan	**Technical Assistance**: NRCS/WDNR/Consultant **Funding Mechanism**: WDNR/ NRCS/ Town of Delavan/Private Funds
BMP: Brown's Channel Wetland Pond **Objective:** Plan and implement pond enhancements to reduce nutrients	Landowner, Town of Delavan, DLSD	**Technical Assistance**: LURM/NRCS/Consultant **Funding Mechanism**: WDNR/Town of Delavan/Private Funds
BMP: Water Quality Monitoring **Objective:** Conduct water quality monitoring to measure progress	USGS, Town of Delavan, DLSD	**Technical Assistance**: USGS/Consultant **Funding Mechanism**: USGS/Town of Delavan/DLSD
BMP: North Inlet Survey **Objective:** Conduct Survey every 5 years to monitor water depths	Town of Delavan, DLSD	**Technical Assistance**: Consultant **Funding Mechanism**: Town of Delavan
BMP: Lake Shoreline Assessment **Objective:** Conduct shoreline assessment of Delavan Lake to identify areas to stabilize	Town of Delavan, DLSD, DLIA	**Technical Assistance**: LURM/NRCS/Consultant/ **Funding Mechanism**: Town of Delavan/WDNR

8.0 Water Quality Targets

This section describes water quality targets and those implementation actions required to meet targets. Reduction targets for Jackson Creek and Brown's Channel are to meet the phosphorus (0.075 mg/l) and total suspended solids (26.0 mg/l) criteria noted in the Rock River TMDL Plan. Water quality targets for Delavan Lake were generated from WDNR Guidelines and from the Rock River TMDL Plan. According to the Rock River TMDL Plan, the average annual percent reduction of Total Phosphorus (TP) and Total Suspended Solids (TSS) required to meet water quality targets are 49% for TP and 25% for TSS. Every two years, Section 303(d) of the Clean Water Act requires states to publish a list of all waters that are not meeting water quality standards. In the proposed 2016 list update, DNR proposes to add 209 new waters. A majority of the listing additions were waters that exceed total phosphorus criteria. A significant number of new listings were also based on poor biological condition. Delavan Lake was recently added to the proposed WDNR 303D Impaired Surface Waters List for phosphorus and algae due to more stringent phosphorus criteria of 30 ug/l. Historical summertime trophic state index (TSI) graphs and targets are presented in Figures 34 and 35.

In order to meet and comply with standards for Delavan Lake, short- and long-term reductions in phosphorus and suspended sediment are required. Tables 30 through 32 compare water quality targets to expected BMP load reductions. Results indicate that implementing all site-specific and basin-wide practices will meet the target reduction percentages. The sediment target will be exceeded if all site-specific and basin-wide practices are implemented. In order to achieve and maintain water quality targets, supplemental management measures are needed and described in Section 5.3.4. Substantial improvements in water quality can be achieved with a gradual and continual implementation and maintenance of the most functional and cost-effective BMPs. The estimated 25% reduction in annual loads resulting from the implementation of Supplemental NPS Management Measures (Section 5.3.4) is conservative and achievable, particularly since In-Lake Management Measures and the Maintenance of Existing BMPs can be accomplished with appropriate funding.

Delavan North Inlet

Table 30 – Delavan Lake Site-Specific BMP Load Reductions & Water Quality Targets

Total Phosphorus Load (lbs/yr)	3,340	Total Sediment Load (tons/yr)	7,209
Phosphorus Load Reduction (lbs/yr)	616	Sediment Load Reduction (tons/yr)	1,207
Phosphorus Reduction Target	49%	Sediment Reduction Target	25%
Reduction % Achieved	18.7%	Reduction % Achieved	16.7%

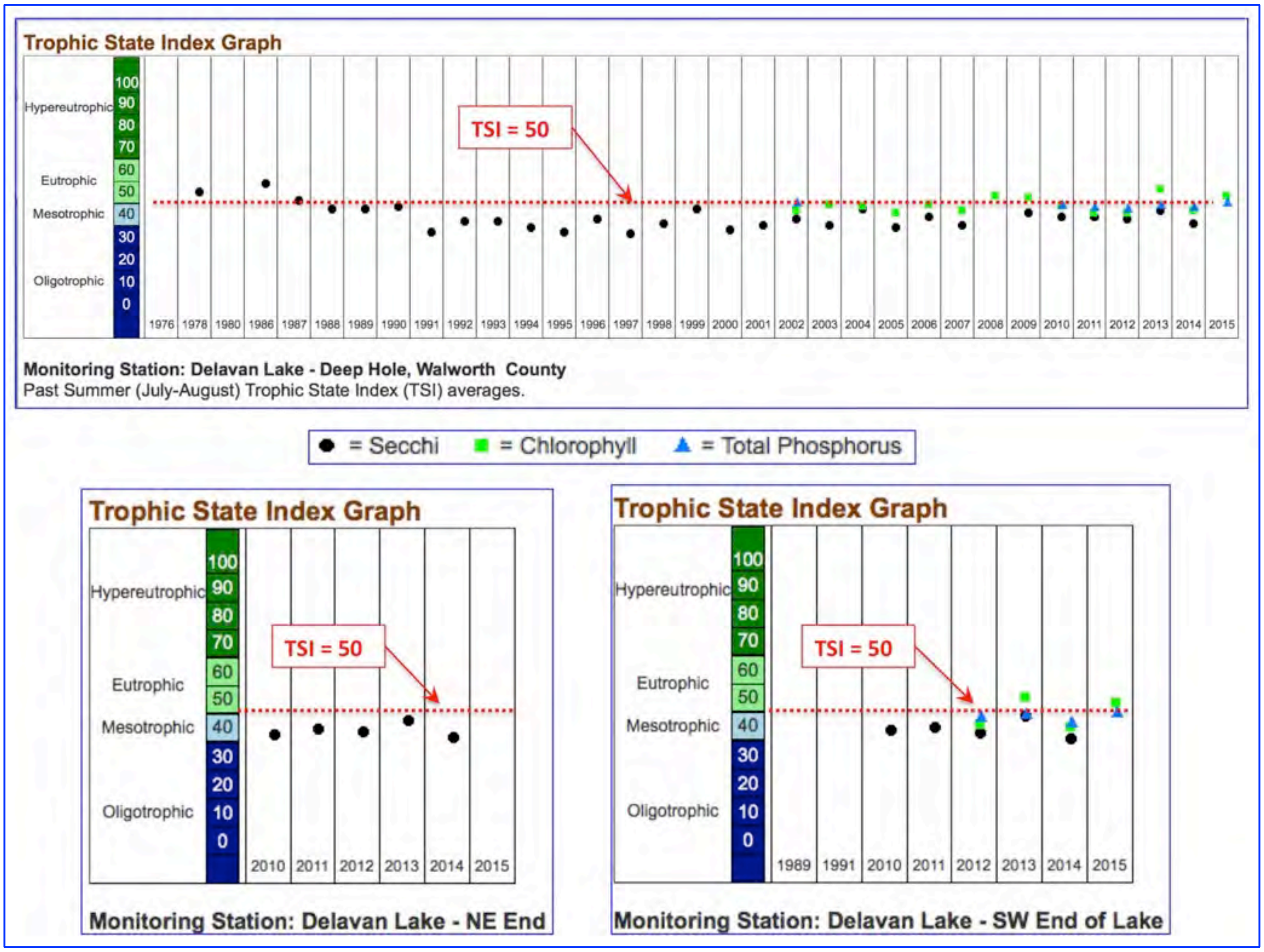
Table 31 – Delavan Lake Basin-Wide BMP Load Reductions & Water Quality Targets

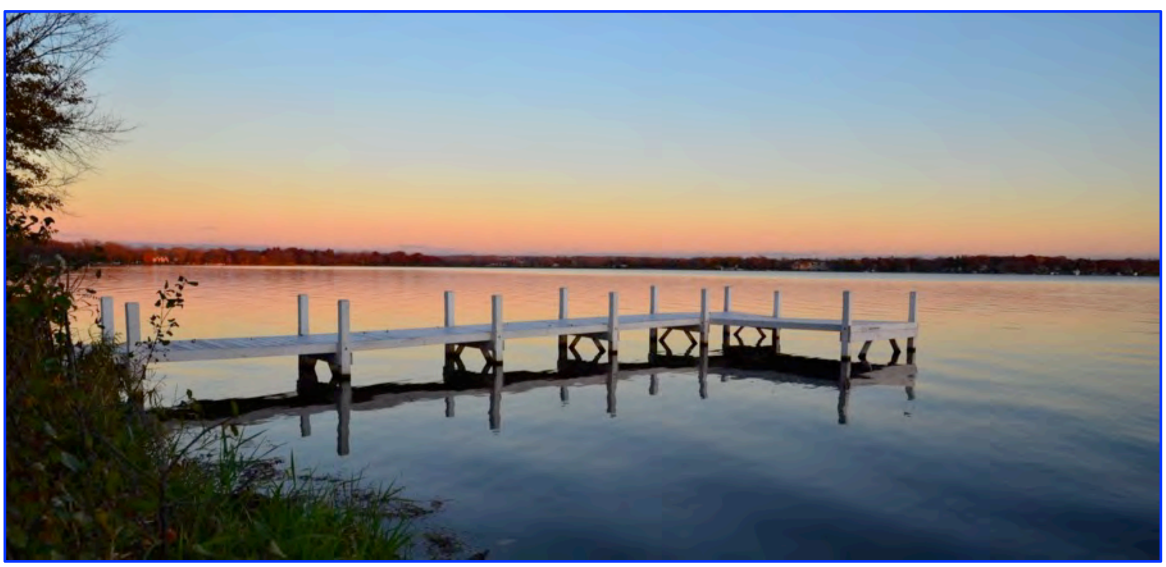
Total Phosphorus Load (lbs/yr)	3,340	Total Sediment Load (tons/yr)	7,209
Phosphorus Load Reduction (lbs/yr)	778	Sediment Load Reduction (tons/yr)	2,946
Phosphorus Reduction Target	49%	Sediment Reduction Target	25%
Reduction % Achieved	23.3%	Reduction % Achieved	40.9%

Table 32 – Supplemental NPS BMP Load Reductions & Water Quality Targets

Total Phosphorus Load (lbs/yr)	3,340	Total Sediment Load (tons/yr)	7,209
Phosphorus Load Reduction (lbs/yr)	835	Sediment Load Reduction (tons/yr)	1,802
Phosphorus Reduction Target	49%	Sediment Reduction Target	25%
Reduction % Achieved	25.0%	Reduction % Achieved	25.0%

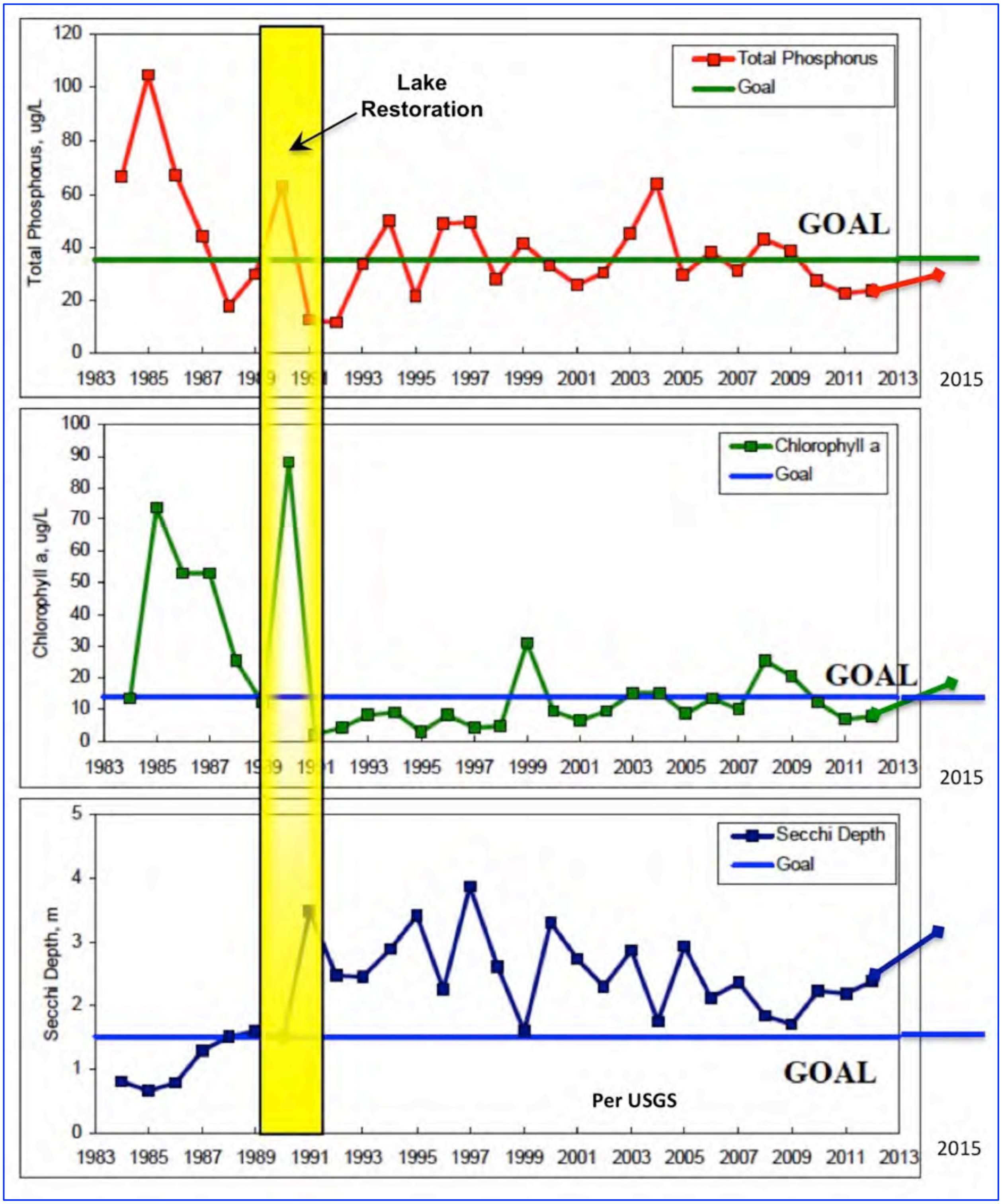
Figure 34 – Historical Summertime Trophic State Index Graphs for Delavan Lake





Delavan Lake looking South East

Figure 35 – Mean Summertime Trophic State Index (TSI) Targets for Delavan Lake



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Dredging & Waterway Consulting
Town of Delavan
walworth county, wisconsin
Northwater Consulting

9.0 Water Quality Monitoring Strategy

The purpose of the monitoring strategy for the Delavan Lake Watershed is to utilize existing monitoring data (existing USGS stations) and to continue monitoring the condition and health of the lake and watershed in a consistent and on-going manner. In addition, the strategy seeks to add seven additional monitoring stations strategically located throughout the watershed at accessible locations. The strategy allows for evaluation of the overall health of the watershed and its changes through time. Another key purpose is to assess the effectiveness of plan implementation projects, and their cumulative watershed-scale contribution towards achieving the goals and objectives of the plan. While programmatic monitoring tracks progress through achievement of actions, this section outlines a strategy to directly monitor the effectiveness of the actions. Monitoring environmental criteria as outlined in this strategy is an effective way to measure progress toward meeting water quality objectives. One potential problem with in-stream indicators is the issue of isolating dependent variables. There are likely many variables influencing the monitoring results, so making conclusions with regard to one specific constituent should be done with caution. It should be noted, however, that the indicators are excellent for assessing overall changes in a watershed's condition.

One active USGS tributary monitoring station exists for Jackson Creek and additional tributary monitoring sites are also proposed and presented (Table 33 and Figure 36). Given the historical data currently available, it is recommended that monitoring continue at the existing Mound Road gaging station and at the in-lake sites, ideally, under direction from the USGS. The proposed monitoring categories and associated recommendations are summarized in Table 34. Monitoring activities should be coordinated with the WDNR and additional resources should be sought, such as the River Watch program through the National Great Rivers Research and Education Center (NGRREC), or through volunteers, as needed, to re-activate monitoring that was completed in 2013 by DLSD at the tributary sites listed below in Table 33. The Town of Delavan, the Delavan Lake Sanitary District and/or local volunteers could manage an expanded sampling program for the Delavan Lake Watershed that includes sites M-1 through M-7.

Table 33 - Existing & Proposed Monitoring Sites & Description

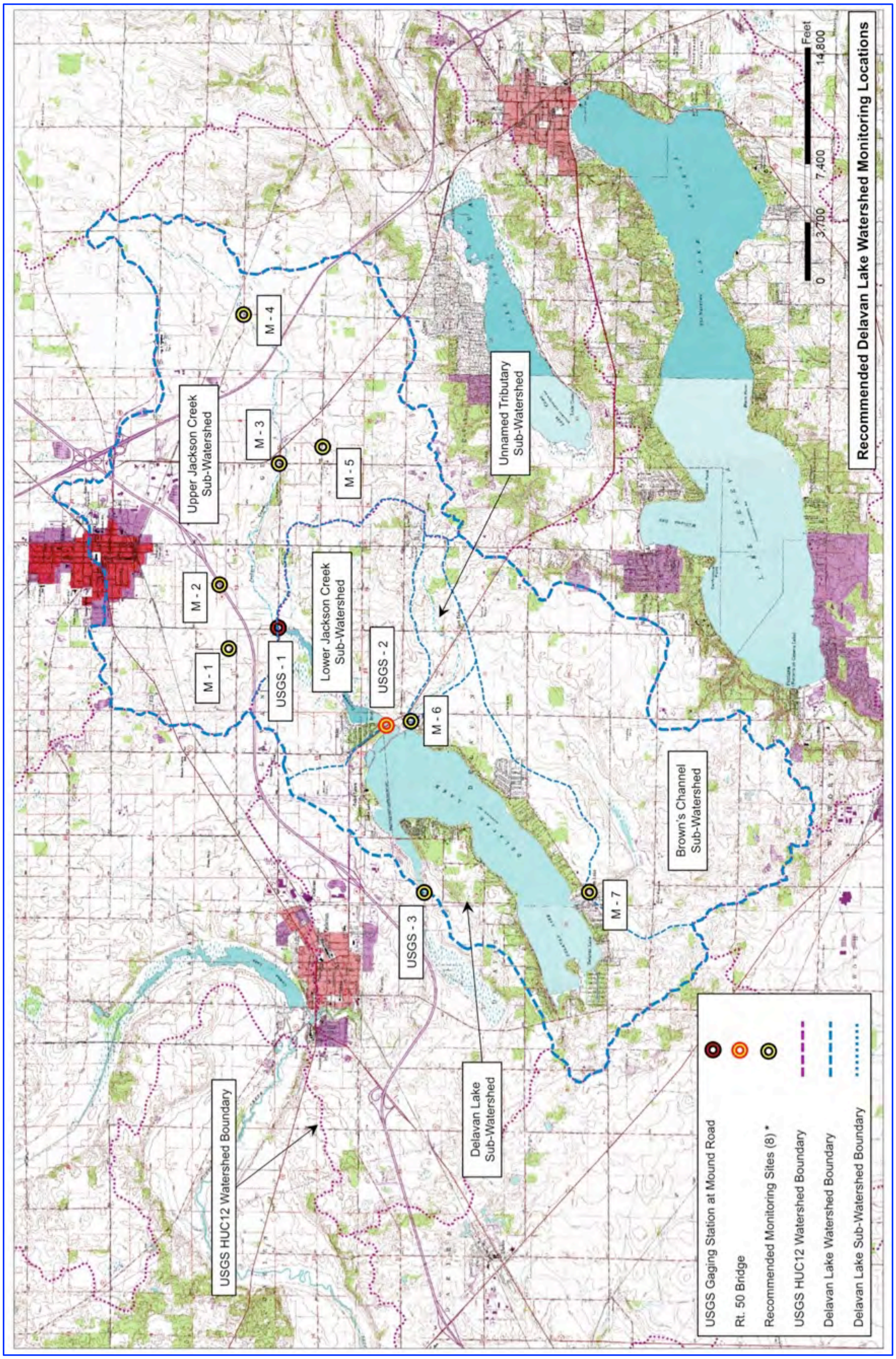
Station ID	Site Description	Notes
USGS - 1	Jackson Creek at Mound Road	Existing USGS monitoring site, Active
USGS - 2	Jackson Creek at HWY 50	Historical USGS monitoring site, Inactive
USGS - 3	Delavan Lake Outlet	Historical USGS monitoring site, Inactive
M - 1	Upper Jackson Creek at Marsh Rd.	New monitoring site
M - 2	Upper Jackson Creek at O'Connor Dr.	New monitoring site
M - 3	Upper Jackson Creek at Petrie Rd.	New monitoring site
M - 4	Upper Jackson Creek at MacLean Rd.	New monitoring site
M - 5	Upper Jackson Creek at Willow Bend Rd.	New monitoring site
M - 6	Town Park at South Shore Dr.	New monitoring site
M - 7	Brown's Channel at South Shore Dr.	New monitoring site

Table 34 - Summary of Monitoring Categories & Recommendations

Monitoring Category	Summary of Recommendations
Stream flow	Measure stream flow during every sampling event, if conditions permit.
Ambient Water Quality	Utilize USGS, WDNR and local volunteers to execute regular monitoring for water quality.
Physical and Biologic Assessment	Considering assessments for fish, macro-invertebrates, habitat and channel morphology on Jackson Creek and Brown's Channel.
BMP Effectiveness	Monitoring BMP effectiveness of specific practices or clusters of practices. Develop a detailed monitoring plan in combination with implementation activities.
Monitoring Partnerships	Coordinate with USGS, DLSD and WDNR. Explore volunteer monitoring program through River Watch, universities, local agencies and volunteers.
Storm Event Runoff Monitoring	Conduct additional monitoring during storm events.

Delavan Lake at Highway 50

Figure 36 – Recommended Monitoring Locations



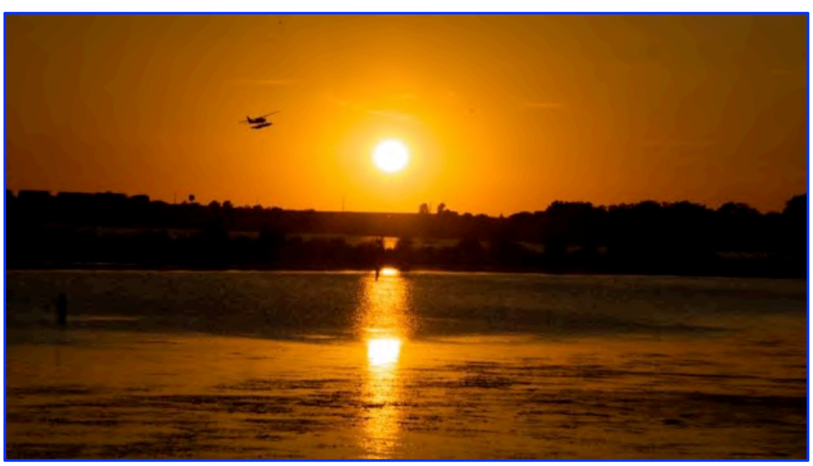
9.1 Water Quality Monitoring

At a minimum, monthly and storm-event water quality monitoring should be considered for all stations in the watershed (Figure 36). It is recommended that the USGS continue with monitoring efforts at Mound Road (USGS-1) in addition to the in-lake monitoring sites, and that the tributary sites M-1 through M-7 are also monitored. Efforts should focus initially on collecting additional storm event data followed by a regular sampling program.

Table 35 includes the minimum parameters that should be considered for monitoring. Quantitative benchmarks that indicate impairment conditions are also illustrated in this table. The establishment of baseline conditions is important, in order to evaluate trends and changes in water quality over time through implementation. Parameters, such as total phosphorus, total suspended sediment, and total nitrogen, should be analyzed considering flow volumes, in order to make relative comparisons year to year, as concentrations of pollutants vary with flow volumes. The water quality monitoring results may also be used to calibrate the nonpoint source pollution load model and make revised annual loading estimates throughout implementation.

Table 35 – Suggested Baseline Water Quality Analysis Parameters

Analyte	Suggested Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/l
Total Nitrogen	Less than 10 mg/L
Total Suspended Sediment (TSS)	Less than 75 mg/l
Turbidity	Less than 20 NTU
Dissolved Oxygen	No less than 6.0 mg/l
Temperature	Less than 90°
pH	Between 6.5 – 9.0
Flow	CFS



Delavan Lake looking West from Highway 50

Appendix A

Pollutant Load Model Methodology

Delavan Lake Watershed Implementation Plan

NORTHWATER CONSULTING

1/30/2016

sWAMM™

Spatial Watershed Assessment & Management Model

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Tables

Pollutant Loading Model Methodology

1.0 Introduction

A GIS spatially based pollutant load model, or *SWAMM* (Spatial Watershed Assessment and Management Model) was developed to estimate field level pollutant loading from, phosphorus and sediment in the Delavan Lake Watershed. Constructed using soils, landuse and precipitation data, the model provides annual event loading for individual land parcels within the watershed. Results are organized through a unique combination of parcel ownership, landuse and soils, delineated into individual units of pollution loading. Accepted equations for calculating runoff and soil erosion are integrated into the model to provide realistic estimations of the quantity and distribution of pollution loading throughout the study area. The model was directly calibrated to historical water quality data. A time period of 1/1/2009 to 1/1/2014 was used for generating rainfall values.

The GIS data set is organized in such a way that results can easily be queried by sub-watersheds, by parcel boundaries and by landuse. Results can also be analyzed based for user-defined boundaries and presented in map format, easily overlaid on existing base maps. The model includes 14,413 unique records from which to assess pollutant loading. The following methodology document provides key model equations and values, references and summary statistics.

2.0 Methodology

The custom SWAMM consists of two primary components:

- Universal Soil Loss Equation (USLE) Component
- Event Mean Concentration (EMC) Component

2.1 USLE Component

The overall analysis methodology modified by Northwater from*:*

Mitasova and Lubos Mitas: Modeling soil detachment with RUSLE3d using GIS, 1999; University of Illinois. http:/skagit.meas.ncsu.edu/~helena/gmslab/erosion/usle.html

The Universal Soil Loss Equation (USLE) component of the model is applied to agricultural land uses within the watershed (Row Crops). The USLE methodology incorporated into the model is summarized below:

- 1:24,000 NRCS Soil Survey Geographic Database (SSURGO) Digital Soils.
- Selected appropriate soil types and relevant USLE factors identified and calculated from SSURGO soils dataset and information from local Soil and Water Conservation District staff and staff from the Natural Resources Conservation Service.
- USLE erosion calculated with the following equation: LS * K * C * R * P.

Table 1 - USLE Factors

C factor	K factor	LS factor	R factor	P factor
Values Provided by County Staff Conventional High – 0.43 Conventional Moderate – 0.35 Wheat/No-Till – 0.1 Hay/Sod Farm – 0.01 Fall Tillage/Mulch Till – 0.23 No-Till with Cover Crop – 0.08 Spring Till with Alfalfa – 0.1	Values included in SSURGO tabular data	Values included in SSURGO tabular data; calculated from slope and slope length values or from local NRCS Staff	140	0.5-0.98

2.2 Event Mean Concentration (EMC) Component

A) All formulas and selected variables are derived from: *STEPL (Spreadsheet Tool for Estimation of Pollutant Load) Version 3, Tetra Tech, 2004.*

B) Event Mean Concentration Values and Curve Numbers were derived from the following sources:

1. *Nonpoint Source Pollution and Erosion Comparison Tool (N-SPECT) Technical Guide, Version 1.0 Release 1, November 2004.*
2. *Lower DuPage River Watershed Plan Pollution Load Model Methodology, 2010.*
3. *V3 Companies, 2008. Elkhart River Watershed Management Plan, Appendix J; Pollutant Load Model Documentation for Critical Areas.*
4. *Price, Thomas H., 1993. Unit Area Pollutant Load Estimates for Lake County Illinois Lake Michigan Watersheds.*
5. *Todd D. Stuntebeck, Matthew J. Komiskey, Marie C. Peppler, David W. Owens, and Dennis R. Frame 2011. Precipitation-Runoff Relations and Water-Quality Characteristics at Edge-of-Field. Stations, Discovery Farms and Pioneer Farm, Wisconsin, 2003–08.*
6. *Northwater Consulting. 2013. Spatial Watershed Assessment and Management Model. Prepared for Chicago Metropolitan Agency for Planning, Chicago, IL.*
7. *Northwater Consulting. 2014. Spatial Watershed Assessment and Management Model. Prepared for Steuben County SWCD, Angola, IN.*
8. *Northwater Consulting. 2014 Spatial Watershed Assessment and Management Model. Prepared for the Agricultural Watershed Institute, Decatur, IL.*

C) Precipitation: annual precipitation, number of rain days and correction factors using the following weather stations: 1) Lake Geneva, 2) Whitewater. A six-year average was generated using both stations for a period of six years (2000-2015).

Table 2 – Rainfall Factors

Average Number of Rain Days	Rain Days Correction Factor	P Value (inches)
136.73	0.36	0.64

D) Delivery Ratio; distance-based delivery ratio: *Minnesota Board of Water & Soil Resources, "Pollution Reduction Estimator Water Erosion - Microsoft Excel® Version September 2010."*

Polygon distance from major stream (ft) $^{\wedge -0.2069}$

Table 3 - Pollutant Load Model Values

Rain days	Correction Factor (precipitation and rain days)	Curve Number (by soil hydrologic group)	Runoff (by soil hydrologic group in inches)	EMC for P, TSS
Table 2	Table 2	Table 4	Calculated using the following equation: $Q = \frac{((P-(Ia \times S))^{2}}{P + 0.8 \times S}$ $S = \frac{1000}{CN} - 10$ Q = Runoff (inches) P = Precipitation (inches) S = Potential max retention (inches) CN = Curve Number Ia = Initial abstraction factor; set to 0 for annual runoff	Table 4

Table 4 - Event Mean Concentrations (EMC) & Curve Numbers

Landuse Category	EMC P (mg/l)	EMC TSS (mg/l)	Curve # A Group	Curve # B Group	Curve # C Group	Curve # D Group
Air Field	0.34	153	96	96	96	96
Air Terminal and Hangar	0.34	240	89	91	93	94
Arterial Road	0.34	153	97	97	97	97
Arterial Road Wetland	0.3	20	38	60	74	80
Bus Terminal	0.34	240	98	98	98	98
Cemeteries	0.46	153	49	69	79	84
Composting (High)	0.8	280	66	77	85	89
Communication and Utilities (Very High)	0.34	153	96	96	96	96
Communication and Utilities (High)	0.33	153	89	92	94	95
Communication and Utilities (Medium)	0.3	77	77	85	90	92
Communication and Utilities (Low)	0.3	65	57	72	81	86
Confinement	0.6	160	89	92	94	95
Cropland; Row Crops **USLE equation used*	0.6	N/A*	72	81	88	91
Cropland; Row Crops (wheat, alfalfa, berries, cover crop, organic)	0.36	N/A*	66	77	85	89
Cropland; Row Crops (hay)	0.25	N/A*	66	77	85	89
Cropland; Row Crops (manure spreading)	0.7	N/A*	72	81	88	91
Farm Building (High)	0.4	280	89	92	94	95
Farm Building (High with Detention)	0.24	168	77	85	90	92
Farm Building (Medium)	0.42	160	61	75	83	87
Farm Building (Medium with Detention)	0.25	96	57	72	81	86
Farm Building (Low)	0.42	72	51	68	79	84
Farm Building (Low with Detention)	0.25	36	46	65	77	82
Feed Area (High)	2.6	390	89	92	94	95
Feed Area (High with Detention)	1.3	195	84	87	89	91

Feed Area (Medium)	1.5	240	77	85	90	92
Feed Area (Medium with Detention)	0.75	120	72	80	85	87
Feed Area (Low)	0.75	120	68	79	86	89
Forest	0.15	60	36	60	73	79
Freeway	0.34	153	98	98	98	98
Freeway Wetland	0.25	25	38	60	74	80
Golf Course	0.6	84	51	71	79	84
Government and Institutional (Very High)	0.4	220	96	96	96	96
Government and Institutional (Very High With Detention)	0.24	110	89	92	94	95
Government and Institutional (High)	0.4	206	89	92	94	95
Government and Institutional (High with Detention)	0.23	103	81	88	91	93
Government and Institutional (Medium)	0.4	153	77	85	90	92
Government and Institutional (Low)	0.4	153	61	75	83	87
Landfill	0.31	230	81	88	91	93
Local Street	0.34	153	98	98	98	98
Local Street - Permeable	0.17	76	49	49	49	49
Manufacturing (Very High)	0.35	230	96	96	96	96
Manufacturing (Very High with Detention)	0.21	115	89	92	94	95
Manufacturing (High)	0.31	215	89	92	94	95
Manufacturing (High with Detention)	0.19	115	81	88	91	93
Manufacturing (Medium)	0.28	200	77	85	90	92
Mobile Homes (High)	0.45	153	80	86	91	95
Mobile Homes (Medium)	0.4	153	72	82	86	90
Mobile Homes (Low)	0.4	153	61	75	83	87
Multi-Family Low Rise (Very High)	0.3	206	96	96	96	96
Multi-Family Low Rise (High)	0.3	206	82	89	92	94
Multi-Family Low Rise (High with Detention)	0.18	103	78	86	91	93
Multi-Family Low Rise (Medium)	0.3	153	65	79	87	89
Multi-Family Low Rise (Low)	0.3	72	58	74	84	88
Open Space - Road	0.6	84	68	79	86	89
Open Water - Pond	0.025	1.5	100	100	100	100
Open Water - Stream	0.11	3.1	100	100	100	100
Orchards and Nursery	0.4	120	62	71	78	81
Parking	0.34	153	96	96	96	96
Parking (With Detention)	0.2	72	89	89	89	89
Pasture (High)	0.9	240	75	84	89	91
Pasture (High with Detention)	0.45	100	68	79	86	89
Pasture (Medium)	0.6	120	68	79	86	89
Pasture (Medium with Detention)	0.3	60	49	69	79	84
Pasture (Low)	0.3	60	39	58	71	78
Pasture (Low with Detention)	0.15	30	35	56	69	76
Railroad Right-of-Way	0.34	240	70	80	85	87
Recreation - Cultural (High)	0.29	153	89	92	94	95
Recreation - Cultural (Medium)	0.29	153	77	85	90	92
Recreation - Cultural (Low)	0.21	115	61	75	83	87
Recreation - Cultural (Low with Detention)	0.11	77	51	68	79	84
Recreation - Park (High)	0.2	30	68	79	86	89
Recreation - Park (Medium)	0.2	30	49	69	79	84
Recreation - Park (Low)	0.2	30	39	61	74	80
Residential Single-Family Low Density (Very High)	0.3	206	96	96	96	96

Residential Single-Family Low Density (High)	0.3	206	81	88	91	93
Residential Single-Family Low Density (High with Detention)	0.18	103	77	85	90	92
Residential Single-Family Low Density (Medium)	0.3	153	61	75	83	87
Residential Single-Family Low Density (Medium with Detention)	0.18	73	57	72	81	86
Residential Single-Family Low Density (Low)	0.3	73	54	70	80	85
Residential Single-Family Low Density (Low with Detention)	0.18	35	51	68	79	84
Residential Single-Family Medium Density (Very High)	0.3	206	96	96	96	96
Residential Single-Family Medium Density (High)	0.3	206	81	88	91	93
Residential Single-Family Medium Density (High with Detention)	0.18	103	77	85	90	92
Residential Single-Family Medium Density (Medium)	0.3	153	61	75	83	87
Residential Single-Family Medium Density (Medium with Detention)	0.18	73	57	72	81	86
Residential Single-Family Medium Density (Low)	0.3	73	54	70	80	85
Residential Single-Family Suburban Density (High with Detention)	0.19	103	82	87	90	92
Residential Single-Family Suburban Density (Medium)	0.3	153	63	77	85	89
Residential Single-Family Suburban Density (Medium Detention)	0.18	73	59	74	83	88
Residential Single-Family Suburban Density (Low)	0.3	73	56	72	82	87
Residential Two-Family (High)	0.3	206	82	89	92	94
Residential Two-Family (High with Detention)	0.18	103	78	86	91	93
Residential Two-Family (Medium)	0.3	153	65	79	87	89
Residential Two-Family (Low)	0.3	73	58	74	84	88
Resource Extraction	0.31	94	77	86	91	94
Retail (Very High)	0.45	206	96	96	96	96
Retail (Very High with Detention)	0.27	103	89	92	94	95
Retail (High)	0.42	206	89	92	94	95
Retail (High with Detention)	0.25	103	81	88	91	93
Retail (Medium)	0.4	153	77	85	90	92
Retail (Low)	0.4	153	61	75	83	87
Rural Open Space	0.15	15	30	58	71	78
Sod Farm *USLE equation used*	0.8	N/A*	66	77	85	89
Truck Terminal (Very High)	0.34	240	96	96	96	96
Truck Terminal (High with Detention)	0.2	100	81	88	91	93
Urban Open Space	0.2	30	49	69	79	84
Wetland	0.01	1	85	85	85	85
Wetland - Degraded	0.3	20	72	81	88	91
Wholesaling and Storage (Very High)	0.4	206	96	96	96	96
Wholesaling and Storage (Very High with Detention)	0.24	103	89	92	94	95
Wholesaling and Storage (High)	0.4	206	89	92	94	95
Wholesaling and Storage (High with Detention)	0.24	103	81	88	91	93
Wholesaling and Storage (Medium)	0.31	153	77	85	90	92
Wholesaling and Storage (Low)	0.31	153	61	75	83	87

3.0 Model Calibration

Model calibration was performed to verify the model results against local water quality data and average per-acre loading results for the Midwest. The calibration and verification served three purposes:

1. Quality Assurance / Quality Control – to find and correct user errors in the model scripts and algorithms.
2. To evaluate whether stream-flow (runoff) and pollutant loading were in the correct ranges based on existing data and literature.
3. To calibrate model by adjusting parameters so that cumulative model results represent regional averages.

The model is estimating accumulated/delivered pollutant loading, represented mostly in the literature. Important notes on the model include:

- The model does not directly account for point source pollution.
- The model estimates annual pollutant mobilization from individual parcels of land and does not take into account fate and transport watershed processes.
- The model accounts for precipitation runoff; but not base flow, point source discharges or drainage-tile contributions.

Model calibration was performed by deriving streamflow statistics and analyzing readily available water quality information at two water quality stations on Jackson Creek using 2007 thru 2014 data. Average annual flow estimates were derived from the USGS gauging data.

To calibrate the Delavan Lake *SWAMM* to existing water quality data, the following was performed:

- Water quality data was analyzed by sub-watershed and annual in-stream loading was calculated at Mound Road and at Highway 50. See Table 5 for results at each station.
- Revised sediment and phosphorus delivery ratios based on a distance to Delavan Lake rather than to the nearest stream to account for pollutant trapping. To account for differences between the delivery of sediment versus the delivery of dissolved pollutants, an adjustment or multiplier of **1.25** was applied to the delivery ratio for phosphorus to get the results within acceptable regional ranges. The assumption was made that dissolved pollutants are delivered at a slightly higher rate than that of sediment.
- Accounted for non-contributing drainage areas.
- Confirmed model results are within an acceptable range.

Table 5 - Measured Water Quality Data & Flow; 2007-2014 Annual Average Calibration Values

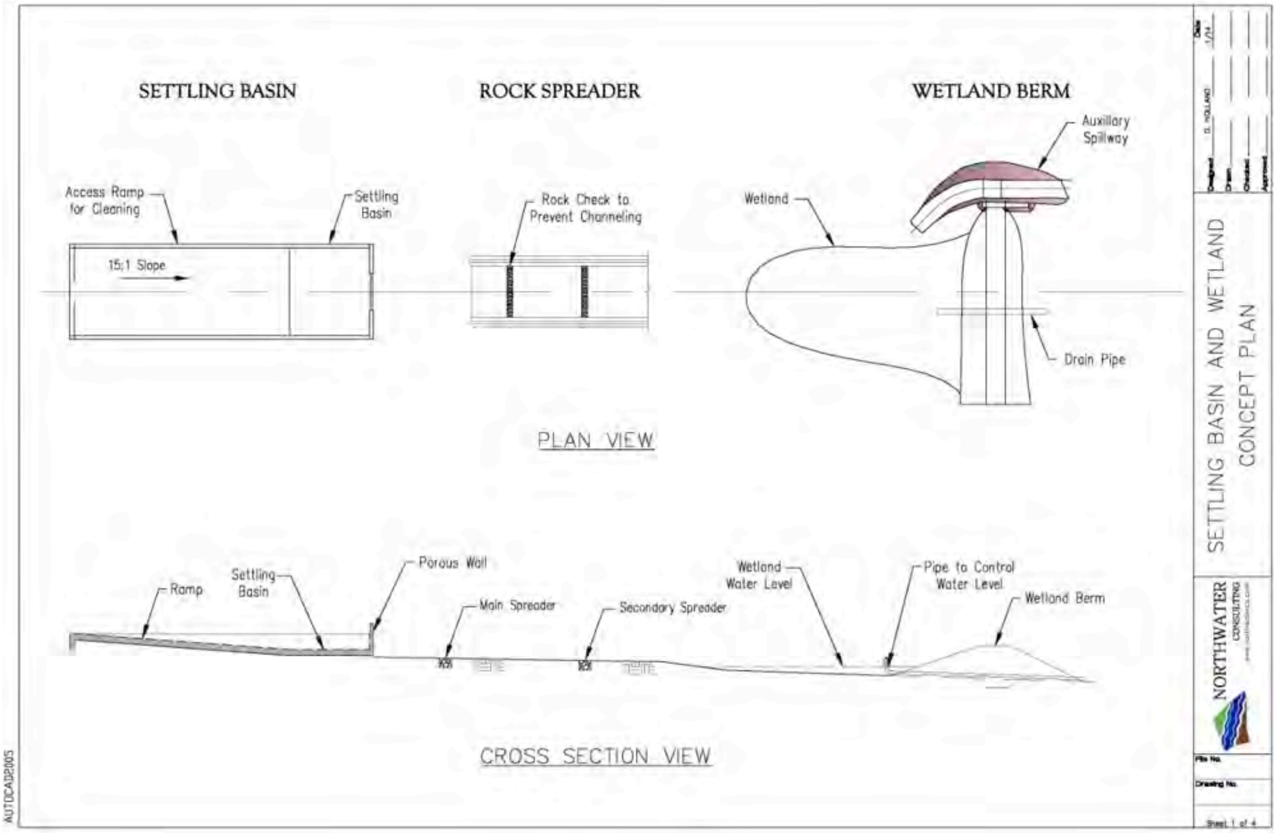
Monitoring Station	Flow (CFS)	Sediment (tons)	Total Phosphorus
Mound Road (Upper Jackson Creek)	6,176	1,288	863
Highway 50 (Lower Jackson Creek)	8,743	981	823

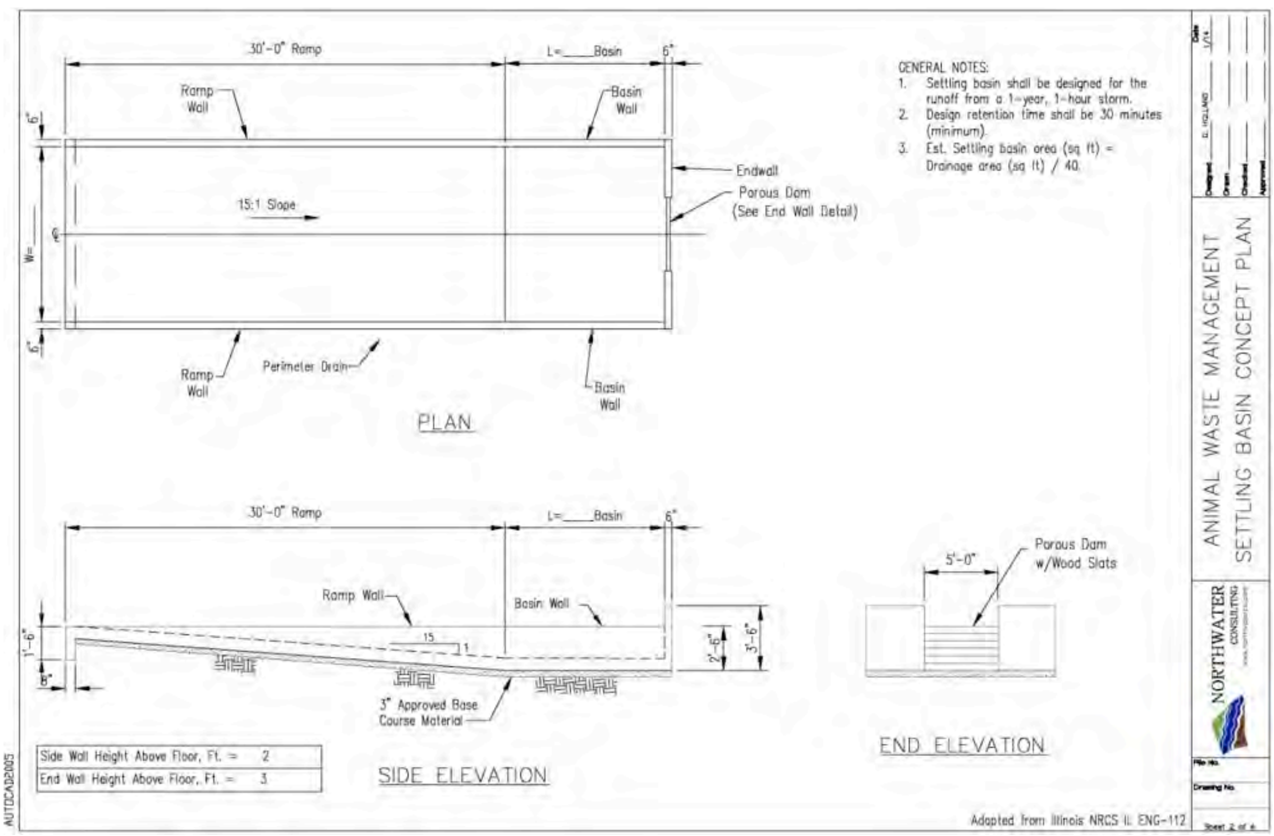
4.0 Model Notes

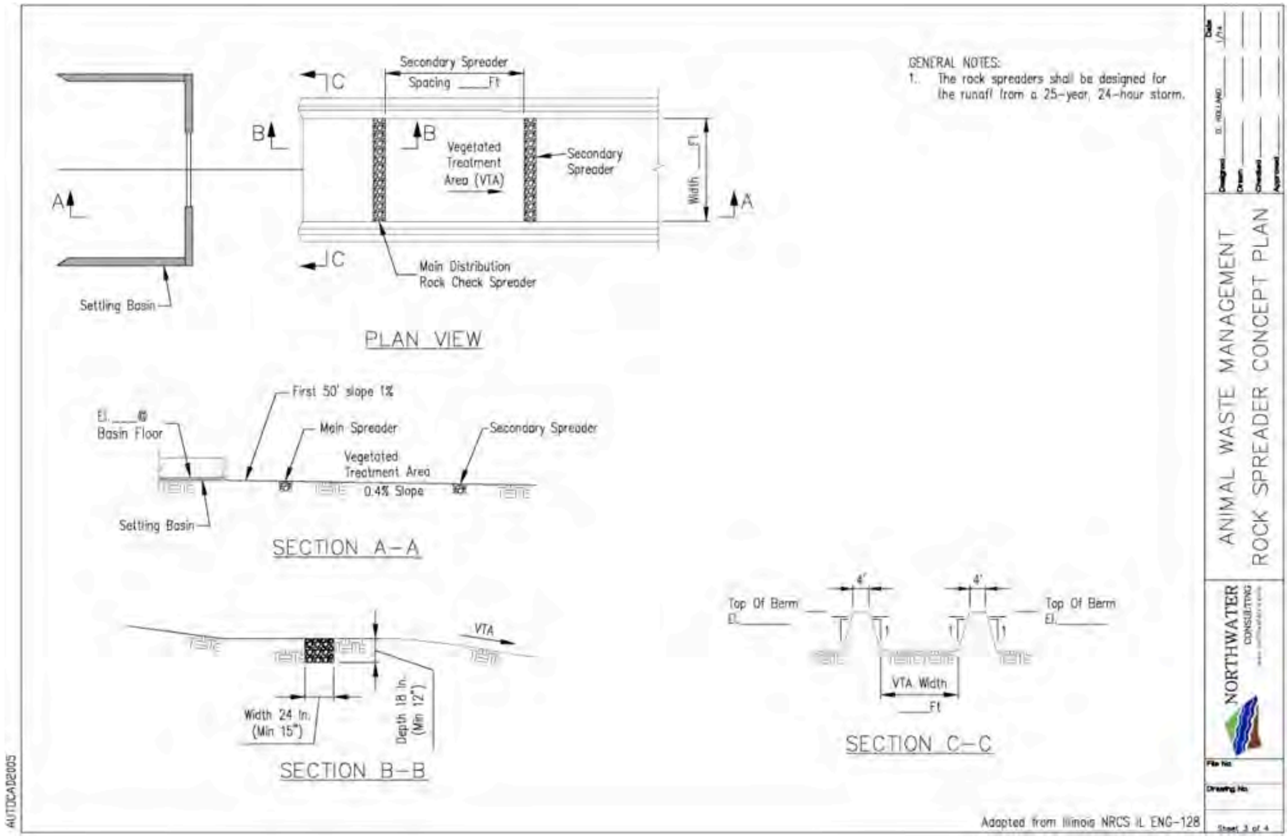
1. A local county landuse layer was modified to represent a more accurate hybrid landuse/landcover layer by interpreting recent aerial imagery and digitizing/labeling polygons. The landuse layer was corrected to represent current conditions.
2. Data on field-specific tillage practices and existing BMPs were incorporated and accounted for.
3. High, medium and low developed areas were determined based on a visual interpretation of density. High areas generally represented greater than 50% impervious, medium 25-50% impervious and low, less than 25%.
4. Model accounts for areas with detention in place.
5. Pasture was classified into high, medium and low based on pasture quality and the observed impact to water quality during a windshield survey.
6. The outline of Delavan Lake was used for proximity calculations to determine delivery ratios.
7. EMC values for phosphorus reflect an existing county phosphorus ordinance.
8. Non-contributing drainage areas were accounted for in the model by reducing runoff by 90%.

Appendix B

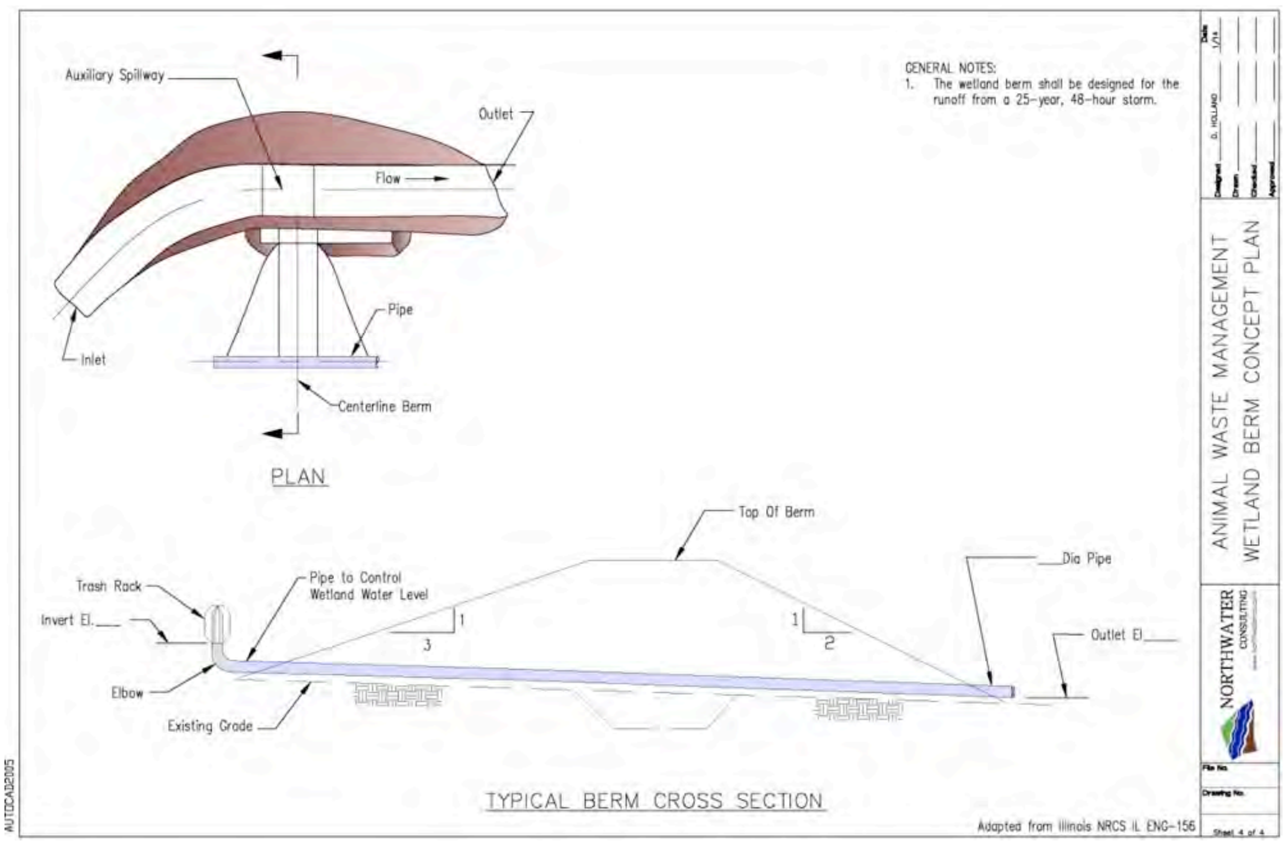
Typical BMP Drawings


SETTLING BASIN
ROCK SPREADER
WETLAND BERM
Access Ramp for Cleaning
Settling Basin
15:1 Slope
Rock Check to Prevent Channeling
Wetland
Auxiliary Spillway
Drain Pipe
PLAN VIEW
Ramp
Settling Basin
Porous Wall
Main Spreader
Secondary Spreader
Wetland Water Level
Pipe to Control Water Level
Wetland Berm
CROSS SECTION VIEW
SETTLING BASIN AND WETLAND CONCEPT PLAN
NORTHWATER CONSULTING
AUTOCAD2005


30'-0" Ramp
L=___Basin
6"
Ramp Wall
Basin Wall
15:1 Slope
W=
Endwall
Porous Dam (See End Wall Detail)
Ramp Wall
Perimeter Drain
Basin Wall
PLAN
GENERAL NOTES:
1. Settling basin shall be designed for the runoff from a 1-year, 1-hour storm.
2. Design retention time shall be 30 minutes (minimum).
3. Est. Settling basin area (sq ft) = Drainage area (sq ft) / 40
Ramp Wall
Basin Wall
1'-6"
8"
2'-6"
3'-6"
3" Approved Base Course Material
5'-0"
Porous Dam w/Wood Slats
Side Wall Height Above Floor, Ft. = 2
End Wall Height Above Floor, Ft. = 3
SIDE ELEVATION
END ELEVATION
Adapted from Illinois NRCS IL ENG-112
ANIMAL WASTE MANAGEMENT SETTLING BASIN CONCEPT PLAN
NORTHWATER CONSULTING
AUTOCAD2005



Secondary Spreader
Spacing ___Ft
C
B
A
Vegetated Treatment Area (VTA)
Secondary Spreader
Width ___Ft
Main Distribution Rock Check Spreader
Settling Basin
PLAN VIEW
GENERAL NOTES:
1. The rock spreaders shall be designed for the runoff from a 25-year, 24-hour storm.
First 50' slope 1%
El.___@ Basin Floor
Main Spreader
Secondary Spreader
Vegetated Treatment Area
0.4% Slope
Settling Basin
SECTION A-A
VTA
Width 24 In. (Min 15")
Depth 18 In. (Min 12")
SECTION B-B
Top Of Berm El.___
4'
VTA Width ___Ft
SECTION C-C
ANIMAL WASTE MANAGEMENT
ROCK SPREADER CONCEPT PLAN
NORTHWATER CONSULTING
D. HOLLAND
Designed
Drawn
Checked
Approved
File No.
Drawing No.
Sheet 3 of 4
Adapted from Illinois NRCS IL ENG-128
AUTOCAD2005



Auxiliary Spillway
Outlet
Flow
Pipe
Inlet
Centerline Berm
PLAN
GENERAL NOTES:
1. The wetland berm shall be designed for the runoff from a 25-year, 48-hour storm.
Top Of Berm
___Dia Pipe
Trash Rack
Pipe to Control Wetland Water Level
Invert El.___
Outlet El.___
Elbow
Existing Grade
1
3
1
2
TYPICAL BERM CROSS SECTION
ANIMAL WASTE MANAGEMENT
WETLAND BERM CONCEPT PLAN
NORTHWATER CONSULTING
D. HOLLAND
Designed
Drawn
Checked
Approved
File No.
Drawing No.
Sheet 4 of 4
Adapted from Illinois NRCS IL ENG-156
AUTOCAD2005

Appendix C

Basin-Wide BMP Load Reduction Tables

Recommended No Till Load Reductions

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
1	Delavan Lake	2.52	0.19	2.03
2	Delavan Lake	19.68	1.33	8.05
3	Delavan Lake	15.31	1.41	7.19
4	Delavan Lake	17.95	1.31	8.99
5	Delavan Lake	2.38	0.16	0.58
6	Delavan Lake	7.12	0.55	1.58
7	Delavan Lake	4.13	0.31	1.11
8	Delavan Lake	18.02	1.50	4.60
9	Delavan Lake	1.44	0.09	0.69
10	Delavan Lake	2.97	0.23	0.89
11	Delavan Lake	17.54	1.11	2.97
12	Delavan Lake	13.37	0.44	1.27
13	Delavan Lake	98.33	6.20	34.49
14	Delavan Lake	9.65	0.03	0.21
15	Delavan Lake	1.82	0.12	0.86
16	Delavan Lake	51.58	3.38	34.92
17	Delavan Lake	16.17	1.21	9.37
18	Delavan Lake	11.09	0.86	3.82
19	Delavan Lake	43.04	3.11	28.78
20	Delavan Lake	19.78	1.31	3.36
21	Delavan Lake	29.45	1.90	5.01
22	Delavan Lake	38.75	2.48	6.53
23	Delavan Lake	20.25	1.60	4.46
24	Delavan Lake	3.64	0.26	1.24
25	Delavan Lake	15.26	1.12	3.06
26	Delavan Lake	16.99	1.21	4.97
27	Delavan Lake	30.81	1.88	5.58
28	Delavan Lake	1.95	0.12	0.30
29	Delavan Lake	13.61	1.07	5.94
30	Delavan Lake	4.22	0.34	2.36
31	Delavan Lake	3.93	0.29	1.77
32	Delavan Lake	16.18	0.45	2.40
33	Delavan Lake	1.01	0.07	0.47
34	Delavan Lake	0.71	0.05	0.72
35	Delavan Lake	23.26	1.80	14.86
36	Delavan Lake	18.53	1.47	18.30
37	Delavan Lake	2.61	0.19	1.43
38	Delavan Lake	12.30	0.84	2.64
39	Delavan Lake	9.03	0.54	6.80
40	Delavan Lake	0.94	0.05	1.34
41	Delavan Lake	14.62	0.84	5.27
42	Delavan Lake	5.34	0.29	1.99
43	Delavan Lake	1.95	0.12	2.23
44	Delavan Lake	3.76	0.21	3.04
45	Delavan Lake	8.36	0.61	2.73
46	Delavan Lake	24.91	1.68	11.07

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
47	Delavan Lake	35.09	2.23	6.15
48	Delavan Lake	13.20	1.10	2.92
49	Delavan Lake	14.02	1.01	2.57
50	Delavan Lake	2.07	0.12	0.45
51	Delavan Lake	4.43	0.27	0.99
52	Delavan Lake	31.99	2.16	9.52
53	Delavan Lake	16.66	1.18	9.90
54	Upper Jackson Creek	15.88	0.64	2.55
55	Upper Jackson Creek	28.94	1.11	7.08
56	Upper Jackson Creek	27.01	1.01	5.03
57	Upper Jackson Creek	13.92	0.60	3.73
58	Upper Jackson Creek	67.07	2.86	8.19
59	Upper Jackson Creek	7.56	0.34	0.92
60	Upper Jackson Creek	3.51	0.16	1.43
61	Upper Jackson Creek	51.34	2.22	10.17
62	Upper Jackson Creek	6.12	0.24	1.64
63	Upper Jackson Creek	6.98	0.32	1.30
64	Upper Jackson Creek	17.48	0.81	3.52
65	Upper Jackson Creek	54.49	2.86	4.87
66	Upper Jackson Creek	24.24	0.95	6.02
67	Upper Jackson Creek	68.44	3.09	25.15
68	Upper Jackson Creek	7.46	0.38	1.36
69	Upper Jackson Creek	134.09	6.09	12.69
70	Upper Jackson Creek	0.55	0.02	0.08
71	Upper Jackson Creek	43.09	1.79	6.68
72	Upper Jackson Creek	45.02	1.75	8.10
73	Upper Jackson Creek	35.20	1.51	4.24
74	Upper Jackson Creek	31.68	1.30	5.87
75	Upper Jackson Creek	6.07	0.25	0.68
76	Upper Jackson Creek	16.12	0.72	4.31
77	Upper Jackson Creek	60.72	3.04	13.57
78	Upper Jackson Creek	31.19	1.59	12.43
79	Upper Jackson Creek	20.52	0.94	2.63
80	Upper Jackson Creek	30.43	1.63	3.01
81	Upper Jackson Creek	71.13	3.29	6.86
82	Upper Jackson Creek	70.49	3.53	14.15
83	Upper Jackson Creek	53.45	2.38	14.51
84	Upper Jackson Creek	8.12	0.38	1.29
85	Upper Jackson Creek	1.50	0.06	0.18
86	Upper Jackson Creek	10.46	0.46	3.69
87	Upper Jackson Creek	23.30	1.06	5.43
88	Upper Jackson Creek	25.94	1.07	4.52
89	Upper Jackson Creek	6.30	0.28	1.59
90	Upper Jackson Creek	4.62	0.21	0.79
91	Upper Jackson Creek	8.22	0.37	1.73
92	Upper Jackson Creek	14.27	0.67	2.72
93	Upper Jackson Creek	7.00	0.33	1.40
94	Upper Jackson Creek	22.40	0.96	2.13

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
95	Upper Jackson Creek	52.41	2.22	11.92
96	Upper Jackson Creek	61.56	2.49	13.25
97	Upper Jackson Creek	3.52	0.14	0.38
98	Upper Jackson Creek	12.28	0.52	3.73
99	Upper Jackson Creek	110.50	5.40	13.94
100	Upper Jackson Creek	38.96	1.73	6.06
101	Upper Jackson Creek	9.39	0.37	1.06
102	Upper Jackson Creek	111.38	4.95	13.76
103	Upper Jackson Creek	63.49	2.57	13.72
104	Upper Jackson Creek	22.00	1.01	3.94
105	Upper Jackson Creek	4.96	0.19	1.84
106	Upper Jackson Creek	6.73	0.26	1.65
107	Upper Jackson Creek	71.53	2.99	16.51
108	Upper Jackson Creek	58.95	2.62	6.00
109	Upper Jackson Creek	42.08	1.83	4.56
110	Upper Jackson Creek	28.93	1.37	3.76
111	Upper Jackson Creek	71.47	3.53	11.55
112	Upper Jackson Creek	73.41	3.68	20.27
113	Upper Jackson Creek	30.25	1.42	2.27
114	Upper Jackson Creek	29.03	1.35	2.60
115	Upper Jackson Creek	12.34	0.60	1.72
116	Upper Jackson Creek	10.48	0.46	0.90
117	Upper Jackson Creek	126.58	5.79	9.98
118	Upper Jackson Creek	12.78	0.58	1.43
119	Upper Jackson Creek	128.80	6.10	16.26
120	Upper Jackson Creek	18.16	0.74	2.40
121	Upper Jackson Creek	6.43	0.25	0.36
122	Upper Jackson Creek	0.96	0.04	0.04
123	Upper Jackson Creek	38.07	1.97	3.65
124	Upper Jackson Creek	47.67	1.88	3.71
125	Upper Jackson Creek	28.87	1.25	3.50
126	Upper Jackson Creek	60.56	2.51	7.54
127	Upper Jackson Creek	114.97	4.80	13.85
128	Upper Jackson Creek	37.29	1.57	4.11
129	Upper Jackson Creek	39.51	1.62	8.95
130	Upper Jackson Creek	57.76	2.62	5.33
131	Upper Jackson Creek	51.03	2.17	8.23
132	Upper Jackson Creek	99.66	4.36	10.81
133	Upper Jackson Creek	36.84	1.73	3.18
134	Upper Jackson Creek	9.92	0.48	1.10
135	Upper Jackson Creek	12.34	0.61	1.02
136	Upper Jackson Creek	24.52	1.27	5.08
137	Upper Jackson Creek	0.66	0.03	0.07
138	Upper Jackson Creek	8.21	0.36	1.99
139	Upper Jackson Creek	40.54	1.93	6.61
140	Upper Jackson Creek	42.86	1.70	7.37
141	Upper Jackson Creek	72.78	3.06	9.14
142	Upper Jackson Creek	59.15	2.44	8.85

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
143	Upper Jackson Creek	27.59	1.15	3.47
144	Upper Jackson Creek	2.69	0.11	0.25
145	Upper Jackson Creek	58.61	2.01	10.96
146	Upper Jackson Creek	37.04	1.83	10.32
147	Upper Jackson Creek	33.13	1.41	9.36
148	Upper Jackson Creek	53.13	1.30	2.07
149	Upper Jackson Creek	46.93	2.24	9.20
150	Upper Jackson Creek	93.47	3.95	14.90
151	Upper Jackson Creek	105.76	5.21	16.84
152	Upper Jackson Creek	47.15	2.18	11.63
153	Upper Jackson Creek	50.75	1.14	10.89
154	Upper Jackson Creek	25.50	1.16	6.58
155	Upper Jackson Creek	1.06	0.05	0.37
156	Upper Jackson Creek	23.59	1.07	6.19
157	Upper Jackson Creek	7.96	0.31	2.09
158	Upper Jackson Creek	7.77	0.35	1.59
159	Upper Jackson Creek	8.55	0.40	3.66
160	Upper Jackson Creek	26.80	1.59	7.36
161	Upper Jackson Creek	0.63	0.02	0.07
162	Upper Jackson Creek	16.59	0.69	1.33
163	Upper Jackson Creek	5.00	0.23	0.58
164	Upper Jackson Creek	3.78	0.18	0.84
165	Upper Jackson Creek	32.06	1.26	3.68
166	Upper Jackson Creek	8.06	0.31	0.61
167	Upper Jackson Creek	17.13	0.69	1.24
168	Upper Jackson Creek	21.28	0.89	4.02
169	Upper Jackson Creek	16.88	1.04	2.54
170	Upper Jackson Creek	42.20	2.11	8.25
171	Upper Jackson Creek	17.41	0.83	2.87
172	Upper Jackson Creek	12.52	0.57	2.48
173	Upper Jackson Creek	53.73	2.51	4.99
174	Upper Jackson Creek	6.79	0.26	2.05
175	Upper Jackson Creek	2.97	0.12	0.51
176	Upper Jackson Creek	8.27	0.37	2.18
177	Upper Jackson Creek	53.34	2.05	15.13
178	Upper Jackson Creek	9.34	0.36	1.83
179	Upper Jackson Creek	54.93	2.35	6.39
180	Upper Jackson Creek	54.73	2.71	19.56
181	Upper Jackson Creek	0.40	0.02	0.03
182	Upper Jackson Creek	4.16	0.20	0.30
183	Upper Jackson Creek	18.19	0.87	1.59
184	Upper Jackson Creek	10.81	0.53	2.02
185	Upper Jackson Creek	16.69	0.76	1.98
186	Upper Jackson Creek	7.13	0.32	0.76
187	Upper Jackson Creek	14.87	0.70	1.81
188	Upper Jackson Creek	23.78	0.98	2.77
189	Upper Jackson Creek	11.54	0.47	1.70
190	Upper Jackson Creek	10.25	0.40	0.73

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
191	Upper Jackson Creek	0.00	0.00	0.00
192	Upper Jackson Creek	7.41	0.38	1.58
193	Upper Jackson Creek	22.00	1.01	11.70
194	Upper Jackson Creek	18.80	0.89	8.53
195	Upper Jackson Creek	34.10	1.56	5.59
196	Upper Jackson Creek	22.68	1.00	8.79
197	Upper Jackson Creek	31.73	1.41	4.42
198	Upper Jackson Creek	21.35	0.71	5.57
199	Upper Jackson Creek	9.60	0.46	2.18
200	Upper Jackson Creek	5.40	0.23	1.57
201	Brown's Channel	1.00	0.07	0.67
202	Brown's Channel	89.65	4.33	19.60
203	Brown's Channel	81.23	4.16	27.99
204	Brown's Channel	3.56	0.18	0.52
205	Brown's Channel	3.01	0.18	0.45
206	Brown's Channel	24.42	1.19	6.51
207	Brown's Channel	74.43	3.97	22.40
208	Brown's Channel	58.58	2.09	17.85
209	Brown's Channel	5.72	0.28	5.86
210	Brown's Channel	13.71	0.03	0.52
211	Brown's Channel	12.01	0.35	3.91
212	Brown's Channel	3.00	0.15	1.16
213	Brown's Channel	15.05	1.00	8.36
214	Brown's Channel	1.03	0.05	0.17
215	Brown's Channel	97.61	4.72	21.31
216	Brown's Channel	33.32	2.13	15.69
217	Brown's Channel	15.21	0.69	2.95
218	Brown's Channel	7.96	0.39	3.15
219	Brown's Channel	8.38	0.41	1.37
220	Brown's Channel	13.87	0.70	2.70
221	Brown's Channel	4.78	0.12	0.37
222	Brown's Channel	0.17	0.01	0.05
223	Brown's Channel	37.03	2.17	7.54
224	Brown's Channel	3.78	0.22	0.63
225	Brown's Channel	1.91	0.12	0.45
226	Brown's Channel	23.36	1.36	4.95
227	Brown's Channel	9.36	0.51	2.02
228	Brown's Channel	2.43	0.13	0.64
229	Brown's Channel	18.31	0.93	5.67
230	Brown's Channel	11.91	0.62	4.65
231	Brown's Channel	31.72	1.61	7.41
232	Brown's Channel	26.24	1.34	7.01
233	Brown's Channel	21.09	1.06	5.37
234	Brown's Channel	69.10	3.36	22.82
235	Brown's Channel	33.60	1.75	6.72
236	Brown's Channel	14.35	0.80	1.71
237	Brown's Channel	56.95	3.06	10.86
238	Brown's Channel	2.70	0.15	0.30

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
239	Brown's Channel	7.84	0.42	0.80
240	Brown's Channel	25.19	1.32	8.46
241	Brown's Channel	116.63	7.17	43.14
242	Brown's Channel	45.57	2.46	18.22
243	Brown's Channel	28.80	1.50	12.01
244	Brown's Channel	2.43	0.13	1.40
245	Brown's Channel	12.47	0.66	4.96
246	Brown's Channel	66.23	3.54	21.12
247	Brown's Channel	21.70	1.28	13.54
248	Brown's Channel	34.88	2.40	6.81
249	Brown's Channel	3.51	0.25	1.89
250	Brown's Channel	19.50	0.99	4.86
251	Brown's Channel	55.30	2.82	18.94
252	Brown's Channel	64.16	3.00	11.94
253	Brown's Channel	47.04	2.23	8.34
254	Brown's Channel	55.52	2.71	14.63
255	Brown's Channel	2.61	0.13	0.84
256	Brown's Channel	8.48	0.47	1.77
257	Brown's Channel	11.08	0.53	2.25
258	Brown's Channel	10.09	0.50	2.88
259	Brown's Channel	9.24	0.45	2.50
260	Brown's Channel	68.18	3.48	19.62
261	Brown's Channel	59.00	3.05	30.62
262	Brown's Channel	26.27	1.42	13.30
263	Brown's Channel	7.69	0.41	2.34
264	Brown's Channel	26.06	1.37	8.26
265	Brown's Channel	26.63	1.73	16.85
266	Brown's Channel	18.11	1.25	8.89
267	Brown's Channel	6.56	0.43	3.80
268	Brown's Channel	0.57	0.03	0.50
269	Brown's Channel	8.41	0.51	7.59
270	Brown's Channel	2.19	0.13	1.70
271	Brown's Channel	13.04	0.06	0.18
272	Brown's Channel	137.89	4.46	41.33
273	Brown's Channel	21.96	0.60	2.66
274	Brown's Channel	62.70	0.30	1.50
275	Brown's Channel	55.14	0.26	1.11
276	Brown's Channel	6.65	0.03	0.14
277	Brown's Channel	23.10	1.29	13.21
278	Brown's Channel	30.34	1.53	15.79
279	Brown's Channel	26.90	1.31	15.39
280	Brown's Channel	2.11	0.00	0.11
281	Brown's Channel	2.32	0.01	0.05
282	Brown's Channel	13.43	0.63	4.83
283	Brown's Channel	27.28	1.28	12.93
284	Brown's Channel	18.92	0.25	1.85
285	Brown's Channel	4.99	0.03	0.74
286	Brown's Channel	0.40	0.00	0.01

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
287	Brown's Channel	6.55	0.30	1.48
288	Brown's Channel	53.44	2.93	9.43
289	Brown's Channel	20.10	1.22	4.24
290	Brown's Channel	9.69	0.54	2.05
291	Brown's Channel	16.33	1.04	5.05
292	Unnamed Tributary	8.85	0.46	3.04
293	Unnamed Tributary	5.88	0.32	1.56
294	Unnamed Tributary	5.63	0.39	2.30
295	Unnamed Tributary	20.78	1.37	8.93
296	Unnamed Tributary	4.16	0.25	2.27
297	Unnamed Tributary	6.62	0.36	3.57
298	Unnamed Tributary	13.94	0.77	4.76
299	Unnamed Tributary	8.96	0.52	1.82
300	Unnamed Tributary	2.58	0.15	0.75
301	Unnamed Tributary	4.65	0.29	1.34
302	Unnamed Tributary	1.71	0.13	0.25
303	Unnamed Tributary	32.61	1.87	16.30
304	Unnamed Tributary	8.51	0.43	3.87
305	Unnamed Tributary	18.70	0.96	5.33
306	Unnamed Tributary	15.42	0.76	3.00
307	Unnamed Tributary	5.42	0.28	1.71
308	Unnamed Tributary	7.66	0.39	1.85
309	Unnamed Tributary	17.95	0.89	3.58
310	Unnamed Tributary	1.36	0.06	0.88
311	Unnamed Tributary	9.00	0.43	2.48
312	Unnamed Tributary	13.18	0.67	3.11
313	Unnamed Tributary	3.12	0.16	0.93
314	Unnamed Tributary	12.69	0.66	3.88
315	Unnamed Tributary	9.43	0.48	3.26
316	Unnamed Tributary	2.24	0.11	0.97
317	Unnamed Tributary	4.56	0.23	0.91
318	Unnamed Tributary	8.03	0.40	1.74
319	Unnamed Tributary	7.80	0.48	1.53
320	Unnamed Tributary	5.27	0.28	1.70
321	Unnamed Tributary	5.67	0.30	1.53
322	Unnamed Tributary	8.32	0.42	2.35
323	Unnamed Tributary	14.66	0.85	5.56
324	Unnamed Tributary	7.28	0.44	1.31
325	Unnamed Tributary	12.79	0.73	3.82
326	Unnamed Tributary	7.60	0.48	1.85
327	Unnamed Tributary	5.45	0.32	1.10
328	Unnamed Tributary	27.42	1.52	5.34
329	Unnamed Tributary	0.34	0.02	0.06
330	Unnamed Tributary	0.08	0.00	0.02
331	Unnamed Tributary	6.36	0.35	1.23
332	Unnamed Tributary	5.07	0.25	1.93
333	Lower Jackson Creek	0.21	0.01	0.02
334	Lower Jackson Creek	11.55	0.57	5.37

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
335	Lower Jackson Creek	7.51	0.35	2.53
336	Lower Jackson Creek	2.53	0.12	1.00
337	Lower Jackson Creek	15.10	0.73	27.52
338	Lower Jackson Creek	17.48	0.94	3.95
339	Lower Jackson Creek	46.11	2.79	11.10
340	Lower Jackson Creek	33.75	1.76	11.26
341	Lower Jackson Creek	68.54	2.17	5.99
342	Lower Jackson Creek	13.68	0.69	2.62
343	Lower Jackson Creek	59.01	3.22	16.99
344	Lower Jackson Creek	20.68	1.08	5.15
345	Lower Jackson Creek	47.99	2.76	12.63
346	Lower Jackson Creek	7.44	0.58	1.41
347	Lower Jackson Creek	12.63	0.90	8.58
348	Lower Jackson Creek	126.44	8.11	38.60
349	Lower Jackson Creek	38.34	2.07	12.54
350	Lower Jackson Creek	32.85	1.68	6.07
351	Lower Jackson Creek	59.12	3.60	25.35
352	Lower Jackson Creek	79.30	4.20	40.14
353	Lower Jackson Creek	189.95	10.78	69.96
354	Lower Jackson Creek	34.49	1.81	10.66
355	Lower Jackson Creek	41.30	2.38	9.73
356	Lower Jackson Creek	33.91	1.70	6.95
357	Lower Jackson Creek	16.89	0.96	4.18
358	Lower Jackson Creek	7.56	0.44	1.05
359	Lower Jackson Creek	2.21	0.11	0.24
360	Lower Jackson Creek	20.60	0.98	5.60
361	Lower Jackson Creek	27.68	1.28	4.08
362	Lower Jackson Creek	18.54	0.87	6.55
363	Lower Jackson Creek	30.22	1.40	12.78
364	Lower Jackson Creek	1.43	0.06	0.97
365	Lower Jackson Creek	14.41	0.66	5.28
366	Lower Jackson Creek	23.24	1.10	9.32
367	Lower Jackson Creek	3.33	0.17	0.88
368	Lower Jackson Creek	1.98	0.10	0.55
369	Lower Jackson Creek	2.80	0.14	1.52
370	Lower Jackson Creek	7.58	0.37	2.29
371	Lower Jackson Creek	8.75	0.42	3.24
372	Lower Jackson Creek	6.70	0.32	3.12
373	Lower Jackson Creek	87.17	4.81	22.84
374	Lower Jackson Creek	33.86	1.70	19.38
375	Lower Jackson Creek	19.11	1.17	6.68
376	Lower Jackson Creek	53.07	3.39	19.23
377	Lower Jackson Creek	44.00	2.66	44.48
378	Lower Jackson Creek	11.13	0.63	3.92
379	Lower Jackson Creek	0.00	0.00	0.00
380	Lower Jackson Creek	3.63	0.20	0.73
381	Lower Jackson Creek	0.04	0.00	0.01
382	Lower Jackson Creek	2.15	0.11	1.06

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
383	Lower Jackson Creek	13.62	0.74	5.05
384	Lower Jackson Creek	1.44	0.07	0.42
385	Lower Jackson Creek	0.64	0.03	0.28
386	Lower Jackson Creek	0.06	0.00	0.03
387	Lower Jackson Creek	0.06	0.00	0.03
388	Lower Jackson Creek	0.09	0.01	0.03
389	Lower Jackson Creek	5.91	0.37	1.26
390	Lower Jackson Creek	4.17	0.22	1.41
391	Lower Jackson Creek	19.03	1.10	7.08
392	Lower Jackson Creek	34.17	1.90	11.39
393	Lower Jackson Creek	25.86	1.57	4.68
394	Lower Jackson Creek	61.89	2.99	33.89
395	Lower Jackson Creek	15.60	0.78	5.22
396	Lower Jackson Creek	20.24	1.16	9.68
		9,885.94	484.57	2,506.85
		Average per acre load reduction	0.05	0.25
			lbs.	tons

Recommended Cover Crop Load Reductions

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
1	Delavan Lake	34.24	0.61	3.41
2	Delavan Lake	22.83	1.58	3.48
3	Delavan Lake	68.36	5.17	9.36
4	Delavan Lake	27.54	2.22	3.56
5	Delavan Lake	44.08	0.22	1.06
6	Delavan Lake	26.25	1.65	6.36
7	Delavan Lake	18.94	1.17	5.66
8	Delavan Lake	16.91	1.34	2.82
9	Delavan Lake	61.21	4.33	9.38
10	Delavan Lake	5.84	0.36	1.36
11	Delavan Lake	4.86	0.30	0.93
12	Delavan Lake	7.43	0.67	1.70
13	Delavan Lake	3.56	0.29	0.70
14	Upper Jackson Creek	17.10	0.74	1.14
15	Upper Jackson Creek	69.25	2.84	4.32
16	Upper Jackson Creek	45.58	1.89	2.96
17	Upper Jackson Creek	78.17	3.22	3.97
18	Upper Jackson Creek	84.06	3.64	6.77
19	Upper Jackson Creek	33.38	1.35	1.44
20	Upper Jackson Creek	68.34	2.68	5.37
21	Upper Jackson Creek	34.19	1.58	2.95
22	Upper Jackson Creek	16.05	0.71	1.88
23	Upper Jackson Creek	37.80	1.67	3.19
24	Upper Jackson Creek	67.97	3.05	5.15
25	Upper Jackson Creek	45.78	2.08	3.41
26	Upper Jackson Creek	20.65	0.98	2.49
27	Upper Jackson Creek	2.22	0.10	0.26
28	Upper Jackson Creek	49.07	1.92	3.18
29	Upper Jackson Creek	10.09	0.39	0.70
30	Upper Jackson Creek	50.21	2.41	2.46
31	Upper Jackson Creek	14.71	0.59	0.71
32	Upper Jackson Creek	37.28	1.60	1.59
33	Upper Jackson Creek	22.96	0.91	1.39
34	Upper Jackson Creek	6.68	0.28	0.29
35	Upper Jackson Creek	13.83	0.57	0.53
36	Upper Jackson Creek	10.12	0.42	0.54
37	Upper Jackson Creek	38.82	1.64	2.19
38	Upper Jackson Creek	17.19	0.73	0.88
39	Upper Jackson Creek	5.68	0.25	0.21
40	Upper Jackson Creek	12.72	0.62	0.59
41	Upper Jackson Creek	37.41	1.75	2.51
42	Upper Jackson Creek	43.96	1.90	5.16
43	Upper Jackson Creek	23.62	1.06	2.42
44	Upper Jackson Creek	31.52	1.32	2.33
45	Upper Jackson Creek	1.47	0.06	0.04
46	Upper Jackson Creek	11.37	0.47	0.42

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
47	Upper Jackson Creek	0.82	0.03	0.03
48	Upper Jackson Creek	19.24	0.78	0.84
49	Upper Jackson Creek	29.84	1.16	1.33
50	Upper Jackson Creek	13.95	0.54	0.59
51	Upper Jackson Creek	22.81	1.14	1.25
52	Upper Jackson Creek	12.90	0.55	0.53
53	Upper Jackson Creek	6.86	0.40	0.34
54	Upper Jackson Creek	38.89	1.85	2.60
55	Upper Jackson Creek	22.85	1.18	1.83
56	Upper Jackson Creek	8.94	0.39	0.86
57	Upper Jackson Creek	51.20	2.21	1.91
58	Brown's Channel	92.02	5.91	17.85
59	Brown's Channel	82.28	5.28	8.32
60	Brown's Channel	35.70	1.87	4.55
61	Brown's Channel	38.11	2.44	5.30
62	Brown's Channel	68.07	2.52	6.94
63	Brown's Channel	30.64	1.59	6.63
64	Brown's Channel	38.06	2.18	2.43
65	Brown's Channel	68.15	2.11	11.36
66	Brown's Channel	26.48	2.09	3.84
67	Brown's Channel	7.33	0.45	1.05
68	Brown's Channel	7.60	0.35	0.97
69	Brown's Channel	45.08	2.41	8.32
70	Brown's Channel	9.33	0.52	0.61
71	Brown's Channel	4.76	0.26	0.34
72	Brown's Channel	6.99	0.40	1.67
73	Brown's Channel	13.75	0.82	2.38
74	Brown's Channel	133.94	5.02	12.71
75	Brown's Channel	63.31	1.39	6.14
76	Brown's Channel	97.22	3.38	10.91
77	Brown's Channel	5.97	0.16	0.59
78	Brown's Channel	107.79	5.50	11.30
79	Brown's Channel	52.78	0.56	1.74
80	Brown's Channel	9.30	0.25	2.16
81	Brown's Channel	14.72	0.39	1.08
82	Brown's Channel	32.87	2.55	7.39
83	Brown's Channel	67.30	3.66	5.96
84	Lower Jackson Creek	3.57	0.18	0.48
85	Lower Jackson Creek	27.09	1.54	3.31
86	Lower Jackson Creek	4.12	0.21	0.21
		2,823.91	131.50	281.85
		Average per acre	0.05 lbs.	0.10 tons

Recommended Detention Area Load Reductions

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
1	Upper Jackson Creek	0.67	0.02	0.01
2	Upper Jackson Creek	0.31	0.01	0.01
3	Upper Jackson Creek	0.76	0.02	0.01
4	Upper Jackson Creek	1.05	0.03	0.01
5	Upper Jackson Creek	0.50	0.01	0.00
6	Upper Jackson Creek	0.31	0.01	0.00
7	Upper Jackson Creek	0.41	0.01	0.00
8	Upper Jackson Creek	0.17	0.02	0.01
9	Upper Jackson Creek	2.23	0.27	0.07
10	Upper Jackson Creek	0.26	0.03	0.01
11	Upper Jackson Creek	0.25	0.03	0.01
12	Upper Jackson Creek	1.38	0.03	0.01
13	Upper Jackson Creek	0.25	0.01	0.00
14	Upper Jackson Creek	0.15	0.01	0.00
15	Upper Jackson Creek	1.47	0.03	0.01
16	Upper Jackson Creek	2.18	0.10	0.04
17	Upper Jackson Creek	1.59	0.07	0.03
18	Upper Jackson Creek	2.80	0.07	0.02
19	Upper Jackson Creek	0.30	0.01	0.00
20	Upper Jackson Creek	0.51	0.02	0.01
21	Upper Jackson Creek	0.19	0.01	0.00
22	Upper Jackson Creek	0.60	0.07	0.02
23	Upper Jackson Creek	0.36	0.04	0.01
24	Upper Jackson Creek	1.22	0.05	0.01
25	Upper Jackson Creek	4.45	0.35	0.11
27	Upper Jackson Creek	42.46	2.38	0.77
28	Upper Jackson Creek	0.92	0.07	0.02
29	Upper Jackson Creek	1.14	0.04	0.01
30	Upper Jackson Creek	0.24	0.03	0.01
31	Upper Jackson Creek	0.07	0.01	0.00
32	Upper Jackson Creek	0.43	0.04	0.01
33	Upper Jackson Creek	0.71	0.04	0.01
34	Upper Jackson Creek	0.43	0.05	0.01
35	Upper Jackson Creek	0.76	0.06	0.02
36	Upper Jackson Creek	0.08	0.01	0.00
37	Upper Jackson Creek	0.10	0.01	0.00
38	Upper Jackson Creek	0.40	0.02	0.00
39	Upper Jackson Creek	0.55	0.07	0.02
40	Upper Jackson Creek	0.35	0.04	0.01
41	Upper Jackson Creek	0.25	0.03	0.01
42	Upper Jackson Creek	1.18	0.14	0.04
43	Upper Jackson Creek	2.57	0.31	0.09
44	Upper Jackson Creek	0.46	0.06	0.02
45	Upper Jackson Creek	0.11	0.01	0.00
46	Upper Jackson Creek	0.31	0.04	0.01
47	Upper Jackson Creek	2.78	0.34	0.09
48	Upper Jackson Creek	0.51	0.06	0.02
49	Upper Jackson Creek	0.17	0.02	0.01

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
50	Upper Jackson Creek	0.30	0.03	0.01
51	Upper Jackson Creek	0.12	0.01	0.00
52	Upper Jackson Creek	0.52	0.02	0.01
53	Upper Jackson Creek	0.55	0.01	0.00
54	Upper Jackson Creek	1.29	0.06	0.03
55	Upper Jackson Creek	0.88	0.02	0.01
56	Upper Jackson Creek	4.22	0.19	0.08
57	Upper Jackson Creek	0.31	0.01	0.00
58	Upper Jackson Creek	4.34	0.20	0.08
59	Upper Jackson Creek	0.26	0.01	0.00
60	Upper Jackson Creek	2.21	0.05	0.02
61	Upper Jackson Creek	0.32	0.01	0.01
62	Upper Jackson Creek	3.60	0.17	0.07
63	Upper Jackson Creek	0.19	0.01	0.00
64	Upper Jackson Creek	0.08	0.01	0.00
65	Upper Jackson Creek	0.59	0.03	0.01
66	Upper Jackson Creek	0.45	0.02	0.01
67	Upper Jackson Creek	0.47	0.02	0.01
68	Upper Jackson Creek	0.19	0.01	0.00
69	Upper Jackson Creek	0.22	0.01	0.00
70	Upper Jackson Creek	0.25	0.01	0.00
71	Upper Jackson Creek	0.19	0.01	0.00
72	Upper Jackson Creek	0.49	0.01	0.00
73	Upper Jackson Creek	0.57	0.02	0.01
74	Upper Jackson Creek	0.44	0.02	0.01
75	Upper Jackson Creek	0.32	0.03	0.01
76	Upper Jackson Creek	0.26	0.01	0.01
77	Upper Jackson Creek	0.49	0.04	0.02
78	Upper Jackson Creek	0.45	0.02	0.01
79	Upper Jackson Creek	0.22	0.01	0.00
80	Upper Jackson Creek	0.19	0.01	0.00
81	Upper Jackson Creek	1.74	0.05	0.02
82	Upper Jackson Creek	0.48	0.04	0.02
83	Upper Jackson Creek	0.78	0.04	0.02
84	Upper Jackson Creek	0.33	0.04	0.01
85	Upper Jackson Creek	0.31	0.02	0.01
86	Upper Jackson Creek	0.56	0.03	0.01
87	Upper Jackson Creek	0.39	0.04	0.01
88	Upper Jackson Creek	1.06	0.11	0.04
89	Upper Jackson Creek	0.24	0.03	0.01
90	Upper Jackson Creek	0.04	0.00	0.00
91	Upper Jackson Creek	1.92	0.21	0.07
92	Upper Jackson Creek	0.51	0.06	0.02
93	Upper Jackson Creek	0.72	0.08	0.03
94	Upper Jackson Creek	0.27	0.03	0.01
95	Upper Jackson Creek	0.33	0.02	0.01
96	Upper Jackson Creek	0.37	0.03	0.01
97	Upper Jackson Creek	1.84	0.24	0.07
98	Upper Jackson Creek	0.65	0.06	0.02
99	Upper Jackson Creek	0.51	0.07	0.02

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
100	Upper Jackson Creek	0.18	0.02	0.01
101	Upper Jackson Creek	0.93	0.08	0.02
102	Upper Jackson Creek	0.73	0.06	0.02
103	Upper Jackson Creek	0.45	0.06	0.02
104	Upper Jackson Creek	0.17	0.02	0.01
105	Upper Jackson Creek	0.19	0.02	0.01
106	Upper Jackson Creek	0.66	0.05	0.02
107	Upper Jackson Creek	1.35	0.16	0.05
108	Upper Jackson Creek	0.22	0.02	0.01
109	Upper Jackson Creek	1.04	0.13	0.04
110	Upper Jackson Creek	0.18	0.02	0.01
111	Upper Jackson Creek	0.61	0.05	0.01
112	Upper Jackson Creek	1.17	0.14	0.04
113	Upper Jackson Creek	0.35	0.04	0.01
114	Upper Jackson Creek	1.99	0.24	0.07
115	Upper Jackson Creek	0.61	0.07	0.02
116	Upper Jackson Creek	0.96	0.12	0.03
117	Upper Jackson Creek	0.41	0.03	0.01
118	Upper Jackson Creek	0.14	0.02	0.00
119	Upper Jackson Creek	0.00	0.00	0.00
120	Upper Jackson Creek	0.55	0.01	0.00
121	Upper Jackson Creek	0.88	0.04	0.02
122	Upper Jackson Creek	0.86	0.04	0.02
123	Upper Jackson Creek	0.54	0.01	0.00
124	Upper Jackson Creek	1.77	0.14	0.06
125	Upper Jackson Creek	1.36	0.12	0.05
126	Upper Jackson Creek	1.93	0.14	0.06
127	Upper Jackson Creek	1.77	0.14	0.06
128	Upper Jackson Creek	2.70	0.09	0.02
129	Upper Jackson Creek	3.39	0.11	0.03
130	Upper Jackson Creek	1.80	0.06	0.01
131	Upper Jackson Creek	1.89	0.08	0.02
132	Upper Jackson Creek	0.50	0.02	0.00
133	Upper Jackson Creek	2.25	0.17	0.07
134	Upper Jackson Creek	0.72	0.02	0.01
135	Upper Jackson Creek	3.80	0.36	0.10
136	Upper Jackson Creek	0.91	0.03	0.01
137	Upper Jackson Creek	1.40	0.05	0.02
138	Upper Jackson Creek	0.33	0.01	0.00
139	Upper Jackson Creek	1.18	0.06	0.01
140	Upper Jackson Creek	0.53	0.04	0.01
141	Upper Jackson Creek	1.73	0.05	0.02
142	Upper Jackson Creek	0.67	0.01	0.00
143	Upper Jackson Creek	0.35	0.01	0.00
144	Upper Jackson Creek	0.00	0.00	0.00
145	Upper Jackson Creek	1.83	0.02	0.01
146	Lower Jackson Creek	1.36	0.04	0.01
147	Lower Jackson Creek	0.42	0.01	0.00
148	Upper Jackson Creek	0.75	0.02	0.01
149	Upper Jackson Creek	0.38	0.01	0.00

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
150	Upper Jackson Creek	0.94	0.02	0.01
151	Upper Jackson Creek	0.61	0.02	0.00
152	Upper Jackson Creek	0.75	0.02	0.01
153	Upper Jackson Creek	0.45	0.01	0.00
154	Upper Jackson Creek	0.22	0.01	0.00
155	Upper Jackson Creek	1.10	0.03	0.01
156	Upper Jackson Creek	0.36	0.01	0.00
157	Upper Jackson Creek	0.44	0.01	0.00
158	Upper Jackson Creek	1.48	0.04	0.01
159	Upper Jackson Creek	1.51	0.04	0.01
160	Upper Jackson Creek	1.69	0.06	0.01
161	Upper Jackson Creek	0.50	0.01	0.00
162	Upper Jackson Creek	1.65	0.04	0.01
163	Upper Jackson Creek	1.01	0.02	0.01
164	Upper Jackson Creek	0.33	0.01	0.00
165	Upper Jackson Creek	0.30	0.01	0.00
166	Upper Jackson Creek	1.80	0.05	0.02
167	Upper Jackson Creek	1.43	0.03	0.01
168	Upper Jackson Creek	0.66	0.05	0.02
169	Upper Jackson Creek	3.13	0.14	0.06
170	Upper Jackson Creek	0.50	0.01	0.00
171	Upper Jackson Creek	1.52	0.05	0.01
172	Upper Jackson Creek	1.46	0.05	0.01
173	Upper Jackson Creek	0.67	0.03	0.01
174	Lower Jackson Creek	2.39	0.09	0.02
175	Upper Jackson Creek	2.10	0.06	0.01
176	Upper Jackson Creek	0.45	0.01	0.00
177	Upper Jackson Creek	1.72	0.07	0.02
178	Upper Jackson Creek	2.48	0.21	0.09
179	Upper Jackson Creek	1.87	0.15	0.07
180	Upper Jackson Creek	1.86	0.15	0.07
181	Upper Jackson Creek	1.57	0.05	0.01
182	Upper Jackson Creek	2.08	0.07	0.02
183	Upper Jackson Creek	2.45	0.19	0.08
184	Upper Jackson Creek	2.81	0.21	0.09
185	Upper Jackson Creek	1.30	0.05	0.01
186	Upper Jackson Creek	3.93	0.31	0.13
187	Upper Jackson Creek	3.28	0.11	0.03
188	Upper Jackson Creek	1.23	0.09	0.04
189	Upper Jackson Creek	0.53	0.02	0.00
190	Upper Jackson Creek	4.01	0.13	0.03
191	Upper Jackson Creek	1.24	0.04	0.01
192	Upper Jackson Creek	4.58	0.41	0.11
193	Upper Jackson Creek	4.06	0.20	0.08
194	Upper Jackson Creek	1.70	0.04	0.01
195	Upper Jackson Creek	0.30	0.01	0.00
196	Upper Jackson Creek	0.52	0.01	0.00
197	Upper Jackson Creek	0.21	0.00	0.00
198	Upper Jackson Creek	2.35	0.11	0.04
199	Upper Jackson Creek	0.28	0.01	0.01

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
200	Upper Jackson Creek	0.28	0.01	0.01
201	Upper Jackson Creek	0.28	0.01	0.00
202	Upper Jackson Creek	3.70	0.09	0.03
203	Upper Jackson Creek	0.95	0.04	0.02
204	Upper Jackson Creek	1.03	0.05	0.02
205	Upper Jackson Creek	0.32	0.01	0.01
206	Upper Jackson Creek	5.66	0.25	0.11
207	Upper Jackson Creek	1.73	0.08	0.03
208	Upper Jackson Creek	1.60	0.07	0.03
209	Upper Jackson Creek	4.05	0.18	0.08
210	Upper Jackson Creek	4.70	0.21	0.09
211	Upper Jackson Creek	3.09	0.14	0.06
212	Upper Jackson Creek	0.27	0.01	0.00
213	Upper Jackson Creek	0.67	0.03	0.01
214	Upper Jackson Creek	3.01	0.07	0.02
215	Upper Jackson Creek	2.58	0.06	0.02
216	Upper Jackson Creek	0.49	0.01	0.00
217	Upper Jackson Creek	2.89	0.07	0.02
218	Upper Jackson Creek	4.62	0.24	0.10
219	Upper Jackson Creek	0.52	0.04	0.02
220	Upper Jackson Creek	6.28	0.30	0.13
221	Upper Jackson Creek	1.16	0.06	0.02
222	Lower Jackson Creek	1.16	0.05	0.02
223	Lower Jackson Creek	5.80	0.51	0.16
224	Lower Jackson Creek	1.36	0.12	0.04
225	Upper Jackson Creek	0.41	0.05	0.01
226	Upper Jackson Creek	0.81	0.07	0.02
227	Upper Jackson Creek	0.58	0.07	0.02
228	Upper Jackson Creek	5.93	0.49	0.15
229	Upper Jackson Creek	0.50	0.05	0.02
230	Upper Jackson Creek	1.13	0.09	0.03
231	Upper Jackson Creek	0.88	0.10	0.03
232	Upper Jackson Creek	0.72	0.08	0.02
233	Upper Jackson Creek	0.92	0.07	0.02
234	Upper Jackson Creek	0.36	0.04	0.01
235	Upper Jackson Creek	2.35	0.26	0.08
236	Upper Jackson Creek	0.37	0.04	0.01
237	Upper Jackson Creek	1.08	0.12	0.04
238	Upper Jackson Creek	0.77	0.08	0.03
239	Upper Jackson Creek	8.10	0.64	0.20
240	Upper Jackson Creek	0.16	0.01	0.00
241	Upper Jackson Creek	1.52	0.16	0.05
242	Upper Jackson Creek	0.54	0.04	0.01
243	Lower Jackson Creek	1.13	0.08	0.03
244	Lower Jackson Creek	1.01	0.04	0.02
245	Lower Jackson Creek	0.55	0.02	0.01
246	Upper Jackson Creek	0.42	0.04	0.02
247	Upper Jackson Creek	2.21	0.22	0.09
248	Upper Jackson Creek	1.29	0.13	0.05
249	Upper Jackson Creek	1.98	0.19	0.08

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
250	Upper Jackson Creek	4.15	0.26	0.11
251	Upper Jackson Creek	0.73	0.07	0.03
252	Upper Jackson Creek	0.29	0.03	0.01
253	Upper Jackson Creek	0.90	0.09	0.03
254	Upper Jackson Creek	5.91	0.21	0.09
255	Upper Jackson Creek	1.29	0.12	0.05
256	Upper Jackson Creek	0.70	0.04	0.02
257	Upper Jackson Creek	1.24	0.12	0.05
258	Upper Jackson Creek	0.29	0.02	0.01
259	Upper Jackson Creek	0.25	0.02	0.01
260	Upper Jackson Creek	1.96	0.19	0.07
261	Upper Jackson Creek	1.79	0.17	0.07
262	Upper Jackson Creek	3.50	0.33	0.13
263	Upper Jackson Creek	1.12	0.07	0.03
264	Upper Jackson Creek	3.66	0.13	0.03
265	Upper Jackson Creek	5.13	0.22	0.06
266	Upper Jackson Creek	1.06	0.06	0.02
267	Upper Jackson Creek	0.25	0.01	0.01
268	Upper Jackson Creek	1.51	0.04	0.01
269	Upper Jackson Creek	0.18	0.01	0.00
270	Upper Jackson Creek	0.54	0.02	0.00
271	Upper Jackson Creek	3.05	0.31	0.10
272	Upper Jackson Creek	3.12	0.23	0.07
273	Upper Jackson Creek	4.42	0.19	0.05
274	Upper Jackson Creek	1.49	0.07	0.02
275	Upper Jackson Creek	6.90	0.42	0.09
276	Upper Jackson Creek	2.65	0.24	0.10
277	Upper Jackson Creek	8.08	0.64	0.20
278	Upper Jackson Creek	6.43	0.73	0.31
279	Upper Jackson Creek	0.56	0.06	0.02
280	Upper Jackson Creek	1.21	0.07	0.02
281	Upper Jackson Creek	0.26	0.03	0.01
282	Upper Jackson Creek	6.84	0.71	0.24
283	Upper Jackson Creek	1.29	0.13	0.04
284	Upper Jackson Creek	0.49	0.04	0.01
285	Upper Jackson Creek	1.41	0.05	0.02
286	Delavan Lake	2.79	0.34	0.08
287	Delavan Lake	2.38	0.11	0.03
288	Delavan Lake	3.85	0.26	0.08
289	Delavan Lake	8.99	0.65	0.20
290	Delavan Lake	0.74	0.07	0.03
291	Brown's Channel	0.39	0.01	0.00
293	Delavan Lake	3.08	0.15	0.05
294	Delavan Lake	0.61	0.03	0.01
295	Delavan Lake	8.20	0.75	0.23
296	Brown's Channel	1.14	0.04	0.01
296	Delavan Lake	6.09	0.25	0.08
297	Brown's Channel	3.67	0.10	0.03
298	Delavan Lake	0.17	0.01	0.00
299	Delavan Lake	42.50	6.95	2.17

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
300	Brown's Channel	0.89	0.03	0.01
301	Brown's Channel	2.12	0.08	0.02
302	Delavan Lake	1.94	0.11	0.03
303	Delavan Lake	8.33	1.03	0.32
304	Delavan Lake	13.61	1.85	0.58
305	Delavan Lake	0.73	0.03	0.01
306	Brown's Channel	0.27	0.01	0.00
307	Delavan Lake	0.30	0.02	0.00
308	Delavan Lake	29.02	4.27	1.33
309	Delavan Lake	0.41	0.04	0.02
310	Delavan Lake	4.45	0.27	0.08
311	Unnamed Tributary	0.30	0.01	0.00
312	Delavan Lake	0.31	0.02	0.01
313	Delavan Lake	2.70	0.10	0.03
314	Delavan Lake	9.77	0.35	0.11
315	Delavan Lake	7.07	0.26	0.08
316	Delavan Lake	17.88	0.70	0.22
317	Delavan Lake	0.46	0.02	0.01
318	Delavan Lake	1.84	0.09	0.03
319	Delavan Lake	1.46	0.07	0.02
320	Delavan Lake	1.99	0.22	0.07
321	Unnamed Tributary	0.16	0.00	0.00
322	Delavan Lake	0.26	0.01	0.00
323	Delavan Lake	1.20	0.04	0.01
324	Delavan Lake	1.26	0.14	0.06
325	Delavan Lake	2.45	0.17	0.07
326	Delavan Lake	25.34	4.72	1.47
327	Delavan Lake	2.76	0.15	0.05
328	Delavan Lake	9.59	0.71	0.30
329	Unnamed Tributary	0.93	0.03	0.01
330	Delavan Lake	3.54	0.49	0.15
331	Delavan Lake	2.17	0.22	0.09
332	Delavan Lake	6.83	0.34	0.11
333	Delavan Lake	1.35	0.07	0.02
333	Unnamed Tributary	2.06	0.11	0.03
334	Lower Jackson Creek	2.48	0.09	0.03
335	Lower Jackson Creek	7.42	0.27	0.08
336	Lower Jackson Creek	5.62	0.20	0.06
337	Lower Jackson Creek	0.35	0.01	0.00
338	Lower Jackson Creek	0.21	0.02	0.01
339	Lower Jackson Creek	0.38	0.01	0.00
340	Lower Jackson Creek	0.46	0.02	0.01
341	Lower Jackson Creek	4.13	0.32	0.13
342	Lower Jackson Creek	1.65	0.12	0.05
343	Lower Jackson Creek	0.41	0.02	0.00
344	Lower Jackson Creek	0.51	0.02	0.01
345	Lower Jackson Creek	5.57	0.42	0.18
346	Lower Jackson Creek	2.38	0.17	0.07
347	Lower Jackson Creek	1.40	0.05	0.02
348	Lower Jackson Creek	0.91	0.03	0.01

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
349	Upper Jackson Creek	1.08	0.03	0.01
350	Upper Jackson Creek	0.30	0.01	0.00
351	Upper Jackson Creek	2.64	0.13	0.05
352	Upper Jackson Creek	6.32	0.16	0.05
353	Upper Jackson Creek	0.49	0.01	0.00
354	Upper Jackson Creek	0.38	0.01	0.00
355	Upper Jackson Creek	0.74	0.02	0.01
356	Upper Jackson Creek	0.41	0.01	0.00
357	Upper Jackson Creek	1.23	0.03	0.01
358	Lower Jackson Creek	0.75	0.03	0.01
358	Upper Jackson Creek	1.10	0.04	0.01
360	Lower Jackson Creek	0.20	0.02	0.01
361	Delavan Lake	0.71	0.04	0.01
362	Delavan Lake	0.94	0.05	0.01
363	Brown's Channel	2.30	0.11	0.03
363	Delavan Lake	0.07	0.00	0.00
364	Delavan Lake	5.29	0.22	0.07
365	Delavan Lake	7.43	0.33	0.10
366	Delavan Lake	6.89	0.34	0.11
367	Delavan Lake	3.93	0.17	0.05
368	Delavan Lake	0.10	0.02	0.01
369	Delavan Lake	0.18	0.04	0.01
370	Lower Jackson Creek	0.30	0.04	0.01
371	Delavan Lake	0.31	0.03	0.00
372	Upper Jackson Creek	2.62	0.25	0.07
373	Upper Jackson Creek	0.65	0.04	0.01
374	Upper Jackson Creek	3.39	0.13	0.02
375	Upper Jackson Creek	0.94	0.04	0.02
376	Upper Jackson Creek	2.06	0.09	0.04
377	Lower Jackson Creek	0.23	0.01	0.00
378	Upper Jackson Creek	1.13	0.05	0.01
379	Upper Jackson Creek	1.54	0.10	0.02
380	Upper Jackson Creek	2.91	0.19	0.04
381	Upper Jackson Creek	0.22	0.01	0.00
382	Brown's Channel	1.04	0.05	0.01
383	Lower Jackson Creek	0.49	0.11	0.03
386	Upper Jackson Creek	1.74	0.15	0.05
387	Upper Jackson Creek	0.99	0.09	0.03
390	Upper Jackson Creek	0.46	0.04	0.01
391	Upper Jackson Creek	1.12	0.10	0.03
392	Upper Jackson Creek	0.28	0.03	0.01
393	Upper Jackson Creek	0.90	0.10	0.03
394	Upper Jackson Creek	0.27	0.03	0.01
395	Upper Jackson Creek	0.24	0.02	0.01
396	Upper Jackson Creek	0.20	0.02	0.00
397	Upper Jackson Creek	0.66	0.08	0.02
398	Upper Jackson Creek	1.11	0.14	0.04
399	Upper Jackson Creek	0.24	0.01	0.00
400	Upper Jackson Creek	0.42	0.05	0.01
401	Upper Jackson Creek	0.58	0.03	0.01

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
402	Upper Jackson Creek	0.39	0.05	0.01
403	Upper Jackson Creek	0.29	0.04	0.01
404	Upper Jackson Creek	0.11	0.01	0.00
405	Upper Jackson Creek	0.12	0.01	0.00
406	Upper Jackson Creek	0.50	0.06	0.02
407	Upper Jackson Creek	0.50	0.04	0.01
408	Upper Jackson Creek	0.11	0.01	0.00
409	Upper Jackson Creek	0.22	0.02	0.01
410	Upper Jackson Creek	1.14	0.14	0.04
411	Upper Jackson Creek	0.73	0.06	0.02
412	Upper Jackson Creek	0.30	0.02	0.01
413	Upper Jackson Creek	0.03	0.00	0.00
414	Upper Jackson Creek	0.28	0.04	0.01
415	Upper Jackson Creek	0.25	0.03	0.01
416	Delavan Lake	0.25	0.04	0.01
417	Brown's Channel	1.85	0.08	0.03
418	Brown's Channel	3.42	0.17	0.05
419	Brown's Channel	1.26	0.13	0.04
420	Brown's Channel	4.09	0.37	0.12
421	Brown's Channel	1.45	0.07	0.02
422	Brown's Channel	5.38	0.54	0.17
423	Brown's Channel	8.08	1.03	0.33
424	Delavan Lake	6.51	0.70	0.30
425	Delavan Lake	0.40	0.02	0.00
426	Delavan Lake	1.68	0.08	0.02
427	Brown's Channel	3.19	0.13	0.03
428	Brown's Channel	0.62	0.02	0.01
429	Unnamed Tributary	0.51	0.02	0.01
430	Lower Jackson Creek	3.34	0.32	0.13
431	Lower Jackson Creek	2.01	0.20	0.09
432	Lower Jackson Creek	3.04	0.28	0.12
433	Lower Jackson Creek	3.28	0.30	0.13
434	Lower Jackson Creek	1.47	0.07	0.02
435	Lower Jackson Creek	2.61	0.30	0.13
436	Upper Jackson Creek	2.62	0.10	0.02
437	Upper Jackson Creek	3.69	0.13	0.03
438	Upper Jackson Creek	0.70	0.02	0.01
439	Delavan Lake	0.80	0.05	0.02
440	Delavan Lake	1.76	0.10	0.03
441	Delavan Lake	1.94	0.10	0.03
442	Delavan Lake	0.44	0.03	0.01
443	Delavan Lake	3.07	0.97	0.41
444	Delavan Lake	7.44	0.41	0.13
445	Delavan Lake	1.17	0.14	0.06
446	Delavan Lake	10.01	1.82	0.57
447	Delavan Lake	4.66	1.66	0.70
448	Delavan Lake	5.82	0.25	0.08
449	Brown's Channel	4.70	0.18	0.06
449	Delavan Lake	1.31	0.05	0.02
450	Delavan Lake	7.30	0.37	0.11

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
451	Delavan Lake	4.70	0.43	0.18
452	Delavan Lake	4.73	0.22	0.07
453	Delavan Lake	4.72	0.20	0.06
454	Delavan Lake	2.86	0.22	0.09
455	Brown's Channel	0.13	0.00	0.00
455	Delavan Lake	3.84	0.16	0.05
456	Delavan Lake	2.84	0.21	0.09
457	Lower Jackson Creek	0.55	0.06	0.01
458	Upper Jackson Creek	0.25	0.02	0.01
459	Upper Jackson Creek	0.52	0.03	0.01
460	Upper Jackson Creek	0.46	0.04	0.02
461	Upper Jackson Creek	0.29	0.02	0.01
462	Upper Jackson Creek	1.78	0.17	0.07
463	Upper Jackson Creek	0.44	0.04	0.02
464	Upper Jackson Creek	4.31	0.41	0.17
465	Upper Jackson Creek	3.22	0.16	0.07
466	Upper Jackson Creek	1.58	0.08	0.03
467	Upper Jackson Creek	0.32	0.03	0.01
468	Upper Jackson Creek	0.70	0.06	0.02
469	Upper Jackson Creek	1.35	0.07	0.03
470	Upper Jackson Creek	0.31	0.03	0.01
471	Upper Jackson Creek	0.76	0.06	0.03
472	Upper Jackson Creek	0.63	0.03	0.01
473	Upper Jackson Creek	0.89	0.02	0.01
474	Upper Jackson Creek	1.05	0.03	0.01
475	Upper Jackson Creek	1.51	0.07	0.03
476	Upper Jackson Creek	3.06	0.15	0.06
477	Upper Jackson Creek	1.50	0.04	0.01
478	Upper Jackson Creek	3.11	0.08	0.02
479	Upper Jackson Creek	0.89	0.04	0.02
480	Upper Jackson Creek	0.82	0.04	0.02
481	Upper Jackson Creek	0.46	0.02	0.01
482	Upper Jackson Creek	3.35	0.16	0.07
483	Upper Jackson Creek	0.75	0.03	0.01
484	Upper Jackson Creek	1.21	0.06	0.02
485	Upper Jackson Creek	5.84	0.14	0.04
486	Upper Jackson Creek	0.44	0.01	0.00
487	Upper Jackson Creek	0.82	0.02	0.01
488	Upper Jackson Creek	5.87	0.27	0.11
489	Delavan Lake	0.52	0.06	0.01
490	Delavan Lake	0.49	0.09	0.03
491	Delavan Lake	0.29	0.07	0.02
492	Delavan Lake	0.52	0.08	0.02
493	Delavan Lake	0.49	0.20	0.05
494	Delavan Lake	0.50	0.12	0.03
495	Delavan Lake	0.84	0.15	0.04
496	Delavan Lake	0.72	0.11	0.03
497	Brown's Channel	0.35	0.02	0.01
498	Delavan Lake	1.04	0.36	0.11
499	Delavan Lake	0.70	0.09	0.02

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
500	Brown's Channel	0.75	0.05	0.01
501	Delavan Lake	0.41	0.07	0.02
502	Delavan Lake	0.96	0.09	0.02
503	Unnamed Tributary	1.09	0.11	0.03
504	Delavan Lake	0.28	0.06	0.02
505	Delavan Lake	0.35	0.08	0.02
506	Delavan Lake	2.05	0.21	0.05
507	Delavan Lake	0.10	0.02	0.01
508	Unnamed Tributary	0.86	0.10	0.03
509	Delavan Lake	0.54	0.05	0.01
510	Delavan Lake	1.37	0.44	0.10
511	Unnamed Tributary	0.32	0.06	0.02
512	Lower Jackson Creek	0.33	0.06	0.02
512	Unnamed Tributary	0.10	0.02	0.00
513	Lower Jackson Creek	0.17	0.02	0.01
513	Unnamed Tributary	0.46	0.06	0.02
514	Lower Jackson Creek	0.43	0.08	0.02
514	Unnamed Tributary	0.62	0.12	0.03
515	Unnamed Tributary	0.46	0.09	0.02
516	Lower Jackson Creek	0.41	0.08	0.02
517	Lower Jackson Creek	0.69	0.17	0.05
518	Lower Jackson Creek	0.86	0.23	0.06
519	Lower Jackson Creek	1.34	0.12	0.05
520	Lower Jackson Creek	0.38	0.11	0.03
521	Lower Jackson Creek	0.50	0.11	0.03
522	Lower Jackson Creek	0.53	0.19	0.05
523	Lower Jackson Creek	0.42	0.08	0.02
524	Lower Jackson Creek	0.22	0.06	0.02
525	Delavan Lake	9.26	1.75	0.41
526	Lower Jackson Creek	0.18	0.05	0.01
527	Lower Jackson Creek	0.11	0.03	0.01
528	Lower Jackson Creek	0.39	0.10	0.03
529	Lower Jackson Creek	0.29	0.07	0.02
530	Lower Jackson Creek	0.64	0.10	0.03
531	Delavan Lake	0.22	0.02	0.01
532	Delavan Lake	1.55	0.23	0.07
533	Delavan Lake	4.95	0.80	0.34
534	Delavan Lake	1.38	0.07	0.02
535	Delavan Lake	1.92	0.56	0.23
536	Lower Jackson Creek	6.66	0.51	0.22
537	Lower Jackson Creek	2.17	0.17	0.07
539	Delavan Lake	5.63	0.55	0.23
540	Delavan Lake	0.59	0.10	0.03
541	Brown's Channel	1.57	0.17	0.05
542	Brown's Channel	1.50	0.11	0.03
543	Brown's Channel	0.56	0.07	0.02
544	Unnamed Tributary	0.98	0.10	0.03
545	Lower Jackson Creek	3.12	0.59	0.20
546	Lower Jackson Creek	0.34	0.07	0.02
547	Upper Jackson Creek	0.43	0.02	0.01

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
548	Upper Jackson Creek	1.37	0.11	0.04
549	Upper Jackson Creek	0.50	0.04	0.01
550	Upper Jackson Creek	0.50	0.05	0.02
551	Delavan Lake	0.64	0.05	0.02
552	Unnamed Tributary	6.35	0.72	0.23
553	Lower Jackson Creek	0.45	0.12	0.04
555	Upper Jackson Creek	0.86	0.07	0.02
556	Upper Jackson Creek	4.31	0.48	0.15
557	Upper Jackson Creek	1.52	0.06	0.02
558	Upper Jackson Creek	0.70	0.08	0.02
559	Upper Jackson Creek	2.13	0.23	0.07
560	Upper Jackson Creek	0.71	0.06	0.02
561	Upper Jackson Creek	0.38	0.04	0.01
562	Upper Jackson Creek	1.25	0.14	0.04
563	Upper Jackson Creek	2.17	0.24	0.07
564	Upper Jackson Creek	3.46	0.14	0.04
565	Brown's Channel	1.93	0.08	0.03
566	Brown's Channel	0.56	0.02	0.01
567	Delavan Lake	1.10	0.05	0.01
568	Delavan Lake	0.51	0.02	0.01
569	Delavan Lake	4.75	0.82	0.26
570	Brown's Channel	1.23	0.06	0.02
571	Brown's Channel	1.21	0.05	0.02
571	Delavan Lake	0.39	0.02	0.01
572	Delavan Lake	3.12	0.13	0.04
573	Delavan Lake	3.11	0.13	0.04
574	Delavan Lake	3.29	0.28	0.12
575	Delavan Lake	3.16	0.30	0.12
576	Delavan Lake	3.20	0.17	0.05
577	Delavan Lake	3.22	0.22	0.07
578	Delavan Lake	1.91	0.36	0.11
579	Delavan Lake	2.50	0.14	0.04
580	Delavan Lake	2.58	0.48	0.15
581	Delavan Lake	3.44	0.26	0.08
582	Delavan Lake	0.89	0.04	0.01
583	Delavan Lake	2.90	0.27	0.08
584	Brown's Channel	2.18	0.11	0.03
584	Delavan Lake	0.16	0.01	0.00
585	Brown's Channel	1.33	0.07	0.02
586	Brown's Channel	1.02	0.05	0.02
587	Delavan Lake	1.00	0.06	0.02
588	Delavan Lake	1.07	0.05	0.02
589	Delavan Lake	2.07	0.60	0.25
590	Delavan Lake	2.81	0.16	0.05
591	Delavan Lake	1.03	0.37	0.15
592	Delavan Lake	3.61	0.15	0.05
593	Delavan Lake	5.44	0.31	0.10
594	Delavan Lake	1.99	0.13	0.04
595	Delavan Lake	3.26	0.12	0.04
596	Delavan Lake	1.77	0.05	0.02

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
597	Delavan Lake	1.73	0.12	0.05
598	Delavan Lake	3.14	0.11	0.03
599	Delavan Lake	3.60	0.29	0.12
600	Delavan Lake	3.29	0.32	0.13
601	Delavan Lake	0.31	0.01	0.00
602	Delavan Lake	4.35	0.16	0.05
603	Delavan Lake	5.62	0.32	0.10
604	Delavan Lake	1.08	0.12	0.05
605	Delavan Lake	5.32	0.29	0.09
606	Delavan Lake	2.17	0.12	0.04
607	Delavan Lake	1.35	0.07	0.02
608	Delavan Lake	2.14	0.15	0.05
609	Delavan Lake	1.20	0.06	0.02
610	Delavan Lake	0.23	0.03	0.01
611	Delavan Lake	0.26	0.03	0.01
612	Delavan Lake	7.38	0.43	0.13
613	Delavan Lake	4.32	0.21	0.07
614	Brown's Channel	3.59	0.13	0.04
614	Delavan Lake	7.08	0.29	0.09
615	Delavan Lake	0.33	0.02	0.00
616	Delavan Lake	1.15	0.06	0.02
617	Delavan Lake	3.43	0.55	0.23
618	Delavan Lake	1.70	0.10	0.03
619	Delavan Lake	7.61	0.71	0.22
620	Delavan Lake	0.41	0.02	0.01
640	Lower Jackson Creek	0.58	0.03	0.01
641	Lower Jackson Creek	1.47	0.15	0.06
642	Lower Jackson Creek	3.52	0.19	0.06
643	Lower Jackson Creek	0.25	0.03	0.01
644	Lower Jackson Creek	5.22	0.26	0.08
645	Lower Jackson Creek	6.32	0.31	0.10
646	Lower Jackson Creek	7.71	0.69	0.29
647	Lower Jackson Creek	3.45	0.16	0.05
648	Lower Jackson Creek	3.37	0.15	0.05
649	Lower Jackson Creek	2.80	0.12	0.04
650	Lower Jackson Creek	16.29	0.80	0.25
651	Lower Jackson Creek	2.97	0.24	0.10
652	Lower Jackson Creek	2.76	0.22	0.09
653	Lower Jackson Creek	4.13	0.17	0.05
654	Lower Jackson Creek	5.98	0.45	0.19
655	Lower Jackson Creek	8.89	0.35	0.11
656	Upper Jackson Creek	5.67	0.14	0.04
657	Upper Jackson Creek	6.18	0.15	0.05
658	Upper Jackson Creek	0.77	0.04	0.01
659	Upper Jackson Creek	1.12	0.05	0.02
660	Upper Jackson Creek	2.49	0.06	0.02
661	Upper Jackson Creek	0.26	0.01	0.00
662	Upper Jackson Creek	0.25	0.01	0.00
663	Upper Jackson Creek	0.25	0.01	0.00
664	Upper Jackson Creek	12.02	0.29	0.09

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
665	Upper Jackson Creek	0.83	0.04	0.02
666	Upper Jackson Creek	1.33	0.03	0.01
667	Upper Jackson Creek	6.48	0.16	0.05
668	Upper Jackson Creek	1.09	0.03	0.01
669	Upper Jackson Creek	1.73	0.08	0.03
670	Upper Jackson Creek	3.93	0.18	0.08
671	Upper Jackson Creek	0.98	0.05	0.02
672	Delavan Lake	1.45	0.20	0.08
673	Upper Jackson Creek	0.29	0.01	0.01
674	Upper Jackson Creek	0.31	0.02	0.01
675	Upper Jackson Creek	0.32	0.02	0.01
676	Upper Jackson Creek	0.27	0.01	0.00
677	Upper Jackson Creek	1.96	0.06	0.02
678	Upper Jackson Creek	0.71	0.04	0.01
679	Upper Jackson Creek	1.52	0.07	0.03
680	Upper Jackson Creek	0.38	0.02	0.01
681	Upper Jackson Creek	1.58	0.08	0.03
682	Upper Jackson Creek	0.25	0.01	0.00
683	Upper Jackson Creek	0.40	0.02	0.01
684	Upper Jackson Creek	0.50	0.02	0.01
685	Upper Jackson Creek	0.25	0.01	0.01
686	Upper Jackson Creek	0.25	0.01	0.01
687	Upper Jackson Creek	0.24	0.01	0.00
688	Upper Jackson Creek	0.25	0.01	0.01
689	Upper Jackson Creek	0.50	0.02	0.01
690	Upper Jackson Creek	0.28	0.01	0.01
691	Lower Jackson Creek	2.32	0.21	0.07
692	Delavan Lake	1.52	0.00	0.00
693	Brown's Channel	0.31	0.00	0.00
694	Brown's Channel	0.27	0.00	0.00
695	Brown's Channel	1.06	0.03	0.01
696	Brown's Channel	0.53	0.00	0.00
697	Brown's Channel	1.37	0.04	0.01
698	Brown's Channel	0.69	0.02	0.01
699	Brown's Channel	0.58	0.02	0.01
700	Delavan Lake	2.98	0.11	0.03
701	Brown's Channel	0.54	0.02	0.00
702	Delavan Lake	1.50	0.06	0.02
703	Delavan Lake	0.07	0.00	0.00
704	Delavan Lake	0.46	0.02	0.01
705	Delavan Lake	0.46	0.02	0.01
706	Delavan Lake	4.94	0.18	0.06
707	Brown's Channel	0.56	0.02	0.01
708	Brown's Channel	1.10	0.00	0.00
709	Brown's Channel	0.19	0.00	0.00
710	Brown's Channel	0.47	0.03	0.01
711	Delavan Lake	1.20	0.09	0.02
712	Delavan Lake	1.53	0.21	0.06
713	Delavan Lake	0.69	0.17	0.05
714	Brown's Channel	0.14	0.01	0.00

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
715	Brown's Channel	10.37	0.59	0.14
716	Brown's Channel	1.86	0.08	0.02
717	Brown's Channel	1.62	0.15	0.07
718	Brown's Channel	1.93	0.08	0.02
719	Brown's Channel	1.46	0.07	0.02
720	Brown's Channel	0.96	0.04	0.01
721	Brown's Channel	0.92	0.09	0.04
722	Brown's Channel	1.45	0.07	0.02
723	Brown's Channel	4.52	0.41	0.18
724	Brown's Channel	1.41	0.06	0.01
725	Delavan Lake	1.84	0.10	0.02
726	Brown's Channel	1.08	0.10	0.03
727	Brown's Channel	0.85	0.01	0.00
728	Brown's Channel	1.24	0.07	0.02
729	Delavan Lake	1.87	0.12	0.03
730	Delavan Lake	0.51	0.08	0.03
731	Delavan Lake	0.51	0.04	0.01
732	Brown's Channel	8.98	0.78	0.25
733	Brown's Channel	2.25	0.09	0.02
734	Brown's Channel	0.96	0.02	0.01
735	Brown's Channel	6.24	0.31	0.13
736	Brown's Channel	1.45	0.04	0.01
737	Brown's Channel	2.38	0.12	0.05
738	Brown's Channel	5.14	0.25	0.11
739	Delavan Lake	0.56	0.02	0.01
740	Delavan Lake	0.66	0.03	0.01
741	Brown's Channel	7.34	0.37	0.15
742	Delavan Lake	1.02	0.09	0.04
743	Delavan Lake	1.78	0.09	0.03
744	Brown's Channel	1.48	0.07	0.03
745	Delavan Lake	0.78	0.04	0.01
746	Brown's Channel	4.91	0.25	0.10
747	Brown's Channel	5.80	0.29	0.12
748	Brown's Channel	3.08	0.08	0.03
749	Upper Jackson Creek	0.22	0.01	0.00
750	Upper Jackson Creek	0.23	0.01	0.00
751	Upper Jackson Creek	1.91	0.09	0.04
752	Upper Jackson Creek	2.27	0.25	0.08
753	Upper Jackson Creek	5.70	0.22	0.07
754	Upper Jackson Creek	0.83	0.02	0.01
755	Upper Jackson Creek	0.21	0.02	0.01
756	Lower Jackson Creek	0.32	0.01	0.00
757	Delavan Lake	9.45	3.45	1.04
758	Delavan Lake	2.05	0.17	0.07
759	Delavan Lake	2.11	0.22	0.09
760	Delavan Lake	1.65	0.08	0.02
761	Delavan Lake	3.72	0.19	0.06
762	Delavan Lake	0.88	0.00	0.00
763	Delavan Lake	1.20	0.05	0.02
764	Delavan Lake	2.05	0.68	0.29

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
765	Brown's Channel	1.18	0.06	0.02
765	Delavan Lake	0.25	0.01	0.00
766	Delavan Lake	0.23	0.01	0.00
767	Brown's Channel	0.64	0.02	0.01
768	Brown's Channel	0.81	0.04	0.02
769	Upper Jackson Creek	7.77	0.43	0.14
770	Upper Jackson Creek	1.50	0.04	0.01
771	Upper Jackson Creek	0.29	0.01	0.00
772	Upper Jackson Creek	3.81	0.18	0.08
773	Upper Jackson Creek	1.27	0.06	0.03
774	Upper Jackson Creek	1.30	0.06	0.03
775	Upper Jackson Creek	0.65	0.02	0.00
776	Upper Jackson Creek	2.71	0.07	0.02
777	Upper Jackson Creek	1.15	0.05	0.02
778	Upper Jackson Creek	0.84	0.02	0.01
779	Upper Jackson Creek	0.99	0.04	0.02
780	Upper Jackson Creek	0.35	0.02	0.01
781	Upper Jackson Creek	3.34	0.15	0.06
782	Upper Jackson Creek	1.12	0.05	0.02
783	Upper Jackson Creek	0.35	0.01	0.00
784	Upper Jackson Creek	0.82	0.04	0.02
785	Upper Jackson Creek	0.69	0.03	0.01
786	Upper Jackson Creek	0.43	0.02	0.01
787	Upper Jackson Creek	0.36	0.02	0.01
788	Upper Jackson Creek	0.11	0.01	0.00
789	Upper Jackson Creek	0.57	0.01	0.00
790	Upper Jackson Creek	0.93	0.02	0.01
791	Upper Jackson Creek	0.67	0.03	0.01
792	Delavan Lake	0.79	0.14	0.04
792	Unnamed Tributary	0.09	0.02	0.00
793	Delavan Lake	2.31	0.57	0.18
794	Delavan Lake	4.75	0.20	0.06
795	Delavan Lake	0.84	0.05	0.01
796	Delavan Lake	1.89	0.08	0.02
797	Brown's Channel	0.86	0.04	0.01
798	Brown's Channel	0.83	0.03	0.01
799	Brown's Channel	0.82	0.03	0.01
800	Delavan Lake	0.97	0.05	0.01
801	Delavan Lake	0.62	0.06	0.02
802	Delavan Lake	0.88	0.04	0.01
803	Delavan Lake	0.35	0.00	0.00
804	Delavan Lake	0.45	0.04	0.02
805	Delavan Lake	0.72	0.04	0.01
807	Delavan Lake	4.31	0.17	0.05
808	Delavan Lake	1.83	0.07	0.02
809	Delavan Lake	2.39	0.09	0.03
810	Delavan Lake	3.60	0.25	0.10
811	Delavan Lake	1.99	0.07	0.02
812	Delavan Lake	1.31	0.05	0.01
813	Delavan Lake	0.76	0.04	0.01

BMP Code	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
814	Upper Jackson Creek	0.99	0.08	0.03
815	Lower Jackson Creek	1.81	0.15	0.06
816	Lower Jackson Creek	1.77	0.07	0.02
817	Upper Jackson Creek	0.35	0.01	0.00
818	Brown's Channel	0.58	0.02	0.00
819	Brown's Channel	1.11	0.06	0.02
820	Brown's Channel	1.18	0.03	0.01
821	Brown's Channel	0.82	0.02	0.01
822	Brown's Channel	0.54	0.02	0.00
823	Brown's Channel	1.96	0.10	0.04
824	Brown's Channel	0.09	0.00	0.00
825	Delavan Lake	0.73	0.10	0.04
826	Delavan Lake	4.58	0.26	0.08
827	Delavan Lake	2.80	0.48	0.20
828	Delavan Lake	4.79	0.54	0.23
829	Delavan Lake	2.13	0.29	0.12
830	Delavan Lake	4.15	0.45	0.14
834	Upper Jackson Creek	3.21	0.11	0.03
		1595.11	122.84	41.12
		Average per acre	0.08 lbs.	0.03 tons

Recommended Permeable Pavement Load Reductions

BMP	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
134	Delavan Lake	2.27	1.97	0.57
135	Delavan Lake	0.33	0.25	0.07
136	Delavan Lake	0.43	0.13	0.04
140	Delavan Lake	1.92	0.44	0.13
148	Delavan Lake	0.62	0.11	0.03
154	Lower Jackson Creek	0.27	0.06	0.02
155	Delavan Lake	1.05	0.19	0.06
156	Delavan Lake	0.75	0.14	0.04
157	Delavan Lake	7.85	1.44	0.41
161	Lower Jackson Creek	0.66	0.15	0.04
162	Delavan Lake	3.36	1.07	0.31
165	Lower Jackson Creek	3.05	0.75	0.21
167	Delavan Lake	16.13	5.83	1.67
168	Lower Jackson Creek	5.30	1.49	0.43
169	Lower Jackson Creek	1.46	0.32	0.09
170	Delavan Lake	0.67	0.19	0.05
171	Delavan Lake	0.79	0.14	0.04
172	Delavan Lake	0.70	0.14	0.04
173	Delavan Lake	3.35	0.66	0.19
174	Lower Jackson Creek	0.45	0.08	0.02
175	Lower Jackson Creek	0.90	0.20	0.06
179	Lower Jackson Creek	0.45	0.12	0.03
186	Delavan Lake	0.69	0.15	0.04
187	Lower Jackson Creek	0.56	0.09	0.03
187	Unnamed Tributary	1.37	0.23	0.06
188	Lower Jackson Creek	1.02	0.18	0.05
188	Unnamed Tributary	1.98	0.34	0.10
189	Unnamed Tributary	0.91	0.16	0.05
190	Lower Jackson Creek	1.32	0.42	0.12
191	Lower Jackson Creek	0.25	0.07	0.02
192	Lower Jackson Creek	0.35	0.09	0.03
193	Delavan Lake	3.82	1.15	0.33
194	Lower Jackson Creek	0.14	0.03	0.01
195	Delavan Lake	1.85	0.45	0.13
196	Lower Jackson Creek	0.69	0.17	0.05
197	Delavan Lake	2.25	0.78	0.22
198	Lower Jackson Creek	0.31	0.07	0.02
200	Upper Jackson Creek	0.00	0.00	0.00
213	Lower Jackson Creek	0.36	0.09	0.03
229	Delavan Lake	2.19	0.40	0.12
241	Delavan Lake	3.07	0.69	0.20
263	Delavan Lake	3.71	1.31	0.37
264	Delavan Lake	1.52	0.49	0.14

BMP	Sub-Watershed Name	Final Acres	Phosphorus	Sediment
264	Unnamed Tributary	0.56	0.17	0.05
265	Delavan Lake	0.28	0.07	0.02
266	Delavan Lake	0.55	0.17	0.05
267	Delavan Lake	0.83	0.23	0.06
268	Brown's Channel	0.78	0.17	0.05
268	Delavan Lake	5.66	1.54	0.44
269	Delavan Lake	0.00	0.00	0.00
271	Delavan Lake	1.22	0.29	0.08
272	Delavan Lake	0.13	0.03	0.01
274	Delavan Lake	0.17	0.04	0.01
275	Delavan Lake	0.20	0.06	0.02
276	Delavan Lake	0.55	0.13	0.04
277	Delavan Lake	0.31	0.07	0.02
278	Delavan Lake	0.20	0.05	0.02
279	Delavan Lake	1.56	0.71	0.20
280	Delavan Lake	0.71	0.20	0.06
281	Delavan Lake	1.12	0.48	0.14
282	Delavan Lake	0.38	0.20	0.06
283	Delavan Lake	2.30	0.78	0.22
284	Delavan Lake	0.42	0.14	0.04
288	Delavan Lake	2.92	0.60	0.17
292	Delavan Lake	1.12	0.28	0.08
293	Delavan Lake	4.01	0.95	0.27
295	Lower Jackson Creek	1.24	0.28	0.08
303	Delavan Lake	0.34	0.13	0.04
305	Delavan Lake	0.58	0.37	0.11
306	Delavan Lake	0.32	0.10	0.03
307	Delavan Lake	0.49	0.16	0.04
308	Delavan Lake	0.46	0.15	0.04
309	Delavan Lake	0.44	0.15	0.04
310	Delavan Lake	0.31	0.09	0.03
311	Delavan Lake	1.88	0.74	0.21
312	Delavan Lake	0.00	0.00	0.00
313	Delavan Lake	0.60	0.25	0.07
317	Brown's Channel	0.00	0.00	0.00
317	Delavan Lake	17.14	9.26	2.65
318	Delavan Lake	0.25	0.08	0.02
318	Unnamed Tributary	0.27	0.08	0.02
319	Lower Jackson Creek	1.40	0.28	0.08
		132.84	42.72	12.23
	Average per acre load reduction		0.32	0.09
			lbs.	tons

Berrini & Associates, LLC
Dredging & Waterway Consulting

Town of Delavan
walworth county, wisconsin

Northwater Consulting

Recommended Rain Barrel and Rain Garden Load Reductions

BMP_code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
1	Delavan Lake	8.59	1.48	0.21
2	Delavan Lake	3.85	0.32	0.10
3	Delavan Lake	8.99	0.80	0.24
4	Delavan Lake	8.20	0.92	0.28
6	Delavan Lake	93.50	12.97	1.87
7	Delavan Lake	36.73	7.92	2.39
8	Delavan Lake	8.33	1.26	0.38
9	Delavan Lake	13.61	2.26	0.68
10	Delavan Lake	24.84	4.62	1.39
11	Delavan Lake	1.99	0.27	0.08
12	Delavan Lake	1.20	0.05	0.02
13	Delavan Lake	25.34	5.77	1.74
14	Delavan Lake	9.59	0.87	0.35
15	Delavan Lake	3.54	0.60	0.18
16	Delavan Lake	7.60	0.40	0.06
17	Delavan Lake	2.44	0.45	0.06
17	Unnamed Tributary	1.73	0.29	0.04
18	Delavan Lake	3.07	1.18	0.48
19	Delavan Lake	10.01	2.22	0.67
20	Delavan Lake	4.66	2.03	0.82
21	Delavan Lake	1.37	0.54	0.12
22	Lower Jackson Creek	0.38	0.13	0.04
23	Lower Jackson Creek	0.50	0.14	0.04
24	Lower Jackson Creek	0.53	0.24	0.06
25	Delavan Lake	9.26	2.14	0.48
26	Delavan Lake	1.55	0.28	0.09
27	Delavan Lake	4.95	0.98	0.40
28	Delavan Lake	1.92	0.68	0.28
29	Delavan Lake	4.75	1.00	0.30
30	Delavan Lake	3.12	0.16	0.05
31	Delavan Lake	3.11	0.16	0.05
32	Delavan Lake	3.29	0.35	0.14
33	Delavan Lake	2.42	0.10	0.01
34	Delavan Lake	3.16	0.36	0.15
35	Delavan Lake	3.20	0.21	0.06
36	Delavan Lake	3.22	0.27	0.08
37	Delavan Lake	1.91	0.43	0.13
38	Delavan Lake	2.58	0.59	0.18
39	Delavan Lake	3.44	0.32	0.10
40	Delavan Lake	1.07	0.06	0.02
41	Delavan Lake	3.20	0.43	0.06
42	Delavan Lake	2.07	0.74	0.30
43	Delavan Lake	1.03	0.45	0.18
44	Delavan Lake	3.26	0.15	0.05
45	Delavan Lake	3.14	0.13	0.04
46	Delavan Lake	3.60	0.35	0.14
47	Delavan Lake	3.29	0.39	0.16

BMP_code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
48	Delavan Lake	4.35	0.19	0.06
49	Delavan Lake	2.37	0.51	0.21
50	Delavan Lake	7.61	0.86	0.26
51	Lower Jackson Creek	16.29	0.98	0.29
52	Delavan Lake	1.45	0.24	0.10
53	Lower Jackson Creek	1.32	0.42	0.11
54	Lower Jackson Creek	0.25	0.07	0.02
55	Delavan Lake	3.82	1.15	0.31
56	Delavan Lake	1.85	0.45	0.12
57	Delavan Lake	2.25	0.78	0.21
58	Delavan Lake	9.45	4.22	1.22
59	Delavan Lake	1.20	0.07	0.02
60	Delavan Lake	2.05	0.83	0.34
61	Delavan Lake	2.31	0.69	0.21
62	Delavan Lake	2.80	0.58	0.24
63	Delavan Lake	4.15	0.55	0.16
64	Delavan Lake	4.79	0.66	0.27
70	Delavan Lake	0.96	0.18	0.03
71	Delavan Lake	1.17	0.17	0.07
72	Delavan Lake	1.94	0.12	0.04
73	Delavan Lake	1.76	0.12	0.04
74	Delavan Lake	1.07	0.05	0.01
75	Delavan Lake	1.77	0.07	0.02
76	Delavan Lake	1.73	0.14	0.06
77	Delavan Lake	2.90	0.33	0.10
78	Delavan Lake	1.00	0.08	0.02
79	Delavan Lake	2.50	0.18	0.05
80	Delavan Lake	0.73	0.12	0.05
81	Delavan Lake	0.80	0.07	0.02
83	Delavan Lake	2.27	1.97	0.53
84	Delavan Lake	0.79	0.17	0.05
84	Unnamed Tributary	0.09	0.02	0.01
		442.92	75.52	20.96
		Average per acre	0.17 lbs.	0.05 tons

Recommended Feed Lot Area Load Reductions

BMP_Code	Sub-Watershed Name	Final Acres Treated	Phosphorus Reduction (lbs./yr.)	Sediment Reduction (tons/yr.)
2	Upper Jackson Creek	3.17	0.40	0.06
3	Upper Jackson Creek	18.85	2.32	0.37
4	Lower Jackson Creek	1.16	1.06	0.09
5	Brown's Channel	3.12	0.51	0.08
6	Upper Jackson Creek	1.27	0.16	0.03
7	Brown's Channel	8.30	1.26	0.20
8	Upper Jackson Creek	0.65	0.55	0.04
9	Lower Jackson Creek	1.70	0.24	0.04
10	Lower Jackson Creek	0.28	0.25	0.02
11	Lower Jackson Creek	3.13	0.50	0.08
12	Upper Jackson Creek	1.76	0.26	0.04
13	Brown's Channel	3.36	0.47	0.08
14	Brown's Channel	0.26	0.23	0.02
15	Upper Jackson Creek	5.88	0.72	0.12
16	Upper Jackson Creek	0.18	0.15	0.01
17	Brown's Channel	3.81	0.05	0.01
18	Upper Jackson Creek	0.46	0.37	0.03
19	Upper Jackson Creek	0.47	0.40	0.03
		57.79	9.92	1.35
		Average per acre	0.17 lbs.	0.02 tons

Appendix D

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