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March 26, 2015

Amy M. Garbe
Wastewater Engineer
Wisconsin DNR
3911 Fish Hatchery Road
Fitchburg, WI 53711

RE: Oconomowoc River Watershed Adaptive Management Plan Submittal

Dear Amy,

Please see the enclosed document titled "Oconomowoc Watershed Protection Program", which will act as the formal adaptive management plan document for the City of Oconomowoc and its project partners. The document is structured around the EPA's 9 Key Elements which were generated to assist in developing watershed-based plans. In addition, the Adaptive Management Technical Handbook was relied upon for guidance on relevant information to include in the plan.

The document's introduction and background section briefly describes the City of Oconomowoc Wastewater Treatment Facility and the general approach that the City will be taking to achieve phosphorus compliance. Next, the document addresses each of the 9 Key Elements in order, including a preliminary list of project partners, a thorough description and inventory of the Oconomowoc River Watershed, and the identification of several potential project sites. The City used several resources to identify these sites, including information from county Land and Water Conservation Department partners, GIS mapping tools, and windshield surveys. The City has already been making contact with local landowners, and is confident that the sufficient participation will be attained in order to achieve project success.

The document also includes several appendices which contain important project information. Please note that several maps are included in Appendix B which should be referenced during the review of the document. Also included in the appendices are comprehensive monitoring results, soil information for the watershed, and a summary of the modeling completed for the action area.

~47-10024 Adaptive Management Program > 100 Planning > Reports > Garbe-20150326-Oconomowoc River Watershed Adaptive Management Plan Submittal.docx~

We look forward to your review of the Oconomowoc Watershed Protection Program plan. Please contact us regarding any questions or comments related to the document.

Very truly yours,

RUEKERT & MIELKE, INC.

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Senior Project Manager
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DWA:tag

cc: Thomas R. Steinbach, City of Oconomowoc
File

OCONOMOWOC WATERSHED PROTECTION PROGRAM

CITY OF OCONOMOWOC
WAUKESHA COUNTY, WISCONSIN

MARCH 26, 2015

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Waukesha, Wisconsin 53188-1020

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LIST OF ABBREVIATIONS

AEA	Agricultural Enterprise Areas
AM	Adaptive Management
CSA	Critical Source Areas
EPA	Environmental Protection Agency
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
LWC	Land and Water Conservation
MGD	Million Gallons Per Day
MS4	Municipal Separate Storm Sewer System
NLCD	National Land Use Database
NRCS	National Resource Conservation Service
OWPP	Oconomowoc Watershed Protection Program
PRESTO	Pollutant Ratio Estimation Tool
R/M	Ruekert & Mielke, Inc.
RCPP	Regional Conservation Partnership Program
RUSLE	Revised Universal Soil Loss Equation
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SLAMM	Source Loading and Management Model
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWAT	Soil and Water Assessment Tool
SWIMS	Surface Water Integrated Monitoring System
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
UW	University of Wisconsin Extension
WAC	Wisconsin Administrative Code
WDATCP	Wisconsin Department of Agriculture, Trade and Consumer Protection
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System
WQC	Water Quality Criterion
WWTF	Wastewater Treatment Facility

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OCONOMOWOC WATERSHED PROTECTION PROGRAM

INTRODUCTION AND BACKGROUND

The City of Oconomowoc received its Wisconsin Pollutant Discharge Elimination System (WPDES) permit renewal for its Wastewater Treatment Facility (WWTF) in March of 2014. The permit contains final mass-based limits for Total Suspended Solids (TSS) and Total Phosphorus (TP) limits. The mass-based limits are derived from the Rock River Total Maximum Daily Load (TMDL) rule-making approved by the Environmental Protection Agency (EPA) in September of 2011 (The Cadmus Group, Inc., 2011).

The WWTF can meet the limits for TSS without any facility improvements. The final limits for TSS are effective immediately.

The WWTF cannot meet the final TP limits without significant facility improvements. The monthly average TP limits expressed as concentrations at the design flow of 4.0 Million Gallons Per Day (MGD) range from 0.17 mg/L in August and September to 0.30 mg/L in February. The City anticipates an effective limit of 0.12 mg/L to safely meet the final TP permit limits in August. The City has an interim monthly average TP limit of 0.95 mg/L that is effective immediately, which can be met with its existing treatment process.

The Oconomowoc WWTF uses an activated sludge treatment process. The treatment processes include influent screening, influent pumping, aerated grit removal, primary clarification, aeration using submerged ceramic diffusers, final clarification, tertiary filters, ultraviolet light disinfection, and dissolved oxygen uptake. Biosolids are wasted from the return activated sludge wet well, stored in a tank, thickened using an air flotation thickener, anaerobically digested, thickened again with a gravity belt thickener and stored. Biosolids are spread on farmland for soil conditioning. Effluent from the WWTF flows in a channel approximately 800 feet westward to the Oconomowoc River. The Oconomowoc River flows into the Rock River in eastern Jefferson County. The Rock River flows west towards the Mississippi River and eventually reaches the Gulf of Mexico.

The WWTF mainly uses ferrous chloride for phosphorus removal. Influent TP levels range from 4 to 6 mg/L. The City adds an average of 130 gallons per day to reduce TP in the effluent to 0.7 to 0.8 mg/L. The current dosing point is just upstream of the two primary clarifiers. WWTF staff have experimented in the past with different dosing locations and configurations with limited success in increasing TP removal efficiency.

The current WPDES permit contains a compliance schedule for meeting the TP limits with a final compliance date of April 1, 2022. The City is in the first step of the permit phosphorus compliance schedule, the Operational Evaluation Report. As part of this report, the City is gathering historical WWTF influent and effluent TP data, summarizing past operational studies to reduce phosphorus levels through the use of it tertiary membrane filters, coordinating with industrial TP sources for reductions, and conducting a pilot study on a rare earth phosphorus-removing chemical that may be more efficient than ferrous chloride.

The City has identified Adaptive Management (AM) as the preferred compliance alternative under Wisconsin Administrative Code (WAC) Chapter NR 217. The City submitted a Watershed Adaptive Management Request Form 3200-139 on February 23, 2015, which can be seen in Appendix A.

The City feels AM is the best alternative for several reasons. First, the point of compliance is at an advantageous location just upstream of the confluence of the Oconomowoc and Rock Rivers. The Oconomowoc WWTF outfall is approximately 9 river miles upstream, providing opportunities for management measures both upstream and downstream of treatment facility. Improvements made to reduce runoff upstream of the WWTF should be noticeable at the confluence. In addition, there are several opportunities to reduce the pollutant loading downstream of the WWTF, which will theoretically lead to the greatest TP level reductions at the point of compliance.

Second, historical sampling from both the City and the Wisconsin Department of Natural Resources (WDNR) indicate average TP concentrations at the confluence of 0.069 mg/L (WDNR SWIMS data from 2007-2008) and 0.08 mg/L (City data from 2014-2015), respectively. These two data sets will be described in more detail later in this report when establishing load reduction goals. The Water Quality Criterion (WQC) for TP is 0.075 mg/L, which means that the magnitude of the pollutant reduction in this instance is relatively small. Assuming an annual average flow of the Oconomowoc River at the confluence of 76.99 MGD (See Table 7 below) and a TP concentration of 0.08 mg/L, the annual TP load reduction required is 1172 pounds. In light of this achievable pollutant loading reduction goal, the City feels that an AM program can be successful.

In addition, there are several opportunities for beneficial partnerships in the Oconomowoc River Watershed. One important partner will be the City of Oconomowoc Storm Water Utility, which is a Municipal Separate Storm Sewer System (MS4) permittee. The utility is required to achieve significant reductions in TSS and TP levels in its storm water, which is anticipated to be especially difficult to accomplish. However, a successful AM program led by the wastewater utility will provide significant benefits to the storm water utility. There are five other MS4 permittees in the watershed. It is anticipated that they will be partners to improve water quality and reap benefits in relation to their MS4 permits as well.

Lastly, the AM program is the most cost effective approach to achieving the WQC for the Oconomowoc River. The City understands that with the AM approach, the root source of the pollutant loading is addressed. There is technology available to remove phosphorus to required levels at the WWTF. However, this technology uses more energy, water, and chemicals compared to the AM approach. The City recognizes the long term sustainability and environmental benefits of the AM approach.

The City would have to invest in significant upgrades to WWTF in order to achieve the required reduction in TP. The City currently has membrane disc filters designed to remove TSS before disinfection, but these filters were not designed to remove TP to the levels required to meet the final permit. As mentioned previously, the City has experimented with adding greater doses of ferrous chloride to the treatment processes; however, at a level below 0.4 mg/L the filters clog with chemical and take on a distinctive orange color associated with the ferrous chloride. To

retrofit the filters to remove TP to a greater degree, chemical coagulation and polymer addition would have to take place immediately before the filtration process. In addition, supplementary filters may be necessary because the hydraulic loading rates would be less than used now. The total estimated capital cost of WWTF modifications to achieve lower effluent TP levels is $1,500,000 to $2,000,000.

For the storm water utility, the cost advantages of the AM approach are even more apparent. It is estimated that without an AM program the City's cost to achieve both TP and TSS reductions approaches $10,000,000. The majority of this anticipated cost would be used for TP reductions.

In order to obtain supplemental financial assistance for the AM program, the City completed a grant proposal for the National Resource Conservation Service (NRCS) known as the Regional Conservation Partnership Program (RCPP) in the summer of 2014. The RCPP program combined existing NRCS programs into a larger, streamlined program. Examples of existing programs under the RCPP include the Environmental Quality Incentive Program, Agricultural Conservation Easement Program, and the Conservation Stewardship Program. The purpose of the RCPP is to promote conservation practices and to leverage federal grant funds with matching non-federal partner funds. The RCPP program is an aggressive conservation program which is limited to a five year period. The money for the conservation practices is for fiscal years 2015 through 2019. Practices where federal money is requested must be in place by and completed by November 1, 2019. The City was awarded the RCPP grant early in 2015, and intends to include this funding as part of the larger AM program.

The City has named the combined effort of the AM program and the RCPP the Oconomowoc Watershed Protection Program (OWPP). Through the RCPP proposal process, the City has formed a network of partnerships and outlined the roles and responsibilities of each partner. This existing organization will be applied to the AM program and developed further as a part of the OWPP.

IDENTIFY PARTNERS

In light of the numerous partners involved in the OWPP, they are categorized as non-point source partners, county groups, and other partners. There are currently no non-MS4 permitted urban source partners in the OWPP besides the MS4's in the action area.

In order to effectively engage non-point sources, the City has formed a Farmer Leadership Group. This is a group of several landowners and farmers who will lead the effort in working with the agricultural community to implement phosphorus management measures. This group will be the point group in making local farmers aware of the AM program and its objectives, promoting the program, coordinating with the agricultural community to identify opportunities for pollutant reduction, and implementing specific reduction practices. The group is comprised of farmers from Jefferson, Waukesha and Washington Counties who understand field-scale conservation practices and who understand the benefits of the OWPP to the larger community.

The county Land and Water Conservation (LWC) Departments will be an important asset to the AM program. The counties represented in the Oconomowoc River Watershed are Jefferson, Waukesha, Dodge, and Washington Counties. Since the watershed area in Dodge County is very

small, this county will not be an initial partner. If in the future it is evident that significant pollutant reduction could take place in this area, Dodge County will be included as a partner in the plan. The City has already coordinated with LWC Department staff in putting together a list of Critical Source Areas (CSAs), determining appropriate management measure for those areas, and estimating pollutant reduction levels for the RCPP grant proposal.

The counties will provide direct, in-kind technical assistance for City of Oconomowoc. They will provide technical assistance on identifying CSAs and appropriate management measures in their respective watershed areas. They will also provide some modeling support and work with the Farmer Leadership Group directly.

The largest group of partners consists of those that are not farmers, landowners, or county groups. These consist of engineering consulting firms, lake management districts, MS4's, government bodies, private landowners, land conservation and environmental groups, and universities.

The roles and responsibilities of all OWPP partners are summarized in Table 1.

Table 1. OWPP Partner Roles and Responsibilities

Party	Roles/Responsibilities
City of Oconomowoc Wastewater Utility	The wastewater utility is the lead partner. The City of Oconomowoc will have the contract with the NRCS. All project components will be driven by and approved by the City. The City will provide annual progress reports to NRCS. The City will be the direct recipient of Financial Assistance from NRCS. The City will collect Financial Assistance from other partners for partial reimbursement to support projects. The City will also contract out and pay for Technical Assistance as needed for the project. The City will provide the administration, reporting, and record keeping for this project.
NRCS	The NRCS will have a contract with the City of Oconomowoc and provide Financial Assistance. The NRCS will provide standards to be followed for management measures. The NRCS will receive annual progress reports from Oconomowoc.
Tall Pines Conservancy	Tall Pines will provide direct, in-kind Technical Assistance for the City of Oconomowoc on watershed issues, resource restoration, education and outreach, its land trust program, and legal issues. Tall Pines will coordinate with farmers and lake management groups. Specifically, it will coordinate with the North Lake Management District and its partners for the Mason Creek Improvement Project. They have estimated a Technical Assistance level of $270,000 for this project. Approximately $200,000 of this assistance will be for matching funds for implementation of agricultural land easements under the Agricultural Conservation Easement Program (ACEP).

Party	Roles/Responsibilities
Farmer Leadership Group	The Farmer Leadership Group will provide Technical Assistance, education, training, and outreach for the agricultural community.
Ruekert & Mielke, Inc.	Ruekert & Mielke, Inc. (R/M) will provide Technical Assistance for Oconomowoc on the AM program. R/M will serve as the regulatory specialist for the TMDL and NR 217 rules. R/M will coordinate with MS4's.
Washington County	Washington County will provide direct, in-kind Technical Assistance for Oconomowoc. They will provide Technical Assistance for field-scale management measures and modeling. The County will also serve as a liaison to local farmers.
Jefferson County	Jefferson County will provide direct, in-kind Technical Assistance for Oconomowoc. They will provide Technical Assistance for field-scale management measures and modeling. The County will also serve as a liaison to local farmers.
Waukesha County	Waukesha County will provide direct, in-kind Technical Assistance for Oconomowoc. They will provide Technical Assistance for field-scale management measures and modeling. The County will also serve as a liaison to local farmers.
Clean Wisconsin	Clean Wisconsin will provide Technical Assistance through public education and outreach and will provide strategic planning for the WDNR AM program.
WDNR	The WDNR will coordinate with the City on the AM program for compliance with NR217 as well as efforts to comply with the TMDL for TP and TSS. The WDNR's WisCALMs testing methodology will be followed to access project results. The WDNR existing fish survey and wetland information will be used.
Southeastern Wisconsin Regional Planning Commission (SEWRPC)	SEWRPC will help coordinate and implement the Mason Creek Improvement Project. They will model stream bank improvements upstream of Mason Creek. Working with the North Lake Management District, they will provide direct Technical Assistance to the project.
North Lake Management District	The North Lake Management District will coordinate and implement the Mason Creek Improvement Project.
SEH Consulting Engineers	SEH Consulting Engineers will coordinate with MS4's in the watershed to reduce TSS and TP in the TMDL reaches. They will liaise between MS4 communities and the City of Oconomowoc on RCPP funded projects.
Greener Oconomowoc	Greener Oconomowoc will provide Technical Assistance, education and outreach, publicity, and coordination with the Farmer Leadership Group.
Mid Kettle Partners	Mid Kettle Partners will provide Technical Assistance, education and outreach, publicity, and coordination with the Farmer Leadership Group.

Party	Roles/Responsibilities
Carmelites of Holy Hill	The Carmelites of Holy Hill will provide Financial and Technical Assistance to Oconomowoc for identified projects.
Camp Whitcomb/Mason	This camp owns a significant amount of land on Lake Keesus in Waukesha County and is eager to implement management measures on their property. They will provide Technical Assistance for services, equipment, and tools.
Okauchee Lake Management District	The Okauchee Lake Management District will provide Technical Assistance to Oconomowoc for identified projects. They will provide upstream and downstream water quality monitoring alongside lake monitoring.
Lac La Belle Lake Management District	The Lac La Belle Lake Management District will provide Technical Assistance to Oconomowoc for identified projects. They will provide upstream and downstream water quality monitoring alongside lake monitoring. Lac La Belle will also provide completion of a stream bank restoration project and enforcement of buffer strips with municipalities near streams entering the lakes.
Friess Lake Advancement Association	This lake group may provide Technical Assistance to Oconomowoc for identified projects. They may assist with upstream and downstream water quality monitoring alongside lake monitoring.
Silver Lake Management Group	This lake group will provide Technical Assistance to Oconomowoc for identified projects. They will provide upstream and downstream water quality monitoring alongside lake monitoring.
Town of Oconomowoc	This town will provide Technical Assistance to Oconomowoc for identified projects and provide MS4 representation.
Town of Merton	The town will provide Technical Assistance to Oconomowoc for identified projects and provide MS4 representation. Merton will also be involved with the Mason Creek improvements project.
Village of Merton	This Village will provide Technical Assistance to Oconomowoc for identified projects and provide MS4 representation.
Village of Summit	This Village will provide Technical Assistance to Oconomowoc for identified projects and provide MS4 representation.
Village of Oconomowoc Lake	This Village will provide Technical Assistance to Oconomowoc for identified projects.
Rock River Coalition	This organization will provide Technical Assistance through coordination with the Rock River TMDL.
Erin Meadows Farms	This farm will initiate the Farmer Leadership Group and provide Technical Assistance among the agricultural community.
Town & Country Resource Conservation & Development, Inc.	Town and Country will provide links to Technical Assistance on filter strips and grazing rotation practices.

Party	Roles/Responsibilities
University of Wisconsin (UW) Extension	UW-extension will provide education and outreach as well as Technical Assistance for project. UW-extension is interested in assisting in nutrient management program implementation.
Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP)	WDATCP will provide Technical Assistance for nutrient management planning, farmland preservation program zoning and agreements, farm succession aid, and other general support for farmers.
Clear Water Association	This group will provide public education and outreach as well as Technical Assistance.
Pabst Farms	This landowner will serve as an example for storm water infiltration basins in the watershed. Several large basins of this type were part of their large development. The basins could serve as a model for similar basins in the watershed to reduce runoff.
American Farmland Trust	American Farmland Trust will work with farmers via education and outreach. Also they will collaborate with the Tall Pines Conservancy in the ACEP program to preserve farmland in the watershed.

Communication in the OWPP will depend on the type information to be conveyed and the scale to which it will be communicated. On a broad scale, the City, with help from UW-Extension, Tall Pines Conservancy, Ruekert & Mielke Inc., Clean Wisconsin, Mid Kettle Partners, and Greener Oconomowoc will lead the effort to promote public awareness and education of the OWPP and its objectives. The City will have quarterly meetings to share updates with the OWPP. In addition, a website will be created to share basic information on the OWPP development to the general public and partners.

For more specific information, a document management platform such as Microsoft Office 365 Business Premium will be used. This is a software turnkey type product where storage, servers, troubleshooting, and maintenance is done by a third party. The service is renewable annually, expandable as the partners grow, and allows multiple tiers of information access and manipulation ability. This service will also allow partners to collaborate through document sharing, review, and development.

Communication associated with management measure implementation will be led by the City working in conjunction with the Farmer Leadership Group. Communication at this level will include targeted CSAs, specific management measure implementation, and project timelines. Communication will also include the status of annual compliance activities for management measures already implemented. Using the document management software, this detailed information will be available to the Farmer Leadership Group and other designated partners. Monthly meetings will take place for this set of partners, with more frequent meetings as an option if needed. When appropriate, guests will be invited to these meetings. For example, landowners, farmers, and county LWC Department staff would be invited to meetings covering details of specific management measure implementation projects. The majority of the work in the OWPP will take place at this level.

Communication for practices such as wetland restoration and stream bank stabilization will be led by the City in conjunction with participating engineering consulting firms, lake management districts, MS4's, government bodies, private landowners, land conservation and environmental groups, and universities. Meetings will occur as needed for this set of activities. The attendees of these meetings will be determined by the type of activity involved. For example, for a wetland restoration project, the Wisconsin DNR and SEWRPC would both be included. This set of partners would also have access to project-document management software.

DESCRIBE THE WATERSHED AND SET LOAD REDUCTION GOALS

The action area in the OWPP is the Oconomowoc River Watershed. Most of the priority CSAs are in western Waukesha County and eastern Jefferson County due to their proximity to the point of compliance; however, Washington County also has several large areas where management measures will be effective in improving water quality. Improvements made to these areas will benefit the many lakes in the watershed, serve as examples of conservation practices to the surrounding community, and will help in the long term sustainability of reducing phosphorus.

Map 1 in Appendix B shows the watershed as well as the surface water details, county boundaries, twelve digit Hydrologic Unit Code (HUCs) areas, impaired waters, major highways and interstates, municipal boundaries, the Oconomowoc wastewater utility monitoring points, dam locations, and WWTF locations in the proximity of the watershed. The WDNR Pollutant Ratio Estimation Tool (PRESTO) indicates that 70 percent of the TP load in the Oconomowoc River watershed is from non-point sources and 30 percent is from point sources – namely the Oconomowoc WWTF. The Oconomowoc WWTF is the only WPDES permittee in the watershed. The watershed includes a number of municipalities including the Town of Erin, Town of Merton, Town of Richfield, Town of Oconomowoc, Town of Concord, Village of Slinger, Village of Hartland, Village of Nashotah, Village of Merton, Village of Chenequa, Village of Lac La Belle, Village of Oconomowoc Lake, City of Oconomowoc, and the Village of Summit. Tables 2 through 5 describe each HUC-12 area in the action area.

Table 2. AM Action Area Description for Plan Development

HUC and Watershed Name	**Total Area of Watershed**	
070900010501 Oconomowoc River	**Acres**	**Square Miles**
	36,003	56.2
County	**Area of Watershed in the County**	**Percentage of Watershed Within the County**
Washington	28,646	80%
Waukesha	7,357	20%
What watershed scale was used to develop the action area? ☒ Full HUC 12 ☐ Portion of the HUC 12 ☐ Based on TMDL Reach ☐ Other		

Table 3. AM Action Area Description for Plan Development

HUC and Watershed Name	Total Area of Watershed	
070900010502 Oconomowoc River	**Acres**	**Square Miles**
	19,059	29.8
County	**Area of Watershed in the County**	**Percentage of Watershed Within the County**
Waukesha	16,229	85%
Washington	2,427	13%
Dodge	403	2%
What watershed scale was used to develop the action area? ☒ Full HUC 12 ☐ Portion of the HUC 12 ☐ Based on TMDL Reach ☐ Other		

Table 4. AM Action Area Description for Plan Development

HUC and Watershed Name	Total Area of Watershed	
070900010503 Oconomowoc River	**Acres**	**Square Miles**
	11,953	18.7
County	**Area of Watershed in the County**	**Percentage of Watershed Within the County**
Waukesha	11,621	97%
Jefferson	332	3%
What watershed scale was used to develop the action area? ☒ Full HUC 12 ☐ Portion of the HUC 12 ☐ Based on TMDL Reach ☐ Other		

Table 5. AM Action Area Description for Plan Development

HUC and Watershed Name	**Total Area of Watershed**	
070900010504 Oconomowoc River	**Acres**	**Square Miles**
	16,735	26.1
County	**Area of Watershed in the County**	**Percentage of Watershed Within the County**
Waukesha	9,360	56%
Jefferson	7,375	44%

What watershed scale was used to develop the action area?

☒ Full HUC 12
☐ Portion of the HUC 12
☐ Based on TMDL Reach
☐ Other

The Oconomowoc River Watershed is a sub-watershed of the Rock River Watershed, both of which are located in the Mississippi River basin. The Oconomowoc River Watershed has a large amount of lakes. Waukesha County contains all or portions of 33 major lakes with a combined surface area of approximately 14,000 acres (21.9 square miles), or about 3.8% of the total area of the County. This area represents about 38% of the combined surface area of the 101 major lakes in the seven-county Southeastern Wisconsin Region, which is larger contribution than any other county in the region. In addition, much of the Oconomowoc River Watershed is considered a high ground water recharge area designated by the SEWRPC. The Oconomowoc River generally flows in a southwesterly direction and passes through six lakes and two mill ponds. West of the City of Oconomowoc, the river flows west and north to the confluence with the Rock River. The Rock River eventually joins the Mississippi River through the State of Illinois.

The Rock River is impaired and identified on the EPA 303 (d) list for TSS and TP. The Oconomowoc River Watershed also contains several surface waters which are impaired including Flynn, Battle and Mason Creeks. In addition, the WDNR's 2014 list of proposed impaired water bodies to the EPA includes three lakes in the watershed: North Lake, Friess Lake, and Okauchee Lake.

Several of the lakes within the action area have lake management districts or some public organization with a mission to protect and rehabilitate a specific inland lake; for example, the North Lake Management District. These lake management groups will serve as partners in management measure implementation in order to support the OWPP objectives of improved water quality and a reduction of soil loss. Public inland lake protection and rehabilitation districts are bodies governed by a Board of Commissioners and a voting membership. These organizations are created for the purpose of undertaking lake protection programs in the surrounding area. These organizations may sue or be sued, make contracts, accept gifts, purchase, lease, devise or otherwise acquire, hold, maintain or dispose of property, disburse

money, contract debt, and do any other acts necessary to carry out a program of lake protection and rehabilitation.

The watershed also includes an Agricultural Enterprise Areas (AEA). The AEA program is a voluntary program supported by the State of Wisconsin, Department of Agriculture, and WDATCP. The program is open to farmers who implement and maintain good land use practices. In return, farmers receive assurance that surrounding land will be protected from development. Approximately 27,000 acres in the watershed in Waukesha and Dodge Counties are already in this program.

The City has been proactive in establishing baseline monitoring information. The United States Geological Survey (USGS) was contracted to estimate the flow rates at the WWTF outfall and at the confluence with the Rock River. The flow Data is shown in Tables 6 and 7 below.

Table 6. Flow Characteristics at the WWTF Outfall

	Flow (cfs)	**Flow (MGD)**
Annual Average Flow	97	62.76
7Q10	2.1	1.36
7Q2	7.7	4.98

Table 7. Flow Characteristics at the Confluence with the Rock River

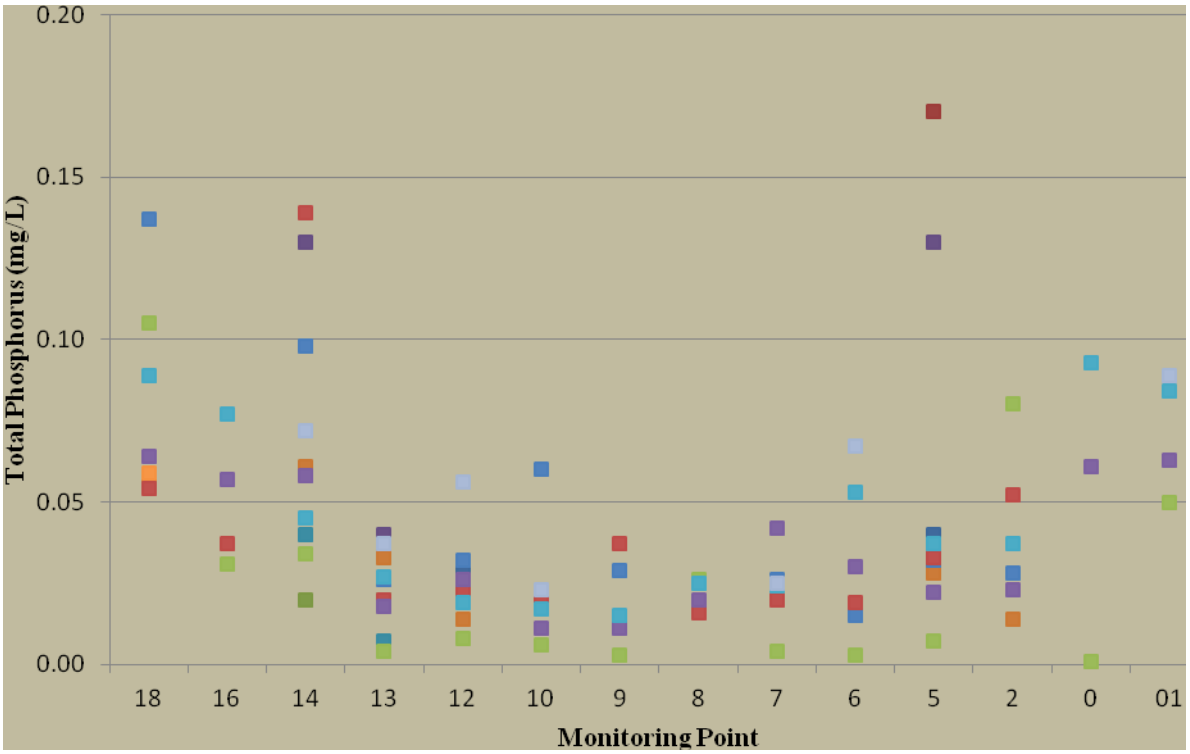
	Flow (cfs)	**Flow (MGD)**
Annual Average Flow	119	76.99
7Q10	2.7	1.75
7Q2	9.6	6.21

WWTF staff have also monitored numerous points in the watershed in recent years for TP. This data is shown in Appendix C. The monitoring location numbers in Appendix C correspond to the monitoring numbers shown in Map 1 in Appendix B. Upstream of the WWTF, the TP concentration in the river and the lakes is generally less than 0.1 mg/L. There is a noticeable increase in TP concentration just downstream of the WWTF outfall discharge (Monitoring Point 14). The TP concentration at the confluence (Monitoring Point 18) ranges from 0.054 to 0.137 mg/L in the 2014-2015 dataset. The average of the concentration at the confluence from April of 2013 to the present is 0.08 mg/L. The results from the City sampling at the confluence are summarized in Table 8 below, and the full set of official data are shown in Figure 1. This data is organized with the confluence on the left, and upstream data to the right. Only monitoring results taken directly from the Oconomowoc River are shown.

Table 8. Sampling Results at the Confluence of the Oconomowoc River and the Rock River

Sampling Date	Result (mg/L)
07/30/2014	0.056
08/12/2014	0.137
09/16/2014	0.054
10/16/2014	0.105
11/13/2014	0.064
12/15/2014	0.089
01/02/2015	0.059

Figure 1. Official Monitoring Data



The WDNR provided monitoring data for the Oconomowoc River from the Surface Water Integrated Monitoring System (SWIMS) database. The SWIMS data did not include the location of the confluence of the Oconomowoc River and the Rock River. The nearest sample location was at the West River Drive bridge approximately 2.6 river miles upstream of the confluence. There are nine TP monitoring points at this location and they were all sampled from 2007 to 2008. The TP concentrations at this location range from a minimum value of 0.026 mg/L to a maximum value of 0.182 mg/L. The average value of these nine data point is 0.0687 mg/L.

Initially, TP will be the only pollutant considered in the OWPP. TSS will not be addressed directly. However, TSS reduction will be achieved in the process of reducing TP by reducing levels of particulate phosphorus in the action area. For the City of Oconomowoc MS4, it is anticipated that minimal efforts will be needed to reach the required TSS reduction levels in its storm water permit. The City has been very proactive in addressing storm water pollution in the last 10 to 15 years. Since the City can take credit for all storm water pollutant control activities and facilities implemented since 2004, the required further reductions are expected to be marginal. The soil in the watershed, especially the City of Oconomowoc area, is sandy and coarse and has a high infiltration rate. This soil characteristic helps reduce runoff from urban storm water. Future storm water modeling efforts will show exactly what the required amount of TSS reduction will be. If it is determined that TSS removal will be a benefit to all partners, it will be added to the OWPP plan.

The load reduction target for TP at the confluence of the Oconomowoc River and the Rock River is determined using the following equation:

Load Reduction = Oconomowoc River annual average flow (MGD)*8.34*(0.08 mg/L-0.075 mg/L)*365 days/year

The 0.08 mg/L TP value is taken from the average of the City monitoring values since April of 2013 at the confluence with the Rock River. With the annual average flow of the Oconomowoc River at the confluence of 76.99 MGD from the USGS, the existing TP concentration of 0.08 mg/L, and the water quality standard of 0.075 mg/L, the phosphorus load reduction target equals 1172 pounds per year. This value will be used in the OWPP as the target reduction in TP.

CONDUCT A WATERSHED INVENTORY

Conducting a watershed inventory is an important step in better understanding the action area to be affected by the AM program. This step will allow OWPP stakeholders to make informed decisions about specific actions to be taken in the watershed to improve water quality. The watershed inventory will help identify important and unique features of the Oconomowoc River Watershed and organize this information in way that summarizes a large amount of relevant data in a manageable format. Input from project partners and stakeholders as well as Geographic Information System (GIS) software were used to obtain much of the data presented in this section, including the watershed boundary, streams, rivers, and surface water information, impaired waterways, TMDL reaches, soils data, land use statistics, zoning information, as well as other relevant information to the inventory. This information was then able to help identify sources of watershed impairment and direct efforts of water quality monitoring and remediation, as will be explained later in this document.

The Oconomowoc River Watershed is a relatively large action area for water quality improvements. The watershed is approximately 84,000 acres (130 square miles) which encompasses land distributed in four counties in southeast Wisconsin as shown in Table 9 below.

Table 9. Oconomowoc River Watershed Land Area Distribution by County

County	Approximate Land Area (acres)
Dodge	400
Jefferson	7,725
Washington	31,075
Waukesha	44,575

Map 2 in Appendix B shows an aerial view image of the Oconomowoc River Watershed with surface water designations. The watershed's northern boundary is near Slinger, WI in Washington County where the Coney River system flows south and joins with the Oconomowoc River. The Oconomowoc River then flows southwest through Friess Lake, Little Friess Lake, and Lowes Lake before being joined by Flynn Creek just north of the Washington County line. Other bodies of water in the Washington County portion of the Oconomowoc River Watershed include Hickey Lake, Beck Lake, McConville Lake, Malloy Lake, Murphy Lake, Werner Pond, and several other smaller lakes and ponds. In total, the Washington County portion of the action area has approximately 400 acres of surface water.

The small portion of the watershed that is in Dodge County does not contain any significant streams, rivers, or bodies of water. After leaving Washington County, the Oconomowoc River continues to flow southwest across the Waukesha County line, through the Monches Millpond and into North Lake. Both the Little Oconomowoc River and Mason Creek similarly flow into North Lake from the north (Mason Creek is one of two Class 1 trout streams in the watershed, the other being Rosenow Creek). After flowing west out of North Lake, the Oconomowoc River flows through a series of lakes northeast of the City of Oconomowoc including Okauchee Lake, Upper Oconomowoc Lake, Oconomowoc Lake, Fowler Lake, and Lac La Belle (Rosenow Creek also flows into Lac La Belle from the east). Next, the river continues south and west out of the City of Oconomowoc and across the Jefferson County line. Other notable water bodies in the Waukesha County portion of the watershed include Lake Keesus, Silver Lake, Laura Lake, Tierney Lake, Cornell Lake, Beaver Lake, Grass Lake, Florence Lake, Forest Lake, Moose Lake, Pine Lake, Round Lake, Garvin Lake, Sybil Lake, Tamarack Lake, and Crystal Lake. This portion of the watershed contains approximately 5900 acres of surface water, which is the largest amount in the Oconomowoc River Watershed.

After crossing the Jefferson County line, the Oconomowoc River is joined by Battle Creek from the south and continues to flow west. Near the crossing with Highway F, the Oconomowoc River turns northwest and eventually joins the Rock River at the outlet of the watershed. The confluence of the Rock and Oconomowoc Rivers is the point of compliance for the OWPP. Other bodies of water in the Jefferson County portion of the watershed include Mud Lake and Round Lake, with the surface water in this portion totaling 145 acres. According to the WDNR, 41% of the fish and aquatic life in the rivers and streams throughout the entire action area are considered in poor condition.

There are several documented dams in the action area. The table below shows information regarding these dams, which are in order from upstream to downstream. The data shown is provided by the WDNR Surface Water Data Viewer, and dam locations are indicated on Map 1 of Appendix B. Note that several monitoring stations are located at dam sites.

Table 10. Dam Information for the Oconomowoc River Watershed

No.	Dam	Adjacent River System	County	Key Seq. No.	Field File No.	Size	Hydraulic Height (ft.)
1	Richfield Dam	Coney River	Washington	4443	66.09	Small	24.0
2	Monches (Burgs) Dam	Oconomowoc River	Waukesha	326	67.14	Large	11.0
3	Lake Keesus Dam	Oconomowoc River	Waukesha	1568	67.34	Small	1.0
4	Beaver Lake Outlet	-	Waukesha	1567	67.32	Small	1.0
5	Okauchee Lake (Upper Oconomowoc) Dam	Oconomowoc River	Waukesha	220	67.42	Large	12.0
6	Oconomowoc Lake (Danforth) Dam	Oconomowoc River	Waukesha	1029	67.26	Large	1.0
7	Peacock (Fowler Lake) Dam	Oconomowoc River	Waukesha	650	67.17	Large	7.0
8	Lake Labelle Dam	Oconomowoc River	Waukesha	1570	67.39	Small	1.0

The topography of the Oconomowoc River Watershed generally slopes from higher elevations in the northeast to lower elevations near the confluence of the Oconomowoc and Rock Rivers. The headwaters of the Oconomowoc River in the Village of Richfield have an approximate elevation of 980 feet. The elevation drops to about 860 feet at the outlet of Lac La Belle in the City of Oconomowoc, 850 feet at the WWTF outfall, and 840 feet at the confluence with the Rock River. The greatest elevation change thus occurs from the northeast part of the watershed to the area near the City of Oconomowoc, which is a relatively low point in the watershed as reflected in the high density of surface water bodies.

Soils data for the watershed was obtained using the Soil Survey Geographic Database (SSURGO) in conjunction with GIS. Several relevant types of soil information were obtained from the database, including the total area occupied by each soil type, soil erosion characteristics of the soils, and soil drainage and flooding information. See Appendix D for the complete soil information table for the Oconomowoc River Watershed.

There are 167 varieties of soils at various slopes represented in the Oconomowoc River Watershed. Soils that populate over 2% of the total land area are listed in Table 11. Loams and silty loams are the most prevalent soil types in the area, with a considerable amount of poorly drained hydric soil (Houghton muck) typical of floodplains and lake plains.

Table 11. Largest Represented Soils by Area in the Oconomowoc River Watershed

Soil Symbol	Soil Name	Area (ac)	% Cover
FsB	Fox silt loam, 2 to 6 percent slopes	8688.9	10.4%
FsA	Fox silt loam, 0 to 2 percent slopes	6055.0	7.2%
ThB	Theresa silt loam, 2 to 6 percent slopes	4997.1	6.0%
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	4121.4	4.9%
ThB2	Theresa silt loam, 2 to 6 percent slopes, eroded	2995.4	3.6%
Hu	Houghton muck	2990.4	3.6%
CrE	Casco-Rodman complex, 20 to 30 percent slopes	2961.0	3.5%
CeC2	Casco loam, 6 to 12 percent slopes, eroded	2487.6	3.0%
HmD2	Hochheim loam, 12 to 20 percent slopes, eroded	2294.8	2.7%
HtA	Houghton muck, 0 to 2 percent slopes	2167.5	2.6%
MmA	Matherton silt loam, 0 to 3 percent slopes	2141.2	2.6%
CeD2	Casco loam, 12 to 20 percent slopes, eroded	2134.8	2.5%
SeA	St. Charles silt loam, gravelly subtratum, 0 to 2 percent slopes	1931.1	2.3%
Sm	Sebewa silt loam	1752.1	2.1%

Several key characteristics of soil have implications for water quality. These soil characteristics are included in Appendix D. First, the general erodibility of the soils is a good indication of how susceptible different types of soil are to releasing particulate phosphorus to nearby surface waters. Soil erodibility is described by many factors provided by SSURGO, but most importantly by the whole soil erosion factor K_w and the ground slope. The soil erosion factor quantifies the tendency of soil particles to detach from their surrounding, as well as their ability to be transported by water, while accounting for the amount of rocks in a given soil. This factor is an important empirical coefficient in a number of soil loss estimation models such as the Universal Soil Loss Equation (USLE) and the Revised USLE (RUSLE). It is a function of the soil's texture, structure, organic matter content, and permeability. In general, then, K_w values will improve with anything that enhances infiltration into the soil, impedes the transport of runoff, or improves the natural cohesion of soil particles. Values of K_w range from 0.02 to 0.69, with higher values indicating a greater propensity for the soil to erode. Another factor contributing to soil erosion provided by SSURGO is the ground slope. Greater soil slopes lead to greater risk of soil detachment and transport due to the increased velocity of runoff over the surface.

The watershed contains predominantly high-rated K factor soils. Figure 2 below illustrates this distribution based on the area of land that each type of soil occupies. In addition, Map 3 in Appendix B shows a map of the Oconomowoc River Watershed with the different soil plots shaded based on K value. The darker blue and yellow indicate larger K_w values and a greater risk of soil erosion. Many of the areas with greatest risk of soil erosion are northeast of Oconomowoc near Mason Creek, the Little Oconomowoc River, and Flynn Creek. However, there are some areas of high erosion risk around Battle Creek and the area south of the confluence of the Oconomowoc and Rock rivers, which may provide critical opportunities for runoff mitigation near the point of compliance.

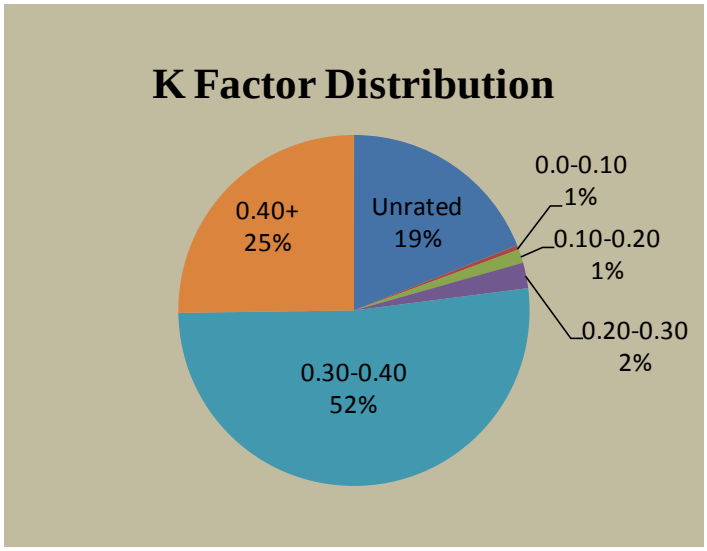


Figure 2. K_w Factor Distribution by Land Area for the Oconomowoc River Watershed

The SSURGO data also includes a soil description giving a class of accelerated erosion which is shown in Figure 3. The classes of accelerated erosion describe the amount of soil that has been removed from the upper horizons of the soil profile. Class A describes sheet erosion where less than 25% of the upper soil has been eroded. Class B describes 25-75% soil removal, and Class C describes soil erosion greater than 75% that usually occurs when deep rill or gullies form on sloped fields. A third rating, "None – deposition", describes soil which is not prone to transport off site. Unfortunately, the majority of the soils in watershed were unrated, giving a limited picture of the extent of existing soil erosion in the action area. This limitation emphasizes the need for site exploration and windshield surveys which will be described later in this document.

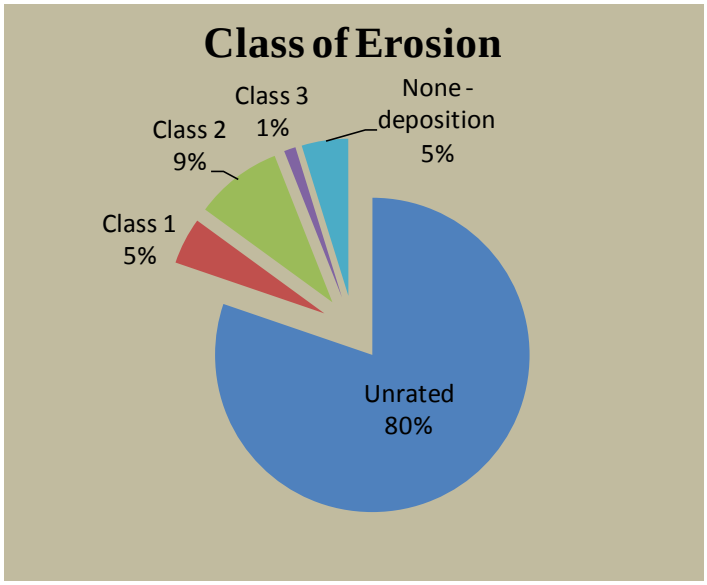


Figure 3. Distribution of Erosion Classes by Land Area for the Oconomowoc River Watershed

The ability for soil to either drain or retain water is another important factor in understanding the behavior of water in a watershed. The SSURGO data provides a number of soil descriptions

along these lines as well, most important of which are the soil hydric rating and the hydrologic soil group. Hydric soil is soil that is saturated with water for all or parts of the year, characteristic of soils found in wetlands or floodplains. This frequent saturation leads to a lack of oxygen in the soil (anaerobic conditions) which promotes the growth of wetland vegetation and species. Hydric soils maintain their physical characteristics even when converted to farmland, keeping these areas prone to water accumulation.

The hydrologic soil group system was developed by the NRCS to describe the infiltration rate of water into the ground by dividing soils into four categories: A, B, C, and D. Class A is characterized by high infiltration rates and low runoff potential, while Class D consists of soils with low infiltration and high risk of runoff and soil transport. Class A soils are typically sandy or granular, Class B soils are silts and loams, Class C soils are sandy clay loams, and Class D soils have high contents of clayey soils or a high water table. If two classes are listed, the first letter describes the soil if it is drained by a man-made drainage system while the second letter describes the soil in its natural state.

In the Oconomowoc River Watershed, about 20% of the soil is hydric (17,200 acres) with the rest being non-hydric or unrated. Figure 4 below illustrates the distribution of hydrologic soil groups in the watershed by area. The results show the majority of the soil is Class B, which is intuitive given the large amounts of silt loam in the area. There is also a considerable amount of less drainable soil in Classes C and D, with a potential for more poorly drained soil depending on the drainage condition of the dual classifications. Map 4 of Appendix B shows both hydrologic soil group ratings and the location of hydric soils.

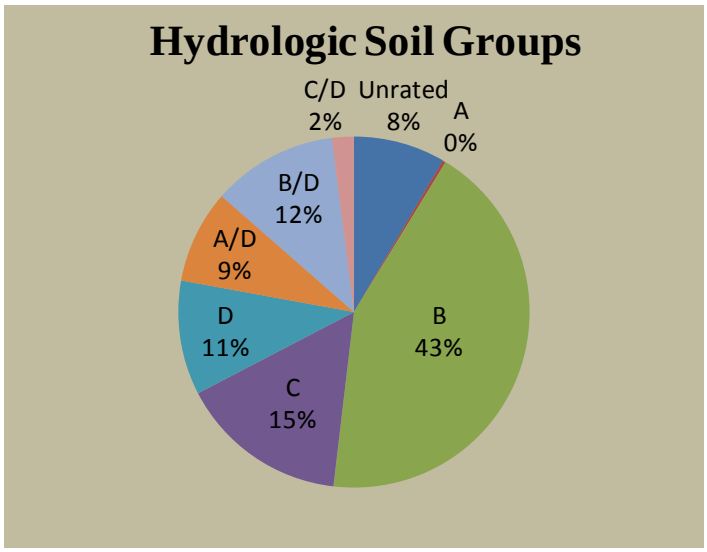


Figure 4. Hydrologic soil group distribution in the Oconomowoc River Watershed

Other SSURGO data that is presented in Appendix D includes the general drainage condition and flooding frequency of the soils listed. Over 80% of the soils were not rated to flood or to rarely flood, with only 3% of the soils rated to flood occasionally or frequently. Table 12 shows the ratings of drainage condition by area. These supporting soil descriptions indicate that the

majority of the watershed is not a risk of flooding, while there is a significant portion of soils that present a risk of overland water flow and erosion.

Table 12. Drainage Condition of the Soils in the Oconomowoc River Watershed

Drainage Condition	Area (ac)	% Cover
Very poorly drained	9512.5	11.4%
Poorly drained	5269.2	6.3%
Somewhat poorly drained	5451.6	6.5%
Moderately well drained	1351.4	1.6%
Well drained	44634.6	53.3%
Somewhat excessively drained	10716.8	12.8%
Excessively drained	47.8	0.1%
Unrated	6765.8	8.1%

The National Land Use Database (NLCD) was used to assess land use in the action area. Map 5 in Appendix B shows the land use map for the watershed, and Table 13 summarizes land use information and agricultural statistics in a tabular format (agricultural statistics were provided by county LWC Departments). In addition, Maps 6 and 7 in Appendix B illustrate the locations of wetlands and floodplains in the action area. Over half of the land use in the watershed consists of croplands or grasslands, with the majority of croplands consisting of typical row crop rotations. Due to the prevalence of dairy farming in the area, there is also a significant amount of forage crops in the action area. Approximately half of the existing cropland is not tilled at any point during the year, while about 35% of the cropland is conventionally tilled. About 16% of the land consists of forests, 13% of the land consists of wetland-type vegetation, and 7.5% of the land is open water. 6% of the land area is developed, with the majority of residential and urban area near the City of Oconomowoc. The majority of livestock in the watershed are dairy cows (49%), with a sizeable portion of beef cattle and horses.

Table 13. AM Land Use Overview

Current Land Use				
Land Use	**Approximate Land Cover (ac)**	**Approximate Land Cover (%)**	**Typical Impervious Fraction/Runoff Coefficient[1]**	**Approximate Impervious Area in Watershed**
High Density Urban	1,428	1.7%	0.7	1.2%
Low Intensity Urban	2,992	3.6%	0.3	1.1%
Golf Course	699	0.8%	0.2	0.2%
Primary Row Crops	4,113	4.9%	0.1	0.5%
Corn	12,545	15.0%	0.1	1.5%

[1]Runoff coefficients are used in the rational equation, which is one of the simplest methods to determine peak discharge from drainage basin runoff. These values are provided as a general approximation for decision-making purposes and should be modified as appropriate.

Table 13. AM Land Use Overview (continued)

Current Land Use				
Land Use	**Approximate Land Cover (ac)**	**Approximate Land Cover (%)**	**Typical Impervious Fraction/Runoff Coefficient[2]**	**Approximate Impervious Area in Watershed**
Other Row Crops	3,381	4.0%	0.1	0.4%
Forage Crops	14,510	17.3%	0.1	1.7%
Grassland	11,813	14.1%	0.1	1.4%
Mix/Other Coniferous	1,321	1.6%	0.1	0.2%
Oak	1,278	1.5%	0.1	0.2%
Mixed/Other Broad-Leaved Deciduous	10,841	12.9%	0.1	1.3%
Open Water	6,244	7.5%	0.0	0.0%
Emergent/Wet Meadow	3,325	4.0%	0.08	0.3%
Lowland Shrub (Broad-Leaved Deciduous)	2,506	3.0%	0.08	0.2%
Lowland Shrub (Broad-Leaved Evergreen)	151	0.2%	0.08	0.0%
Lowland Shrub (Needle-Leaved)	141	0.2%	0.08	0.0%
Forested Wetland (Broad-Leaved Deciduous)	4,602	5.5%	0.08	0.4%
Forested Wetland (Coniferous)	327	0.4%	0.08	0.0%
Forested Wetland (Mixed Deciduous/Coniferous)	65	0.1%	0.08	0.0%
Barren	1,296	1.5%	0.2	0.3%
Shrubland	203	0.2%	0.2	0.0%
Total	**83,782**	**100.0%**		**11.0%**

Description of Cropping Practices		
Common Rotations	**Approximate Land Cover (ac)**	**Approximately Land Cover (%)**
Corn-Soybean	9,768	45.3%
Hayland	2,556	11.9%
Dairy Rotation	2,171	10.1%
Corn-Oats-Hay (5 Year)	1,776	8.2%
Row-Grain-Hay (7 Year)	1,754	8.1%
Corn-Soybean w/Cover Crop	1,332	6.2%
Row-Grain-Hay (6 Year)	1,116	5.2%
Corn-Soybean-Wheat	957	4.4%
Continuous Corn	82	0.4%
Potato-Grain-Vegetable	36	0.2%
Total	**21,548**	**100.0%**

[2]Runoff coefficients are used in the rational equation, which is one of the simplest methods to determine peak discharge from drainage basin runoff. These values are provided as a general approximation for decision-making purposes and should be modified as appropriate.

Table 13. AM Land Use Overview (continued)

Tillage Practices	
Common Rotations	**Approximate Land Cover (ac)**
No-till (ac)	10,072
Conservation Tillage (30% or more) (ac)	2,643
Conventional Tillage (less than 30%) (ac)	6,999
Unknown (ac)	1,834
Livestock Density	
	Approximate Number of Animas in Watershed
Dairy	1,545
Beef	833
Horses	625
Poultry	20
Pork	10
Other	145
Total	3,178

The zoning maps for Jefferson and Waukesha Counties were reviewed to compare existing land use with potential future land use. Information provided by Jefferson and Waukesha Counties indicated how land use could change near some of the larger cities and areas where management measures will be implemented. Based on this exercise, land use in Jefferson County is not expected to change significantly and there will not be significant development. For Waukesha County, the City of Oconomowoc Zoning Map was reviewed. The zoning map indicated several areas designated "urban reserve" along the western edge of the City of Oconomowoc at the Waukesha County line as well as in the southwestern and northeastern parts of the City. This zoning designation denotes land that is in transition between urban and rural areas, and has the potential to be zoned for industrial or residential use in the future. The urban reserve areas on the southwestern part of the City are the most important to monitor in the future as many lots are adjacent to the Oconomowoc River flowing south out of Lac La Belle. The area east and northeast of the City of Oconomowoc consists of the Oconomowoc, Okauchee and North Lakes. These lakes already have significant development at or near the shoreline. Okauchee Lake in particular has significant development that extends thousands of feet from its northern and western borders. It is anticipated that the northern half of Okauchee Lake will be served with a sanitary sewer system in the future.

There are several secondary projects and objectives associated with the OWPP that will be occurring alongside agricultural management measures as a part of the AM program. One of these secondary objectives is to reduce known runoff problems in the watershed. There has been severe soil deposition in North Lake in the area where Mason Creek enters the lake. This has been a well-documented problem for many years. The Rock River TMDL identified the area tributary to Mason Creek as extremely high in background non-point baseline TSS and TP loading per acre. There is also evidence of stream bank erosion along Mason Creek. Several OWPP partners have partnered the Mason Creek Project. The Town of Merton, Village of Merton, North Lake Management District, Tall Pines Conservancy, and SEWRPC have been organizing to address this problem for the past several years. Also, SEWRPC is in the process of applying for an Environmental Protection Agency (EPA) 319 grant to address the soil erosion

tributary to Mason Creek. Through coordination with the OWPP, additional resources may be brought to this area.

The restoration of degraded habitat for fish and wildlife in the watershed is another secondary objective. One way to reduce phosphorus runoff from agricultural lands is to restore wetlands. Waukesha and Washington counties have identified areas where wetland restoration is possible. Increased wetland areas will allow birds, waterfowl, and other wildlife to depend on these lands for their habitat.

Another secondary objective of the OWPP is to save energy through the application of municipal biosolids from wastewater treatment facilities on agricultural land. The Oconomowoc Wastewater Utility can directly help with this objective as a source of fully digested, safe, and stable biosolids that have a high level of nitrogen and P. Through this program, additional farmers in the watershed will be made aware of this resource. Farmers can save money by using biosolids instead of traditional fertilizers to condition their soils. Per WAC, biosolids applied to farm field must be incorporated in the ground as it is applied. This reduces any possibility that the nutrients from the biosolids could runoff. Using biosolids as a natural fertilizer reduces energy consumption as traditional fertilizer production is energy and water intensive.

Several partners involved in the OWPP see the potential benefits of improved lake health and water quality through this project as a secondary objective. Concerns for the lakes in the action area include the clarity of the water, health of habitat for fish and other aquatic organisms, and weed control. With reduced TSS and TP, the water quality in the lakes should be improved. This in turn may reduce the need for extensive weed harvesting that several of the lakes need to conduct for boating purposes.

The last secondary objective is farmland preservation. The Tall Pines Conservancy is a key partner in the OWPP. This land trust works to provide deed restrictions to prevent farm land from becoming developed into a different land use. Land trusts are an essential tool to preserving the rural character of many of the townships in the watershed. Waukesha County in particular has experienced development pressure and the loss of high quality farm land. Typically these deed restrictions have requirements that sound conservation practices are in place and working to reduce soil and nutrient runoff. In this way the objectives of the AM program and farmland preservation are common.

IDENTIFY WHERE REDUCTIONS WILL OCCUR

CSAs for agricultural lands were identified in a variety of ways depending on the county staff members involved.

In Jefferson County and western Waukesha County, a preliminary list of sites was compiled by using orthophotography overlaid with topographic maps. Areas with steeper slopes and minimal natural buffer between farmland and the river were identified. The City of Oconomowoc then contracted with Ken Denow, a soil scientist formerly with the WDNR, to conduct a windshield survey of these areas and other areas nearby. Through this windshield survey, a general understanding of the soil types, crop rotations, and drainage patterns was obtained for the identified sites.

In Waukesha County, GIS was first used to identify cropland areas within 750 feet of surface waters. The then county analyzed these areas using soil and maps, and orthophotography overlaid with topography information to further refine areas for phosphorus runoff reduction potential.

Washington County had very specific information on areas for runoff and phosphorus reduction potential. The lands identified in Washington County were further refined using orthophotography overlaid with topography information. One of the OWPP's core partners runs Erin Meadows Farms, a sizeable operation in Washington County. He was able to identify improvements on his land and his neighbors' lands. This partner has also expressed interest in being one of the initial sites where management measures will be implemented in the OWPP.

Maps 8 and 9 in Appendix B show the CSAs in the action area. Map 8 shows the southwest portion of the watershed. Map 9 shows the northeast portion of the watershed. Two maps were needed to show the areas for phosphorus reduction potential at a usable scale. Each CSA has a unique identification number.

Table 14 below further describes the CSAs compiled for the action area. The numbers in the table correspond to the numbers in Maps 8 and 9 of Appendix B.

Table 14. OWPP CSAs and Management Measures.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
1	Jefferson, Ixonia	43.113245, -88.619499	Cropland	5	Nutrient management; additional buffer; conservation tillage; cover crop.	Small field near the confluence of the Rock and Oconomowoc Rivers.
2	Jefferson, Ixonia	43.112620, -88.616174	Cropland	20	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Field slopes to Oconomowoc River at two different points.
3	Jefferson, Concord	43.098922, -88.612055	Cropland	40	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Multiple areas of the field are adjacent to the river with minimal buffer.
4	Jefferson, Concord	43.097767, -88.617280	Cropland	65	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Direct runoff conduits to river; additional buffer necessary.
5	Jefferson, Concord	43.094727, -88.608983	Cropland	50	Nutrient management; additional buffer; reroute field drain; conservation tillage; cover crop.	Crops adjacent to river; drainage ditch ties directly into the river.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
6	Jefferson, Concord	43.097375, -88.602579	Cropland	90	Nutrient management; additional buffer; conservation tillage; cover crop.	Offshoot of Oconomowoc River near the confluence is surrounded by highly erodible soil. Further site investigation needed to understand drainage pattern.
7	Jefferson, Concord	43.086521, -88.602593	Cropland	60	Nutrient management; additional buffer; reroute field drain; conservation tillage; cover crop.	Field drains directly to the river; possible dairy pasture next to river.
8	Jefferson, Concord	43.087677, -88.602350	Cropland	45	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Signs of erosion around the source of an ephemeral stream connecting to the Oconomowoc River.
9	Jefferson, Concord	43.072235, -88.607279	Cropland	30	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Signs of erosion around the source of an ephemeral stream connecting to the Oconomowoc River.
10	Jefferson, Concord	43.072616, -88.593707	Cropland	10	Nutrient management; additional buffer; conservation tillage; cover crop.	Minimal buffer to adjacent stream.
11	Jefferson, Concord	43.068217, -88.591901	Cropland	15	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Minimal buffer to adjacent stream; signs of erosion to stream location.
12	Jefferson, Concord	43.062866, -88.607689	Cropland	30	Nutrient management; rotate contours 45 degrees; additional buffer; conservation tillage; cover crop.	Offshoot of Oconomowoc River south of the interstate is surrounded by moderate to highly erodible soil. Field drains directly into stream.
13	Jefferson, Concord	43.067926, -88.569931	Cropland	125	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	Minimal buffer to adjacent stream/drainage network; signs of erosion to stream; highly erodible soil in the area.
14	Jefferson, Concord	43.081950, -88.574255	Cropland	10	Nutrient management; additional buffer; rotate contours 90 degrees; conservation tillage; cover crop.	Small areas of field adjacent to Oconomowoc River.
15	Jefferson, Concord	43.078592, -88.558061	Cropland	35	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Relatively steep slope to the confluence of Battle Creek and Oconomowoc River.
16	Jefferson, Concord	43.063890, -88.557820	Cropland	65	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	Minimal buffer to adjacent stream/drainage network; signs of erosion to stream.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
17	Jefferson, Concord	43.082165, -88.548016	Cropland	25	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	Signs of erosion to drainage ditches on west and south sides of the field; ditches drain to both Oconomowoc River and Battle Creek.
18	Jefferson, Concord	43.088621, -88.553319	Cropland	30	Nutrient management; additional buffer; reroute drainage; conservation tillage; cover crop.	Field adjacent to the river; contains highly erodible soil types.
19	Jefferson, Concord	43.088530, -88.541900	Cropland	20	Nutrient management; additional buffer; reroute drainage; conservation tillage; cover crop.	Field adjacent to the river; contains highly erodible soil type; some field drainage appears to tie into the Oconomowoc River.
20	Waukesha, Summit	43.092539, -88.535525	Cropland	20	Wetland restoration; nutrient management; additional buffer; reroute field drains; conservation tillage; cover crop.	Soybean field with hydric soils (high flooding potential) close to the river; field drains directly to river.
21	Waukesha, Summit	43.096515, -88.537801	Cropland	30	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	Several signs of erosion to river; significant field slopes into wetland area.
22	Waukesha, Summit	43.100765, -88.535359	Cropland	15	Nutrient management; additional buffer; reroute field drainage; rotate contours 90 degrees; conservation tillage; cover crop.	Small contact area between field and adjacent river; drainage ditch ties into river.
23	Waukesha, Summit	43.101674, -88.531400	Cropland	15	Nutrient management; additional buffer; reroute field drainage; rotate contours 90 degrees; conservation tillage; cover crop.	Small field area slopes into the river; drainage ditch ties into river.
24	Waukesha, Summit	43.036862, -88.513365	Cropland	20	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop.	Field adjacent to the river; sizable slopes with minimal buffer.
25	Waukesha, Summit	43.103897, -88.506212	Public Park	15	Optimize fertilizer usage; additional buffer.	Champion Field adjacent to river; City of Oconomowoc can easily put conservation practices into place.
26	Jefferson, Concord	43.076758, -88.548347	Cropland	50	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Field slopes to Battle Creek at several points and contains some highly erodible soils.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
27	Waukesha, Summit	43.082238, -88.538162	Cropland	15	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop.	Field drains to a northern offshoot of Battle Creek.
28	Jefferson, Concord	43.075436, -88.542372	Cropland	25	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Field on both sides of a northern offshoot of Battle Creek.
29	Waukesha, Summit	43.065258, -88.537197	Cropland	35	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Field on both sides of Battle Creek with significant slopes to the river; signs of existing erosion on both fields.
30	Waukesha, Summit	43.063930, -88.527743	Cropland	10	Nutrient management; additional buffer; conservation tillage; cover crop.	Minimal buffer to drainage ditch.
31	Waukesha, Summit	43.060129, -88.532177	Cropland	10	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Significant slope to river area.
32	Waukesha, Summit	43.057328, -88.534607	Cropland	20	Nutrient management; additional buffer; reroute field drainage; rotate contours 45 degrees; conservation tillage; cover crop.	Minimal buffer to drainage ditch which flows into Battle Creek; signs of erosion into drainage ditch.
33	Waukesha, Summit	43.056875, -88.528298	Cropland	15	Wetland Restoration	Signs of erosion into drain to Battle Creek; area recommended for wetland restoration by Waukesha County LWC Department.
34	Waukesha, Summit	43.051585, -88.516961	Cropland	7.5	Nutrient management; additional buffer; conservation tillage; cover crop.	Some addition buffer could be needed by river.
35	Waukesha, Summit	43.055066, -88.515920	Cropland	15	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; wetland restoration.	Signs of erosion to river location; grassed waterway recommended.
36	Waukesha, Summit	43.058117, -88.507600	Cropland	20	Nutrient management; additional buffer; reroute drainage; grassed waterways; conservation tillage; cover crop.	Signs of erosion into ditch which eventually drains to Battle Creek.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
37	Waukesha, Summit	43.068308, -88.513916	Cropland	105	Wetland Restoration	Large near Battle Creek recommended for wetland restoration by Waukesha County LWC Department.
38	Waukesha, Oconomowoc	43.154395, -88.516423	Cropland	110	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Signs of significant erosion to stream draining to Lac La Belle; grassed waterway recommended.
39	Waukesha, Oconomowoc	43.141518, -88.497118	Cropland	80	Nutrient management; additional buffer; rotate contours 90 degrees; grassed waterway; conservation tillage; cover crop; wetland restoration.	Signs of erosion to field drainage with minimal buffer.
40	Waukesha, Oconomowoc	43.140242, -88.48275	Cropland	50	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Field drains to Rosenow Creek offshoot to the north; signs of erosion to stream location.
41	Waukesha, Oconomowoc	43.144745, -88.475757	Cropland	55	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Minimal buffer on both sides of stream offshoot; stream crossing apparent from aerial photography.
42	Waukesha, Oconomowoc	43.123576, -88.468090	Cropland	30	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Recent develop in this areas; may require additional protection of Rosenow Creek.
43	Waukesha, Merton	43.148417, -88.403573	Cropland	75	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; reevaluate site drainage.	Crops adjacent to river between North Lake and Okauchee Lake.
44	Waukesha, Merton	43.155795, -88.397444	Cropland	30	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; reevaluate site drainage.	Crops adjacent to river between North Lake and Okauchee Lake.
45	Waukesha, Merton	43.171957, -88.379867	Cropland	85	Nutrient management; additional buffer; conservation tillage; cover crop; wetland restoration.	Several fields adjacent to stream draining to North Lake.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
46	Waukesha, Merton	43.174542 ,-88.389537	Cropland	10	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	Field slopes towards Mason Creek; additional buffer possibly needed.
47	Waukesha, Merton	43.183146, -88.392669	Cropland	40	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	Signs of erosion to a drainage ditch between two fields; grassed waterway possibly needed on east field.
48	Waukesha, Merton	43.189628, -88.386979	Cropland	65	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Field drains to a northern offshoot of Mason Creek.
49	Waukesha, Merton	43.188727, -88.407825	Cropland	15	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; wetland restoration.	Minimal buffer to Mason Creek; field contours perpindicular to the creek.
50	Waukesha, Merton	43.193286, -88.403283	Cropland	25	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	Field on both sides of a northern offshoot of Mason Creek; stream crossings apparent from aerial photos.
51	Waukesha, Merton	43.191759, -88.411599	Cropland	65	Nutrient management; additional buffer; grassed waterways; reroute drainage; conservation tillage; cover crop.	Field drains directly to the river at multiple locations; some areas with minimal buffer.
52	Washington, Erin	43.202364, -88.416205	Cropland, Feedlot	50	Pasture/Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Significant slope to river area; Washington County LWCD indicates the presence of a feedlot and pasture management opportunities.
53	Washington, Erin	43.207287, -88.397819	Cropland	7.5	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Two small fields adjacent to the creek; further site investigation necessary.
54	Waukesha, Merton	43.176621, -88.370363	Feedlot	0.35	Manure storage/management; filter strips.	Feed lot next to Little Oconomowoc River west offshoot.
55	Waukesha, Merton	43.176490, -88.359182	Cropland	10	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	Fields on three sides of the Little Oconomowoc River with some areas with minimal buffer and significant slopes.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
56	Waukesha, Merton	43.181073, -88.362060	Cropland	15	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	Little Oconomowoc River is adjacent to the field on three sides; some vehicle tracks crossing the river.
57	Waukesha, Merton	43.179198, -88.369245	Cropland	5	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop.	Signs of erosion into the adjacent stream.
58	Washington, Erin	43.241444, -88.363907	Cropland, Feedlot	350	Sedimentation pond installation/maintenance; manure storage optimization; nutrient/pasture management; wetland restoration; additional buffer; grassed waterways; conservation tillage; cover crop.	A large sedimentation pond would help the Erin Meadows farm and neighboring farms reduce runoff and be a source of irrigation water. The pond could also serve a nearby dairy and beef cattle farm located on both sides of the river. In addition, an existing sedimentation pond needs to be cleaned out for better performance. There are seven springs on this farm that could be developed with a grass waterway to create a new trout stream. The Washington County LWCD also indicates the need for wetland restoration, pasture management, and manure storage optimization at this site.
59	Washington, Erin	43.249216, -88.352284	Cropland	45	Nutrient management; additional buffer; check field contours; reroute drainage; grassed waterways; conservation tillage; cover crop.	Several fields surrounding a complicated drainage network; further site investigation necessary to determine most effective BMPs.
60	Waukesha, Merton	43.164281, -88.354853	Cropland	12.5	Nutrient management; additional buffer; conservation tillage; cover crop.	Field adjacent to Funks Millpond.
61	Waukesha, Merton	43.168732, -88.347290	Cropland	17.5	Wetland Restoration	Field draining to Funks Millpond; significant signs of erosion in center of field; opportunity for wetland restoration.
62	Waukesha, Merton	43.165853, -88.346102	Cropland	50	Nutrient management; wetland restoration; rotate contours 90 degrees; additional buffer; grassed waterway; conservation tillage; cover crop.	Field on both sides of tributary to Funks Millpond; signs of erosion to stream; opportunity for wetland restoration.
63	Waukesha, Merton	43.176823, -88.349449	Cropland	3.5	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Signs of significant erosion to the Oconomowoc River in multiple areas.

CSA #	County, Township	Lat, Long	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Comments
64	Washington, Erin	43.216611, -88.330096	Cropland	5	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Two small fields adjacent to the creek; further site investigation necessary.
65	Washington, Erin	43.227020, -88.327181	Cropland	25	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Flynn Creek cuts through the field, and there are signs of erosion to the creek.
66	Washington, Erin	43.238459, -88.318669	Cropland	100	Wetland Restoration	Several fields surrounding a complicated drainage network; Washington County LWCD indicates site as priority wetland restoration area.
67	Washington, Erin	43.245314, -88.309547	Cropland	25	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Field with signs of erosion adjacent to Flynn Creek.
68	Washington, Erin	43.249043, -88.305541	Cropland	25	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Minimal buffer to Flynn Creek.
69	Washington, Richfield	43.259668 ,-88.268711	Cropland	20	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Ephemeral stream drains the field to the Oconomowoc River, and no conservational practices are in place.
70	Washington, Richfield	43.270409, -88.256031	Cropland	15	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	Several fields surrounding the Coney River with minimal buffer in place.
71	Washington, Richfield	43.267116, -88.230414	Cropland	95	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; reevaluate site drainage.	There is an opportunity to improve severe runoff conditions on the Pleasant Hill sod farm. Sedimentation basins and traps for runoff capture and irrigation would be located downstream of the sod farm at strategic locations. An innovative phosphorus filtration process could be used at the ponds to remove TSS and TP.
72	Washington, Richfield	43.270750, -88.229803	Cropland	40	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; reevaluate site drainage.	Signs of erosion into the nearby headwaters of the Oconomowoc River.

DESCRIBE MANAGEMENT MEASURES

The OWPP team coordinated with the three county LWC Departments and our partners to identify various management measures to be used. The agricultural management measures are briefly described below in the text below, and can be seen associated with CSAs in Table 14. Multiple management measures were identified for most areas to provide flexibility. In most of the areas, coordination with the farmers has not happened yet. The exact management measure to be implemented will depend on what the farmer is agreeable to and the nature of their operations.

Nutrient Management Plan

Nutrient management plans are required by WAC Chapter NR 151. The purpose of the plans is for farmers to have a proactive plan for managing the amount of nutrients in the soil for optimum crop yields. The plans also help prevent an excess of nutrients in the soil. When there is an excess of nutrients, pollutant runoff associated with soil loss is exacerbated. The plans consider the soil type, crop rotation, nutrient uptake of the crops, the amount and type of fertilizer applied, and other general operation details. The goal of the plans is to balance the optimum amount of nutrients required for a particular farming operation taking into account soil type, field slope, crop rotation and tillage practices.

Cover Crops

Cover crops are vegetation that is planted typically in the fall after the main crop (for example corn or soy beans) is harvested. The cover crop grows quickly and establishes a substantive root structure near the surface of the soil, thus holding the soil in place and helping to prevent soil erosion. The crop dies in the cold weather, but the root structure remains in the soil to stabilize it during the winter months. Winter wheat and winter rye are two examples of cover crops that could be used in the OWPP.

Riparian Buffers

Riparian buffers are meant inhibit solids transport and promote nutrient uptake from runoff originating from agricultural operations before reaching nearby surface water. Riparian buffers are typically effective starting at a minimum width of 75 feet. Washington County has been engaged with the farming community to implement buffers that could be harvested (e.g. hay), a couple times a year. Through the harvesting program, the buffer area still provides some economic value to farmers. Harvesting also removes the phosphorus taken up by the plant.

Improved Tillage

Improved tillage practices can result in healthier soil and reduced soil loss. Improvements could include implementing no-till or conservation tillage practices to reducing the magnitude of tilling (e.g. going from chisel plowing to disc tilling). The OWPP project team is ready to work with the county LWC Departments, the NRCS, and the Farmer Leadership Group to analyze where improved tillage practices could be implemented.

Grassed Waterways

Grassed waterways are drainage channels in a field that are planted with grass to reduced erosion and the transport of TSS to the ditch line. Grassed waterways are typically more effective at TSS reduction compared to TP. However, there is still a benefit for TP reduction.

Retention Ponds

Retention ponds help to capture solids and particulate phosphorus during and after a precipitation event. The ponds collect the storm water and settle out the solids as opposed to having the solids transported to surface water. There are several locations in Washington County where these ponds can be implemented.

Barnyard Improvements

Barnyard improvements consist of practices that could implemented in areas of concentrated livestock feeding. These areas typically lack vegetation or well-established root systems because of the high traffic from livestock. Improvements could include the installation of terraces, re-grading, having multiple feed points, and covering the feed points.

Other Management Measures

Aside from agricultural practices, other practices were considered for phosphorus removal. These included wetland restoration and stream bank stabilization. Further investigation into the stream bank stabilization option is required before specific sites are identified.

Wetland restoration would consist of taking land in a low area with hydric soils out of production and converting it back into a wetland. Some farmland in the area has been drained with a network of tile drains to convert it into farm land. This land is still marginal for production and is prone to flooding with heavy rains. Waukesha and Washington counties have identified specific areas that would be good candidates for wetland restoration. In addition there were a couple farm areas in Jefferson County that may be successfully converted to wetland.

Stream bank erosion is a source of TSS and TP. As the stream bank erodes, the velocity of the water increases during and after precipitation events. The increased velocity further erodes the stream bank. This erosion reduces the meandering nature of the stream and straightens it, shortening the detention time to the nearest lake. The phenomenon is present in Mason Creek which flows into North Lake. Stream bank erosion is very subtle and happens very slowly over time. Nonetheless, stream bank erosion can be a significant source of TSS and TP pollution.

There are a number of MS4 areas in the watershed. These include the City of Oconomowoc and portions of the Town of Oconomowoc, Town of Merton, Village of Merton, Village of Hartland Village of Summit and Waukesha County. The MS4s have a storm water permit that mandates levels of reductions for TSS and TP. These MS4 areas are also required to conduct modeling to determine the effectiveness of various practices (e.g. improved leaf collection) and new facilities (e,g, a storm water detention pond) to reduce TSS and TP from urban storm water. The modeling also shows to what extent the new practices or facilities will meet the pollutant

reduction requirements if implemented. Also, detailed map studies are required to verify storm water drainage patterns in the municipalities. The modeling and mapping activities are not complete. It is anticipated that meaningful results from these activities will not be available until fall of 2015. These activities must be complete to identify urban practices and facilities that could be implemented to reduce pollutants in storm water and help in the OWPP. Since the timing of the AM plan submittal and the storm water initial activity does not coincide, the OWP plan will not include urban reductions initially. The OWPP will be revised in the future to include specific urban storm water reductions after the modeling and mapping are complete.

As a backup strategy, the WWTF may be able to achieve a lower than typical effluent TP level through optimization of the new phosphorus precipitation chemical that has recently been pilot tested at the WWTF. These lower effluent levels would complement the OWPP plan target reductions. The pilot testing has indicated that effluent levels as low as 0.3 mg/L TP may be achievable while adding a smaller daily volume of chemical when compared to ferrous chloride - the chemical that is currently in use at the Oconomowoc WWTF.

ESTIMATE LOAD REDUCTION EXPECTED BY PERMIT TERM

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) model is a landscape model that estimates watershed-scale nutrient transport by accounting for land use, local precipitation data, soils data, agricultural statistics, and other related factors. For the OWPP, STEPL was used to estimate baseline load information for nitrogen, phosphorus, biological oxygen demand, and sediment in each of the HUC-12 areas represented in the action area. Another output of the STEPL model provided broad-scale estimations of pollutant load reductions based on agricultural management measures. The model worked well to assess general “what if” scenarios, providing pollutant load reduction estimates associated with several combinations of agricultural best management practices. An average annual pollutant load reduction (expressed in lb/year) was calculated for each HUC-12 based on the suite of management measures incorporated in the model. Also, these loads were converted to reduction factors (expressed in lb/acre-year) which were applied to many of the identified CSAs in Table 14.

While the STEPL model is accessible and user-friendly, it has several limitations. First, the input parameters of the model are approximate and empirical due to the broad scope of the model. Average precipitation data was taken from a built-in weather station approximately 50 miles away from the project location, and a single soil hydrologic group was approximated for each HUC-12 area. In addition, septic system information was taken from dated surveys from the National Small Flows Clearinghouse, and manure application rates were expressed as the approximate number of months in a year that manure is spread. Finally, highly empirical formulas including the curve number method and the original USLE were used in conjunction with approximate existing pollutant concentrations in soil and runoff to predict the baseline loads.

Second, the hydrologic effect of the large number of lakes in the watershed was not incorporated in the model, so their propensity to act as pollutant sinks was not evaluated. Thus, pollutant load reductions generated for upstream HUC-12 areas (Watersheds 2, 3, and 4 in the model) may not affect the nutrient levels seen at the point of compliance. Taken together, these limitations associated with the model yielded very approximate results. However, the results of the STEPL

model were useful in understanding how nutrient loads are distributed in the Oconomowoc River Watershed. The results also illustrated relative management measure efficiency. The incorporation of management measures in the STEPL model is described below.

The STEPL program has a built-in best management practice calculator. This calculator allows users to evaluate the pollutant removal efficiencies of several combinations of management measures in series or in parallel, giving a single removal efficiency as an output. In this way, the calculator helps accommodate the STEPL requirement of a single removal efficiency factor for each of the modeled pollutants in each watershed. Due to the fact that the OWPP is still in the planning stages, a specific set of management measures was not selected to represent each of the watersheds in the model. Instead, the project team intends to present each agricultural partner with a large selection of management measures so that they are able to select options that are appropriate for their operation. Taking these factors into account, Table 1 shown in Appendix E was developed. This table lists the output of the best management practice calculator for several combinations of management measures, including the phosphorus reduction factor expressed in lb/acre-year. These reduction efficiencies were averaged over the entire list, and the result was selected as the input for each watershed in the STEPL model. A complete summary of the output of the STEPL model and related discussion can be found in Appendix E.

In addition to the STEPL model, the OWPP considered modeling results included in the Rock River TMDL. The group that developed this report used the Soil and Water Assessment Tool (SWAT) to calculate pollutant loads from agricultural and natural areas, and the Source Loading and Management Model (SLAMM) to calculate loads from urban areas for each TMDL reach in the Rock River Basin. Both of these models have more complex and dynamic input parameters than STEPL, giving more comprehensive outputs. The baseline loading results generated in the Rock River TDML were used as a check for the STEPL output. A summary of the SWAT and SLAMM models and related discussion is included in Appendix E.

As field-level implementation starts in the OWPP, the SnapPlus modeling tool will be used to further refine phosphorus reduction estimations from the CSAs. SnapPlus requires many field-specific inputs that are not available presently. It is expected that the modeling conducted in the future with SnapPlus will be more appropriate for field-scale applications than the modeling described in Appendix E.

The county LWC Departments will be consulted for realistic pollutant reductions for management measures that were not modeled. These include stream bank stabilization and wetland restoration.

The expected reductions for each area and management measure are shown in Table 15. An average phosphorus reduction factor of 1.45 pounds of phosphorus per acre per year was derived from the STEPL model. Table 15 is sorted according to the expected order of implementation. The approximate permit term of expected future WPDE permits is also shown in Table 15 for reference. Even though the expected target reduction is 1,172 pounds per year, Table 15 identifies at total of 3,995 pounds per year. It is expected that a number of the opportunities in the table will not be implemented for a variety of reasons. These could include lack of farmer cooperation, not being able to reach an agreement with a farmer, or general lack of interest. In addition, some practices may not be as effective as expected, and the expected water quality

reductions may not materialize. To account for the extra reductions that may be necessary to achieve the target TP concentration at the confluence of the Oconomowoc and Rock rivers, a "stretch" target reduction of 150 percent of the 1,172 reduction was identified, giving a goal of 1,758 pounds per year. This reduction represents 44 percent of the total potential reduction of 3,995 pounds per year.

It was assumed that 75 percent of the of the identified CSAs would participate in the OWPP in the HUC-12 area closest to the confluence. Significant resources will be brought to this area to encourage participation and promote the OWPP. The OWPP assumed the participation rate of the remaining three HUC-12 areas in order of decreasing proximity to the confluence will be 35, 35 and 30 percent, respectively. The overall watershed participation rate is then 44 percent which equals the "stretch" goal reduction to the total potential reduction. This percent was used to derive the overall costs of the management measures in the OWPP.

Table 15 also includes a column representing the cost of implementation and ongoing maintenance of management measures. There is one value for the cost for each CSA item. The majority of the CSA item costs in the table are approximated on a yearly basis assuming a value of $30 per pound of phosphorus removal (Winsten, 2014). Several of the CSA items involve more substantial capital construction costs (e.g. sedimentation ponds or manure storage). These practices are not shown as annual costs, but are intended to be a capital cost and are noted with an asterisk.

Because the threshold of needed pollutant reduction is so low, it will not be possible to achieve an amount of phosphorus reduction equal to the WWTF loading in the first year. The OWPP has identified a total phosphorus reduction potential of approximately 2,062 pounds during the first permit term. However, with the assumed CSA participation rate of 75 percent in HUC-12 closest to the confluence, and adjusting for planned projects located farther upstream in the watershed where water quality improvements will not noticeable for some time, the majority of the total needed reductions for the OWPP will theoretically obtained in the first permit term.

Table 15. OWPP CSAs, Management Measures, Reduction Amounts, and Cost Estimates.

Priority #	CSA #	Permit Term	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Reductions (lbs. P/year)	Annual Cost
1	*58	1	Cropland, Feedlot	350	Sedimentation pond installation/maintenance; manure storage optimization; nutrient/pasture management; wetland restoration; additional buffer; grassed waterways; conservation tillage; cover crop.	300	$170,000
2	2	1	Cropland	20	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	29	$870
3	3	1	Cropland	40	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	58	$1,740
4	4	1	Cropland	65	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	94	$2,828
5	5	1	Cropland	50	Nutrient management; additional buffer; reroute field drain; conservation tillage; cover crop.	73	$2,175
6	6	1	Cropland	90	Nutrient management; additional buffer; conservation tillage; cover crop.	131	$3,915
7	20	1	Cropland	20	Wetland restoration; nutrient management; additional buffer; reroute field drains; conservation tillage; cover crop.	29	$870
8	7	1	Cropland	60	Nutrient management; additional buffer; reroute field drain; conservation tillage; cover crop.	87	$2,610
9	1	1	Cropland	5	Nutrient management; additional buffer; conservation tillage; cover crop.	7	$218
10	8	1	Cropland	45	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	65	$1,958
11	13	1	Cropland	125	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	181	$5,438
12	16	1	Cropland	65	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	94	$2,828
13	21	1	Cropland	30	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	44	$1,305
14	10	1	Cropland	10	Nutrient management; additional buffer; conservation tillage; cover crop.	15	$435

Priority #	CSA #	Permit Term	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Reductions (lbs. P/year)	Annual Cost
15	11	1	Cropland	15	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	22	$653
16	9	1	Cropland	30	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	44	$1,305
17	12	1	Cropland	30	Nutrient management; rotate contours 45 degrees; additional buffer; conservation tillage; cover crop.	44	$1,305
18	14	1	Cropland	10	Nutrient management; additional buffer; rotate contours 90 degrees; conservation tillage; cover crop.	15	$435
19	*71	1	Cropland	95	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; reevaluate site drainage.	138	$100,000
20	72	1	Cropland	40	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; reevaluate site drainage.	58	$1,740
21	15	1	Cropland	35	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	51	$1,523
22	17	1	Cropland	25	Nutrient management; additional buffer; grassed waterways; reroute field drains; conservation tillage; cover crop.	36	$1,088
23	18	1	Cropland	30	Nutrient management; additional buffer; reroute drainage; conservation tillage; cover crop.	44	$1,305
24	22	1	Cropland	15	Nutrient management; additional buffer; reroute field drainage; rotate contours 90 degrees; conservation tillage; cover crop.	22	$653
25	23	1	Cropland	15	Nutrient management; additional buffer; reroute field drainage; rotate contours 90 degrees; conservation tillage; cover crop.	22	$653
26	26	1	Cropland	50	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	73	$2,175
27	28	1	Cropland	25	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	36	$1,088
28	27	1	Cropland	15	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop.	22	$653

Priority #	CSA #	Permit Term	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Reductions (lbs. P/year)	Annual Cost
29	19	1	Cropland	20	Nutrient management; additional buffer; reroute drainage; conservation tillage; cover crop.	29	$870
30	29	1	Cropland	35	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	51	$1,523
31	37	1	Cropland	105	Wetland Restoration	152	$4,568
					Permit Term 1 Subtotal:	**2,062**	**$318,720**
32	31	2	Cropland	10	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	15	$435
33	32	2	Cropland	20	Nutrient management; additional buffer; reroute field drainage; rotate contours 45 degrees; conservation tillage; cover crop.	29	$870
34	33	2	Cropland	15	Wetland Restoration	22	$653
35	30	2	Cropland	10	Nutrient management; additional buffer; conservation tillage; cover crop.	15	$435
36	35	2	Cropland	15	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; wetland restoration.	22	$653
37	34	2	Cropland	7.5	Nutrient management; additional buffer; conservation tillage; cover crop.	11	$326
38	24	2	Cropland	20	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop.	29	$870
39	36	2	Cropland	20	Nutrient management; additional buffer; reroute drainage; grassed waterways; conservation tillage; cover crop.	29	$870
40	43	2	Cropland	75	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; reevaluate site drainage.	109	$3,263
41	25	2	Public Park	15	Optimize fertilizer usage; additional buffer.	22	$653
42	66	2	Cropland	100	Wetland Restoration	145	$4,350
43	65	2	Cropland	25	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	36	$1,088
44	38	2	Cropland	110	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	160	$4,785

Priority #	CSA #	Permit Term	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Reductions (lbs. P/year)	Annual Cost
45	39	2	Cropland	80	Nutrient management; additional buffer; rotate contours 90 degrees; grassed waterway; conservation tillage; cover crop; wetland restoration.	116	$3,480
46	64	2	Cropland	5	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	7	$218
47	40	2	Cropland	50	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	73	$2,175
48	41	2	Cropland	55	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	80	$2,393
49	42	2	Cropland	30	Additional buffer; wetland restoration.	44	$1,305
50	44	2	Cropland	30	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; reevaluate site drainage.	44	$1,305
51	67	2	Cropland	25	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	36	$1,088
52	68	2	Cropland	25	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	36	$1,088
					Permit Term 2 Subtotal:	**1,077**	**$32,299**
53	45	3	Cropland	85	Nutrient management; additional buffer; conservation tillage; cover crop; wetland restoration.	123	$3,698
54	47	3	Cropland	40	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	58	$1,740
55	51	3	Cropland	65	Nutrient management; additional buffer; grassed waterways; reroute drainage; conservation tillage; cover crop.	94	$2,828
56	*52	3	Cropland, Feedlot	50	Pasture/Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	73	$50,000
57	62	3	Cropland	50	Nutrient management; wetland restoration; rotate contours 90 degrees; additional buffer; grassed waterway; conservation tillage; cover crop.	73	$2,175
58	46	3	Cropland	10	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	15	$435

Priority #	CSA #	Permit Term	General Land Use Category	Controlled Area (Ac)	Management Measure Description	Reductions (lbs. P/year)	Annual Cost
59	50	3	Cropland	25	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	36	$1,088
60	55	3	Cropland	10	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	15	$435
61	56	3	Cropland	15	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop; wetland restoration.	22	$653
62	60	3	Cropland	12.5	Nutrient management; additional buffer; conservation tillage; cover crop.	18	$544
63	61	3	Cropland	17.5	Wetland Restoration	25	$761
64	49	3	Cropland	15	Nutrient management; additional buffer; grassed waterways; rotate contours 90 degrees; conservation tillage; cover crop; wetland restoration.	22	$653
65	48	3	Cropland	65	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop; wetland restoration.	94	$2,828
66	53	3	Cropland	7.5	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	11	$326
67	*54	3	Feedlot	0.35	Manure storage/management; filter strips.	50	$60,000
68	63	3	Cropland	3.5	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	5	$152
69	57	3	Cropland	5	Nutrient management; additional buffer; grassed waterway; conservation tillage; cover crop.	7	$218
70	59	3	Cropland	45	Nutrient management; additional buffer; check field contours; reroute drainage; grassed waterways; conservation tillage; cover crop.	65	$1,958
71	69	3	Cropland	20	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	29	$870
72	70	3	Cropland	15	Nutrient management; additional buffer; grassed waterways; conservation tillage; cover crop.	22	$653
					Permit Term 3 Subtotal:	**856**	**$132,011**
					Total:	**3,995**	**$483,030**

MEASURING SUCCESS

The City has a standard monitoring program for TP in the watershed. The monitoring used in the OWPP will be based on the standard monitoring already in place. For the past two years, the wastewater utility has conducted once a month monitoring of various points in the watershed. These locations are shown in Map 1 of Appendix B. The parameters tested at the points are TP and, at some locations, TSS as well. Most of the monitoring locations will be monitored once per month. The sampling will occur on or close to the same day every month (the fifteenth day of the month). By sampling the same day, there will be a reduction in any bias in the pollutant concentrations from very wet or very dry weather. This sampling method is in accordance with Wisconsin DNR guidance. Some of the critical monitoring points (e.g. just upstream and just downstream of the WWTF outfall and the confluence) will be monitored twice per month. For these locations, samples will be collected on the first and fifteenth days of each month.

In the case of wet weather and very dry weather, the City will conduct "unofficial" event-specific sampling to determine how increased river flow rates affect TP and TSS levels. The City plans to conduct this event-specific sampling after 1.5 inch of rainfall in a time period of 24 hours or less.

"Unofficial" monitoring will also take place at additional locations in the watershed as practices are implemented. The monitoring will help determine if the implemented management measures are effective. Edge-of-field monitoring may take place to better assess reductions in phosphorus loading to surface waters.

When sampling, the City takes a grab sample from the portion of the river with the greatest flow at a depth below the water surface of three to six inches. The sample bottles are rinsed three times before the sample is taken. Staff are careful not to disturb the river bottom while taking the sampling. In addition, staff collect the sample facing upstream.

The monitoring guidance in Section 5.01 of the Guidance for Implementing Wisconsin's Phosphorus Water Quality Standards for Point Source Discharges will be followed. The sample containers are preserved using 2 ml of 50% sulfuric acid solution. This ensures the samples have a pH of 2 or lower. Containers are put on ice in a cooler shortly after they are collected. The analytical portion of the testing is conducted at the Oconomowoc WWTF which is a certified laboratory.

The City is beginning to collaborate with Jefferson County on a citizen-based monitoring program for the Rock River basin. This program could potentially be used to reduce the monitoring work on wastewater utility staff. Any monitoring personnel used through this program would be fully trained in the proper collection and preservation procedures.

Information on the monitoring locations is summarized in the table below.

Table 16. AM Monitoring Overview

Monitoring Location					
Sample Point	**Sample Point Description**	**Latitude**	**Longitude**	**Parameters to be Collected**	**Sampling Frequency**
01	Hwy. 167	43.251229	-88.272887	TP	Monthly
0	Hubertus Rd.	43.221488	-88.289700	TP	Monthly
1	Flyn Creek Emerald Rd.	43.209365	-88.336630	TP	Monthly
2	Hwy. Q Monches	43.193608	-88.338054	TP	Monthly
3	Mason Creek CW	43.181144	-88.405995	TP	Monthly
4	Mason Creek No. Woods Dr.	43.160064	-88.380645	TP	Monthly
5	Oconomowoc River Hwy. 83	43.159970	-88.370098	TP	Monthly
6	Oconomowoc River Hwy. K	43.139345	-88.406940	TP	Monthly
7	Okauchee Dam (in) Oconomowoc Lake	43.108264	-88.454194	TP	Monthly
8	Oconomowoc Lake (out)	43.104390	-88.469026	TP	Monthly
9	Oconomowoc River Cemetery	43.112414	-88.488332	TP	Monthly
10	Fowler Lake Dam	43.117746	-88.499270	TP	Monthly
11	Rosenow Creek (Blackhawk)	43.128992	-88.504776	TP	Monthly
12	LaBelle Dam	43.118540	-88.517419	TP	Monthly
13	Oconomowoc River (up)	43.105539	-88.511613	TP	Monthly
14	Oconomowoc River (down)	43.095803	-88.521340	TP	Monthly
15	Battle Creek Hwy. B	43.074758	-88.545601	TP	Monthly
16	Oconomowoc River Hwy. F	43.082673	-88.586287	TP	Monthly
17	Rock River Hwy. F	43.114159	-88.589009	TP	Monthly
18	Oconomowoc River McNamara Farm (fence)	43.113318	-88.617344	TP	2x Monthly
19	Rock River Hwy. P/E (down)	43.142781	-88.645001	TP	Monthly

Table 16. AM Monitoring Overview (continued)

Sampling Methodology		
Who will collect samples?	City of Oconomowoc Wastewater Utility	
Lab Information	Name:	Wastewater Treatment Facility
	Lab ID:	268004550
	Address:	900 South Worthington Street Oconomowoc, WI 53066
Phosphorus Analysis	Methodology Used:	4500 PE STO Methods 19th Ed.
	LOD:	0.02 mg/l
	LOQ:	0.07 mg/l

Other Lab Analysis for AM			
Pollutant 1 Name:	Methodology Used:	LOD	LOQ
Chloride*	4500 Chl. - B Std. Meth. 19th	N/A	N/A
Pollutant 2 Name:	Methodology Used:	LOD	LOQ
TSS*	2540-D Std. Meth. 19th	2.0 mg/l	2.0 mg/l
Pollutant 3 Name:	Methodology Used:	LOD	LOQ
Temp.	N/A Traceable Inst.	N/A	N/A

*Frequency of analysis varies based on river conditions, weather events, ambient temperature.

FINANCIAL SECURITY

There are many costs involved in the OWPP. Costs include (1) implementing agricultural management measures such as cover crops, riparian buffers, nutrient management plans, sedimentation basins and grassed waterways; (2) implementing other practices such as wetland restoration or stream bank restoration; (3) optimizing the WWTF to meet interim limits; (4) conducting outreach and education; (5) modeling; (6) river monitoring; (7) the cost advantage of the RCPP grant; and (8) administration.

Optimization to meet interim limits of TP at the WWTF consists of the additional chemical usage needed to meet the lower interim permit term TP concentrations of 0.6 mg/L and 0.5 mg/L. This cost was assumed using additional ferrous chloride. The WWTF can meet an effluent TP level of 0.5 mg/L with ferrous chloride. The City is presently piloting a new rare-earth coagulant product that has shown promise at other WWTFs in southeastern Wisconsin. This product may provide additional TP removal efficiency compared to ferrous chloride. In addition, there are benefits to the settleability and compaction of biosolids with the product. If

this product is used at the Oconomowoc WWTF going forward, there could be a cost advantage compared to the historical use of ferrous chloride at the WWTF.

Administration consists of compiling monitoring data, tracking watershed activities with a GIS interface, planning for, holding, and debriefing many meeting with various stakeholders, stakeholder communication and coordination, updates to the document management site, and writing the annual report and conducting compliance checks.

These anticipated costs and others are summarized in Table 17 for a ten year period. Costs for City staff are assumed to be over and above their normal job duties. The table details various assumptions used. For example for communication with the Farmer Leadership Group, it is assumed that monthly meetings lasting approximately 3 hours including preparation will take place for 10 years. The meetings will include one City of Oconomowoc staff member and a consultant acting on behalf of the City. The assumptions in the table serve as basis for determining a cost. Actual costs will be different based on many factors.

Table 17. OWPP Overall Costs – Ten Year Period

Type of Activity/Practice	Component	Cost	Comments
Management Measures	Selected Management Measures	$575,073	Assume $30/lb P removed. Total cost was estimated assuming 150% of the required management measures were implemented to achieved the target reduction amount of 1172 lbs P/year.
	Subtotal	**$575,073**	
	Meetings with Farmer Leadership Group - Staff	$31,320	Meetings once a month. Assume 3 hours per meeting including preparation.
	Meetings with Farmer Leadership Group - Consultant/Partner	$60,480	Meetings once a month. Assume 3 hours per meeting including preparation.
	Travel Costs	$6,720	Meetings once a month. Use $0.70 per mile. Assume 40 miles per meeting. Includes one trip each meeting for staff and consultant/partner.
	Subtotal	**$98,520**	
Other Practices	Wetland Restoration	**$45,458**	Assume $30/lb P removed. Total cost was estimated assuming 150% of the required management measures were implemented to achieved the target reduction amount of 1172 lbs P/year.
	Subtotal	**$45,458**	
	Meetings - Staff	$20,880	Meetings once every two months. Assume 4 hours per meeting including preparation.
	Meetings - Consultant/Partner	$40,320	Meetings once every two months. Assume 4 hours per meeting.

Table 17. OWPP Overall Costs – Ten Year Period (continued)

Type of Activity/Practice	Component	Cost	Comments
	Travel Costs	$3,360	Meetings once every two months. Use $0.70 per mile. Assume 40 miles per meeting. Includes one trip each meeting for staff and consultant/partner.
	Subtotal	**$64,560**	
WWTF Optimization to Meet Interim Limits	Additional Chemical	$51,000	Assume 40 extra gallons per day at $0.35 per gallon.
	Consultant Cost for Industrial Program	$35,000	Work with industries to reduce phosphorus discharge to plant.
	Staff Costs for Industrial Program	$50,000	Work with industries to reduce phosphorus discharge to plant.
	Subtotal	**$136,000**	
Outreach and Education	Staff Time for Meetings	$17,400	Meetings once a quarter for overall group. Assume 5.0 hours per meeting including preparation.
	Consultant/Partner Time for Meetings	$33,600	Meetings once a quarter for overall group. Assume 5.0 hours per meeting including preparation.
	Materials	$5,000	Assume $500 per year.
	Meeting Room Rental	$8,000	Meetings once a quarter for overall group. Assume $200 per quarter.
	Travel For Meetings	$2,240	Meetings once a quarter for overall group. Includes one trip each meeting for staff and consultant/partner.
	Website	$18,000	$8,000 initial cost and $1,000 per year for maintenance.
	Collaboration Software	$80,000	8,000 per year, 50 users on Office 365 Platform
	Consultant Cost For Updating Document Information	$80,640	Assume 48 hours per year of consultant/partner cost to update and maintain website.
	Partner	$30,000	Assume $3,000 per year for outreach and education.
	Partner	$30,000	Assume $3,000 per year for outreach and education.
	Subtotal	**$304,880**	
Modeling	Technology Needs to Run Models	$10,000	Assume $1,000 per year for technology needs to run models.
	Consultant/Partner	$120,000	Assume $12,000 per year.
	Financial Needs of County Land and Water Conservation Departments	$50,000	Assume $5,000 per year for county resources.
	Subtotal	**$180,000**	

Table 17. OWPP Overall Costs – Ten Year Period (continued)

Type of Activity/Practice	Component	Cost	Comments
River Monitoring	Staff Time to Gather Sample	$41,760	Assume an extra 4 hours per month.
	Staff Time to Run Test	$41,760	Assume an extra 4 hours per month.
	Supplies (Reagents, Bottles)	$15,000	Assume an extra $1,500 per year.
	Testing Cost (Outside Services)	$30,000	Assume an extra $3,000 per year.
	Travel costs	$3,780	Assume 18 trips per year at 30 miles per trip and 0.70 per mile.
	Subtotal	**$132,300**	
RCPP Grant	Grant amount	-$406,000	
	Administration (reports) Associated with Grant - Staff Time	$32,400	Assume 80 hours per year for staff time for 5 years.
	Administration (Reports) Associated with Grant - Consultant/Partner Time	$39,000	Assume 50 hours per year for consultant/partner time for 5 years.
	Subtotal	**-$334,600**	
Technical Support	Consultant/Partner	$200,000	Assume $20,000 per year.
	Financial Needs of County Land and Water Conservation Departments	$150,000	Assume 15,000 per year.
	Partner	$100,000	Assume 10,0000 per year.
	Partner	$100,000	Assume 10,0000 per year.
	Subtotal	**$550,000**	
Compliance Checking	Consultant/Partner Time to Track Activities with GIS	$134,400	Assume 80 hours per year.
	Communication, Administration and Coordination with DNR - Staff	$34,800	Assume 40 hours per year.
	Misc. Administration and Coordination with DNR - Consultant/Partner	$67,200	Assume 40 hours per year.
	Annual DNR Report - Staff	$34,800	Assume 40 hours per year.
	Annual DNR Report - Consultant/Partner	$67,200	Assume 40 hours per year.

Table 17. OWPP Overall Costs – Ten Year Period (continued)

Type of Activity/Practice	Component	Cost	Comments
	Field Visits - Staff	$20,880	Assume 24 hours per year.
	Field Visits - Consultant/Partner	$40,320	Assume 24 hours per year.
	Travel	$3,360	Includes 12 visits per year with 40 miles per visit. Use $0.70 per mile. Includes one trip for each meeting for staff and consultant.
	Subtotal	**$402,960**	
	Grand Total	**$2,155,151**	

The City of Oconomowoc understands that the OWPP is a long term program that will last 10 years or more and is fully committed to supporting this program.

Name: Sarah Kitsembel

Title: Director of Finance/Administrative Services

Date: 3-26-2015

IMPLEMENTATION SCHEDULE WITH MILESTONES

The priority of the management measures is shown in Table 15. The highest priority management measures will be implemented first.

With the OWPP, an important metric will be the areas where management measures have been implemented. Table 18 shows the milestones for implementing management measures and the associated projected phosphorus reductions using the derived factor of 1.45 pounds of phosphorus reduced per acre per year.

Table 18. Project Milestones

Year End	Cumulative Controlled Area Due to Management Measures in Place (Acres)	Cumulative Phosphorus Reduction (lbs./year)
2015	220	319
2017	496	719
2019	744	1,079
2021	883	1,280
2023	993	1,440
2025	1,103	1,599
2027	1,214	1,760

The water quality milestone is achieving a statistically significant TP concentration at the confluence of the Oconomowoc River and the Rock River of less than or equal to 0.075 mg/L. The statistically significant methodology will be in accordance with the Wisconsin Consolidated Assessment and Listing Methodology. The goal of the OWPP is to meet the water quality milestone in under ten years.

A back up strategy the City can use is achieving a greater portion of the load reduction through optimization at the WWTF. The new product the City is piloting for a chemical coagulant may allow the WWTF to discharge lower TP levels. This backup strategy would only be used after significant effort is made in the watershed.

Various practices will be used in combination for the annual compliance check for load reductions by permit term.

The most important practice will be the river monitoring program. The standard program will be used as the indicator. Non-official sampling at different times (e.g. a very wet period) or different places (e.g. a small stream feeding into the Oconomowoc River with a location not in Appendix C) will not be used for the load reduction assessment. Rather, this information will be used to ascertain how different weather patterns affect phosphorus transport through the watershed and the effectiveness of specific management measures.

With the RCPP program, the City will have a contract with the United States Department of Agriculture. NRCS staff has indicated to the City that the RCPP program will likely be open to audits by other federal agencies. As a condition to receiving RCPP funds, the City of Oconomowoc is required to maintain detailed project documentation and to submit routine reporting on specific activity. The NRCS will also work closely with the county LWC staff for the RCPP. The NRCS and county LWC staff will conduct intermittent farm visits and windshield checks as a part of the RCPP program.

Another important part of the annual compliance check will involve regular (perhaps bi-monthly) status checks with partners in the agricultural community. Through the Farmer Leadership Group, the OWPP plans to establish a farmer peer-led audit system. The OWPP plans leverage the respect, knowledge, trust, and support in place already in the agricultural community. This type of compliance mechanism will promote trust rather than a top down system. The NRCS and county LWC staff check will supplement the primary system of the farmer self-audit system. The farmer-led system will also help reduce the compliance checking effort of the City of Oconomowoc.

Geographical Information Systems will be used to track the management measures throughout the action area. GIS is an ideal tool for obtaining information on areas of land in a rural setting. The GIS system will provide detailed mapping for areas where practices have been implemented. Color coding and line work can be used to quickly convey information about the type, effectiveness, and compliance status of management measures.

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Appendix A

AM Request Form

Ruekert • Mielke

Your Infrastructure Ally

W233 N2080 Ridgeview Parkway • Waukesha, WI 53188-1020 • Tel. (262) 542-5733

Letter of Transmittal

Date: **February 23, 2015**
Project: **City of Oconomowoc Adaptive Management**

TO: Mr. Timothy A. Thompson
Wastewater Engineer
Southeast Region Headquarters
Wisconsin Department of Natural Resources
2300 North Dr Martin Luther King Jr Drive
Milwaukee, WI 53212

RE: **Watershed Adaptive Management Request**

WE ARE SENDING YOU X Attached ___ Under separate cover via _____ the following items:

___ Shop drawings ___ Prints ___ Drawings ___ Samples ___ Specifications

___ Copy of letter ___ Change order ___ _____

Copies	Date	No.	Description
1	**2/2015**		**Watershed Adaptive Management Request Form 3200-139 (1/12)**

THESE ARE TRANSMITTED as checked below:

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___ For review and comment ___ _____

REMARKS:

Copy to: **Thomas R. Steinbach, City of Oconomowoc**
File

Signed: David W. Arnott

David W. Arnott, P.E.

If enclosures are not as noted, kindly notify us at once

DWA:tag

~47-10024 Adaptive Management Program > 100 Planning > Correspondence > Thompson-20150223-Watershed Adaptive Management Request.docx~

State of Wisconsin
Department of Natural Resources
Bureau of Watershed Management
PO Box 7921, Madison WI 53707-7921
dnr.wi.gov

Watershed Adaptive Management Request

Form 3200-139 (1/12)

Notice: Pursuant to s. NR 217.18, Wis. Adm. Code, this form must be completed and submitted to the Department at the time of the reissuance of an existing WPDES (Wisconsin pollutant discharge elimination system) permit to request adaptive management for phosphorus water quality based effluent limits (WQBEL).Failure to provide all requested information may result in denial of your request. Personal information collected will be used for administrative purposes and may be provided to requestors to the extent required by Wisconsin Open Records law [ss. 19.31-19.39, Wis. Stats.].

Type of Request:

- ☐ This is the formal adaptive management request as required in s. NR 217.18(2)
- ☒ This is a preliminary adaptive management request (to be submitted as part of facility planning.)

Facility and Permit Information

Facility Name	WPDES Permit No.
City of Oconomowoc	**WI -** 0021181-08-0

Facility Address	City	State	ZIP Code
900 South Worthington St.	Oconomowoc	WI	53066

Receiving Water: Oconomowoc River

Owner Contact Information

Last Name	First Name	MI	Phone No. (incl. area code)
Steinbach	Thomas	R.	(262) 569-2192

Street Address	FAX Number
900 South Worthington St.	(262) 569-3273

City	State	ZIP Code	Email address
Oconomowoc	WI	53066	tsteinbach@oconomowoc-wi.gov

Facility Information

Provide listed information for each lagoon or pond basin

Required for AM Request	Wis. Administrative Code Reference	Conclusion	Evidence/Source of information (attach as needed)
1. NPS contribute at least 50% of total P contribution	s. NR 217.18(2)(b)	☒ NPS contributes at least 50% ☐ NPS DOES NOT contribute at least 50%	PRESTO GIS Tool
2. WQBEL Requires Filtration	s. NR 217.18(2)(c)	☒ Filtration required ☐ Filtration NOT required	
3. AM Plan	s. NR 217.18(2)(d)	☐ Plan is Included – Page 3 ☒ Plan is NOT Included *For a preliminary adaptive management request, AM plan not required*	

Facility Operation and Performance

1. **Current P removal capability** – If the facility is currently required by a WPDES permit to monitor effluent phosphorus (P) provide a summary of the influent and effluent annual average P concentrations for each of the past three (3) years. If permit required P data is not available, the applicant should provide any other P data that may be applicable and available. If no data is available, the Department may estimate the P effluent concentration by based on data from other similar facilities.

   See Attachment A.

2. **Facility Operation** – Provide a summary description of overall facility operation. If not a continuously discharging facility, describe storage procedures and the time periods when effluent discharge occurs.

The Oconomowoc Wastewater Treatment Facility (WWTF) uses an activated sludge process. The treatment processes at the WWTF include screening, influent pumping, grit removal, primary clarification, aeration, final clarification, tertiary filtration, UV disinfection and dissolved oxygen uptake. Solids are thickened with an air flotation thickener, anaerobically digested, thickened with a gravity belt thickener and land-applied as a soil conditioner. Discharge from the WWTF is on a continuous basis to the Oconomowoc River.

3. **Previous Studies** – Reference or attach any facility planning or evaluation study that evaluated facility performance capabilities (Note – Only include studies that are recent, within 5 years, or otherwise applicable for the evaluation of the existing facility and current conditions).

The City has experimented with varying doses of ferrous chloride in 2011. The dose - response information is shown on Attachment B. The lower limit that can be achieved is 0.2 mg/L. At this level, ferrous chloride severely fouls the membrane filter used for polishing effluent total respended solids.
The City has also hosted a pilot test to determine the cold weather flux using ultrafiltration with equipment provided by Ovivo.

Adaptive Management Plan (s. NR 217.18(d))

This section should summarize the Adaptive Management Plan for internal and external review. A complete Adaptive Management Plan should be attached. Note: If this is a preliminary adaptive management request, this section is not required.

Watershed	Percent Contribution of Applicant Discharge

Action Area (include map)

Watershed Characteristics and Timeline Justification

Key Proposed Actions

Key Goals and Measures for Determining Effectiveness

Partner(s)

Funding Sources

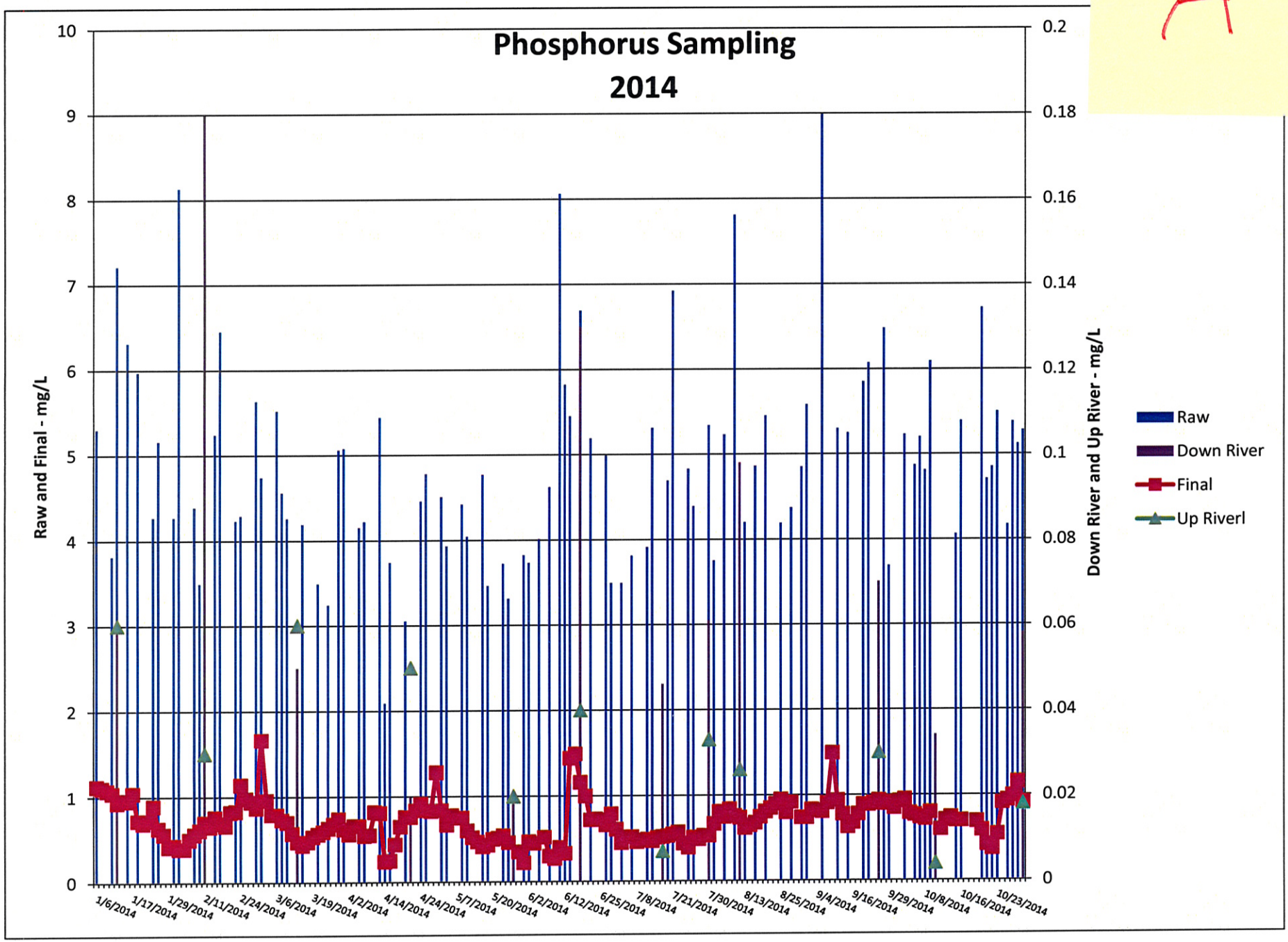
Adaptive Management Request and Certification

Based on the information provided, I am requesting the Watershed Adaptive Management option to achieve compliance with phosphorus water quality standards in accordance with s. NR 217.19, Wis. Adm. Code.
I certify that the information provided with this request is true, accurate and complete to the best of my knowledge.

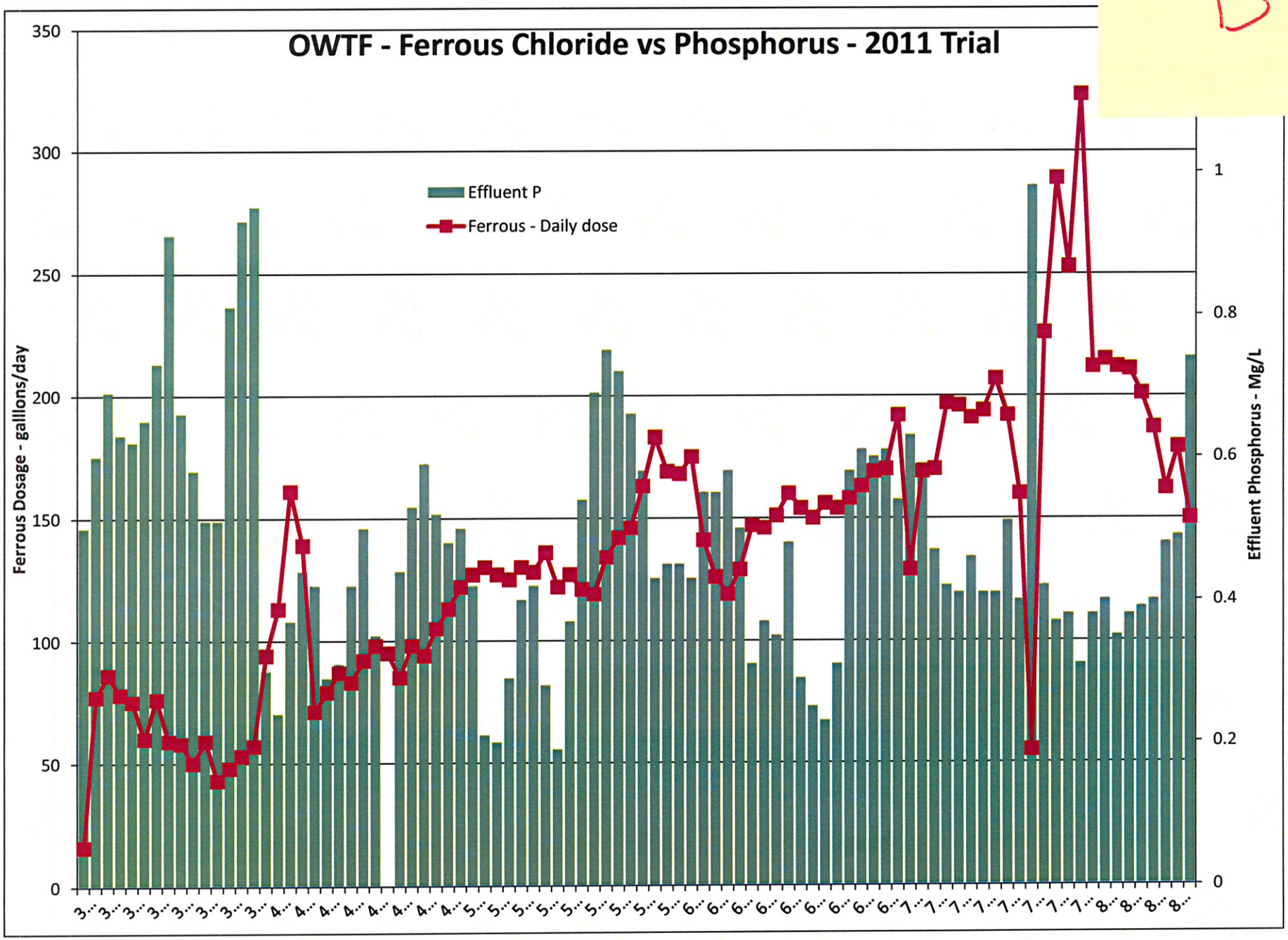
Print or type name of person submitting request*	Title
Thomas R. Steinbach	Wastewater Operations Manager
Signature of Official	Date Signed
Thomas R. Steinbach	02/23/2015

*Must be an Authorized Representative for the treatment facility

A

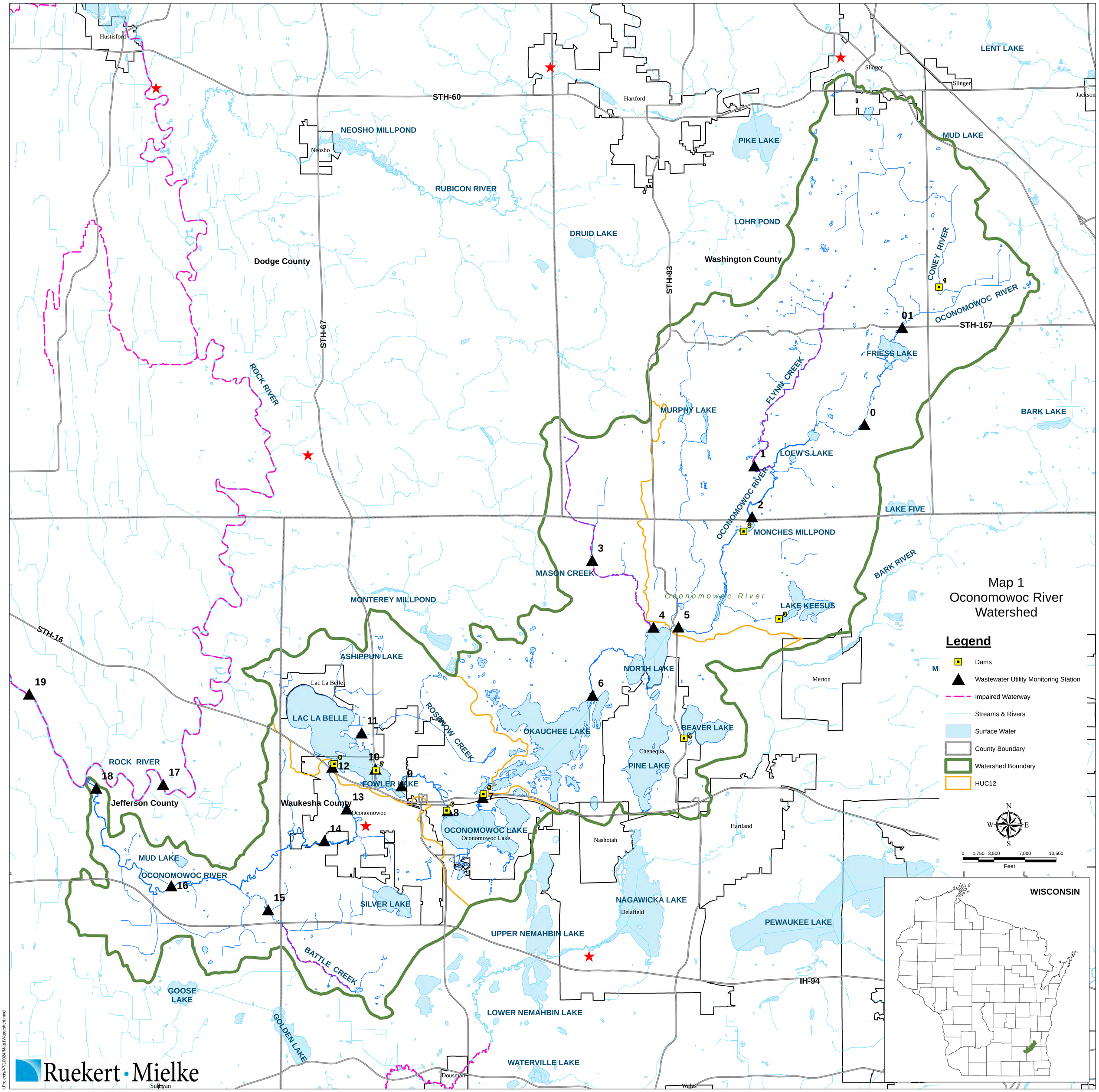

Phosphorus Sampling
2014
Raw and Final - mg/L
Down River and Up River - mg/L
0
1
2
3
4
5
6
7
8
9
10
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
1/6/2014
1/17/2014
1/29/2014
2/11/2014
2/24/2014
3/6/2014
3/19/2014
4/2/2014
4/14/2014
4/24/2014
5/7/2014
5/20/2014
6/2/2014
6/12/2014
6/25/2014
7/8/2014
7/21/2014
7/30/2014
8/13/2014
8/25/2014
9/4/2014
9/16/2014
9/29/2014
10/8/2014
10/16/2014
10/23/2014
Raw
Down River
Final
Up Riverl

B


OWTF - Ferrous Chloride vs Phosphorus - 2011 Trial
Effluent P
Ferrous - Daily dose
Ferrous Dosage - galllons/day
Effluent Phosphorus - Mg/L
350
300
250
200
150
100
50
0
1
0.8
0.6
0.4
0.2
0

Appendix B

Map 1 - Oconomowoc River Watershed
Map 2 - Watershed Orthophotography
Map 3 - K Factor
Map 4 - Hydric Soils Information
Map 5 - Land Use
Map 6 - Wetlands
Map 7 - Floodplain
Map 8 - Critical Source Areas - Southwest
Map 9 - Critical Source Areas - Northeast



Source: WiDNR, WisconsinView

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Map 2
Surface Water Map

Legend

- Streams & Rivers
- Watershed Boundary
- Surface Water
- Corporate Limits
- County Boundary

N
W E
S

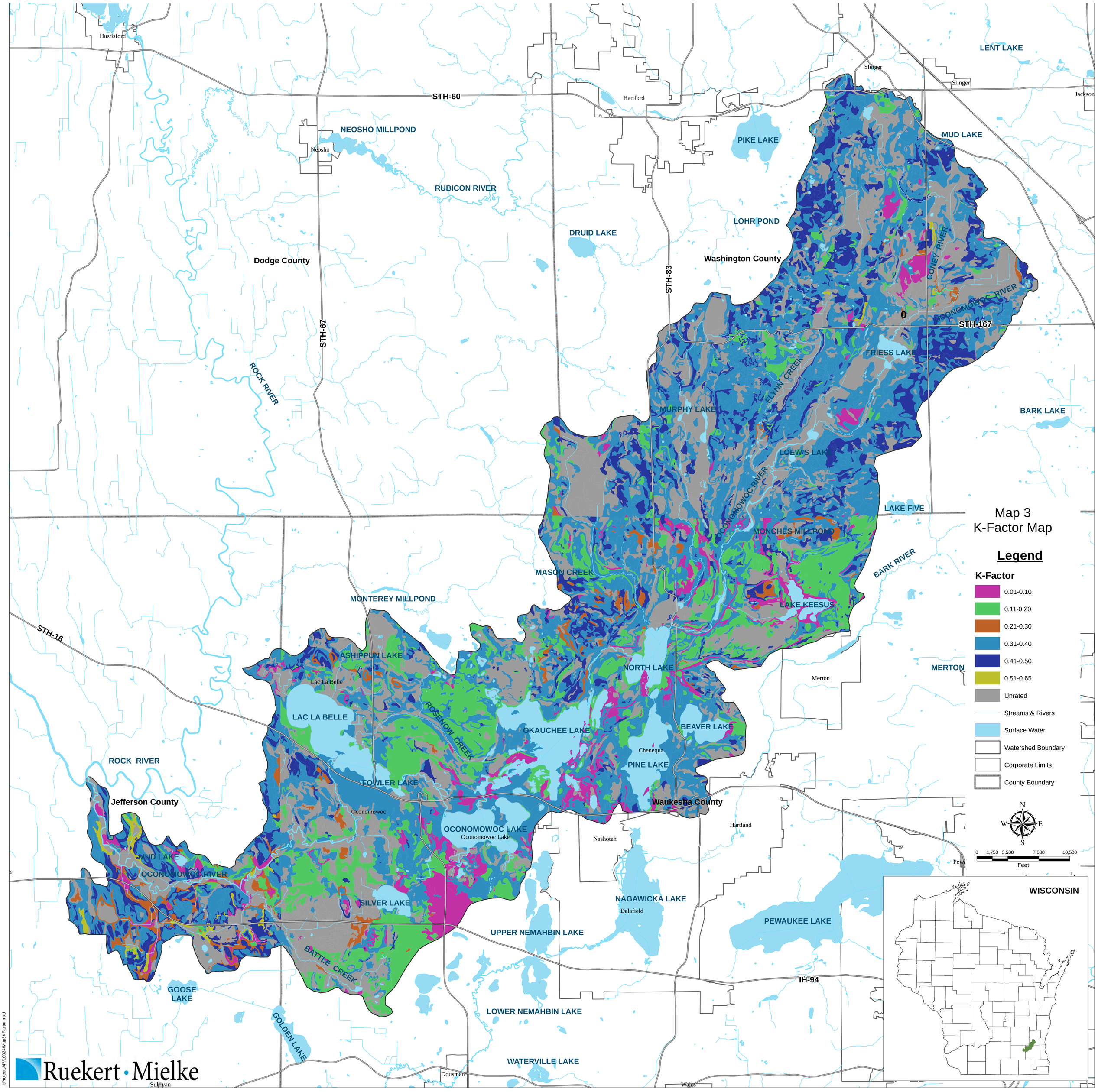
0 1,750 3,500 7,000 10,500
Feet

WISCONSIN

Ruekert · Mielke

Source: Tiger, WiDNR, WisconsinView

I:\Projects\47\10024\Map2Water.mxd


Map 3
K-Factor Map
Legend
K-Factor
0.01-0.10
0.11-0.20
0.21-0.30
0.31-0.40
0.41-0.50
0.51-0.65
Unrated
Streams & Rivers
Surface Water
Watershed Boundary
Corporate Limits
County Boundary
N
W
E
S
0 1,750 3,500 7,000 10,500
Feet
WISCONSIN
Dodge County
Washington County
Jefferson County
Waukesha County
Hustisford
Hartford
Slinger
Jackson
Neosho
Merton
Chenequa
Nashotah
Hartland
Delafield
Oconomowoc
Oconomowoc Lake
Lac La Belle
Sullivan
Dousman
Wales
STH-60
STH-67
STH-83
STH-167
STH-16
IH-94
LENT LAKE
MUD LAKE
PIKE LAKE
NEOSHO MILLPOND
RUBICON RIVER
LOHR POND
DRUID LAKE
CONEY RIVER
OCONOMOWOC RIVER
FRIESS LAKE
ELVAIN CREEK
MURPHY LAKE
BARK LAKE
LOEW'S LAKE
LAKE FIVE
MONCHES MILLPOND
BARK RIVER
MASON CREEK
LAKE KEESUS
MONTEREY MILLPOND
ROCK RIVER
ASHIPPUN LAKE
NORTH LAKE
MERTON
ROSENOW CREEK
LAC LA BELLE
OKAUCHEE LAKE
BEAVER LAKE
PINE LAKE
FOWLER LAKE
OCONOMOWOC LAKE
MUD LAKE
OCONOMOWOC RIVER
SILVER LAKE
NAGAWICKA LAKE
PEWAUKEE LAKE
UPPER NEMAHBIN LAKE
BATTLE CREEK
GOOSE LAKE
GOLDEN LAKE
LOWER NEMAHBIN LAKE
WATERVILLE LAKE
Ruekert·Mielke
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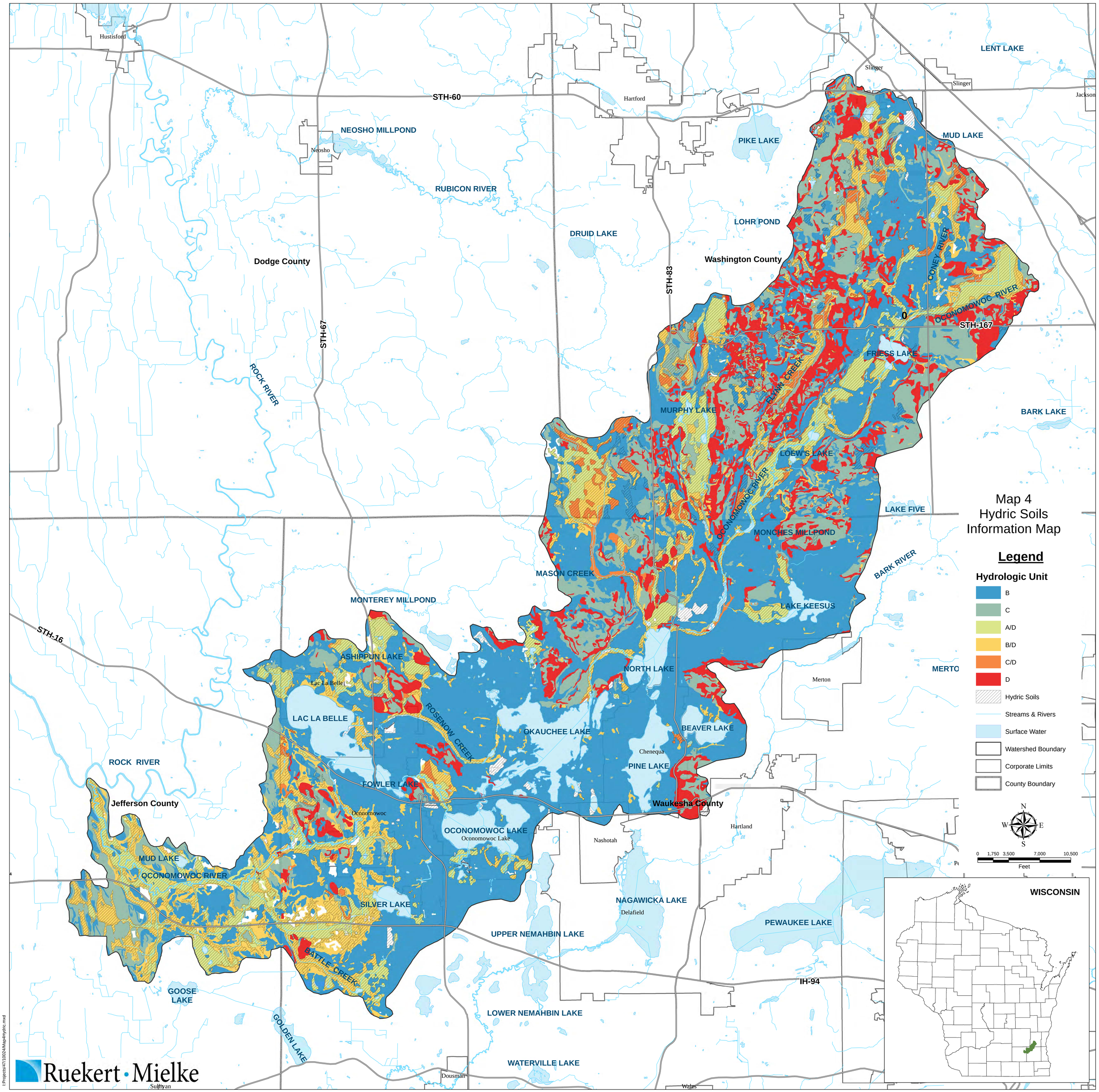
Source: Tiger, NRCS



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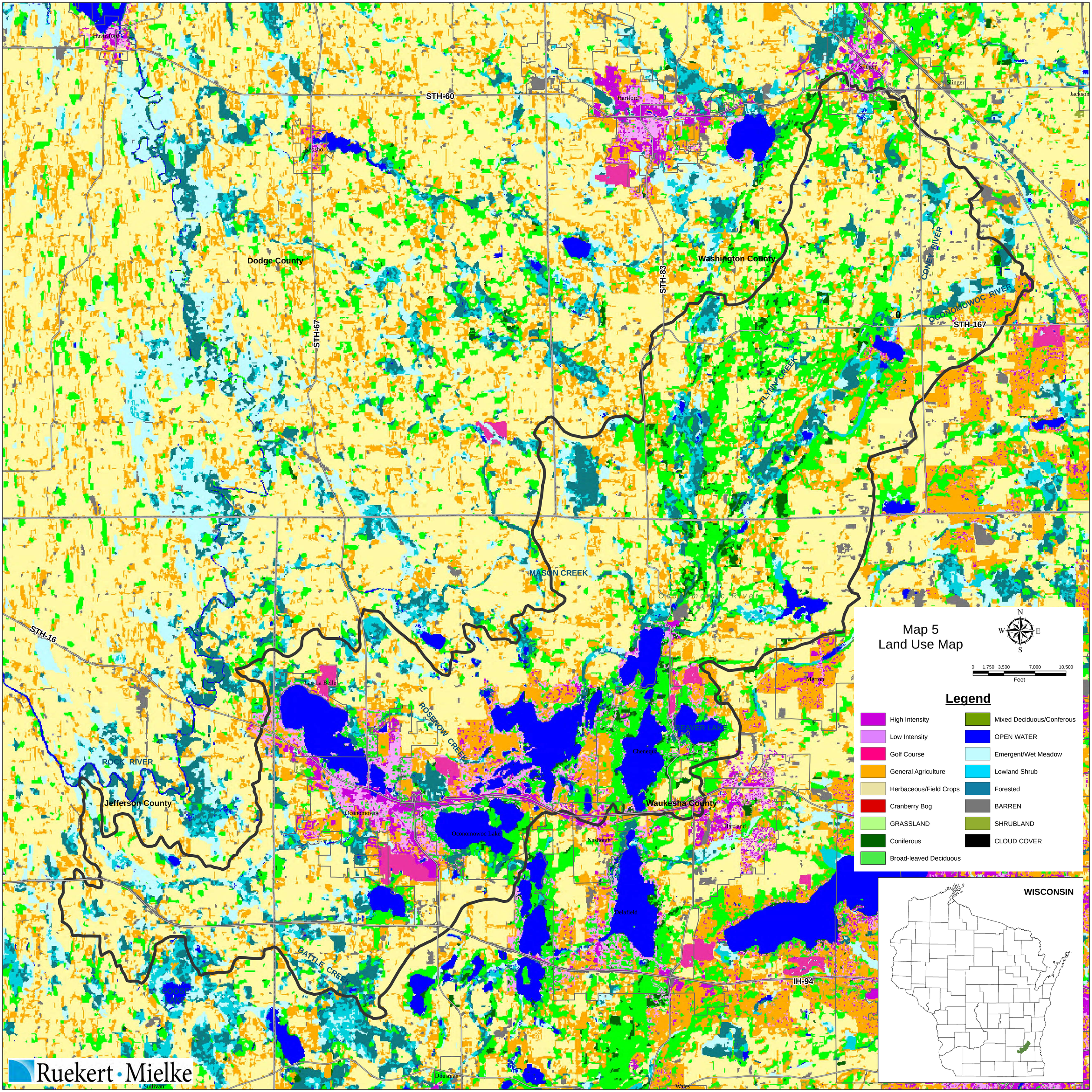
Map 5
Land Use Map
N
W
E
S
0 1,750 3,500 7,000 10,500
Feet
Legend
High Intensity
Low Intensity
Golf Course
General Agriculture
Herbaceous/Field Crops
Cranberry Bog
GRASSLAND
Coniferous
Broad-leaved Deciduous
Mixed Deciduous/Conferous
OPEN WATER
Emergent/Wet Meadow
Lowland Shrub
Forested
BARREN
SHRUBLAND
CLOUD COVER
WISCONSIN
Hustisford
Hartford
Slinger
Jackson
Neosho
Dodge County
Washington County
Waukesha County
Jefferson County
STH-60
STH-67
STH-83
STH-167
STH-16
IH-94
CONEY RIVER
OCONOMOWOC RIVER
FLYNN CREEK
MASON CREEK
ROSENOW CREEK
BATTLE CREEK
ROCK RIVER
BEAVER LAKE
Lac La Belle
Oconomowoc
Oconomowoc Lake
Chenequa
Nashotah
Merton
Hartland
Delafield
Dousman
Wales
Sullivan
Ruekert · Mielke
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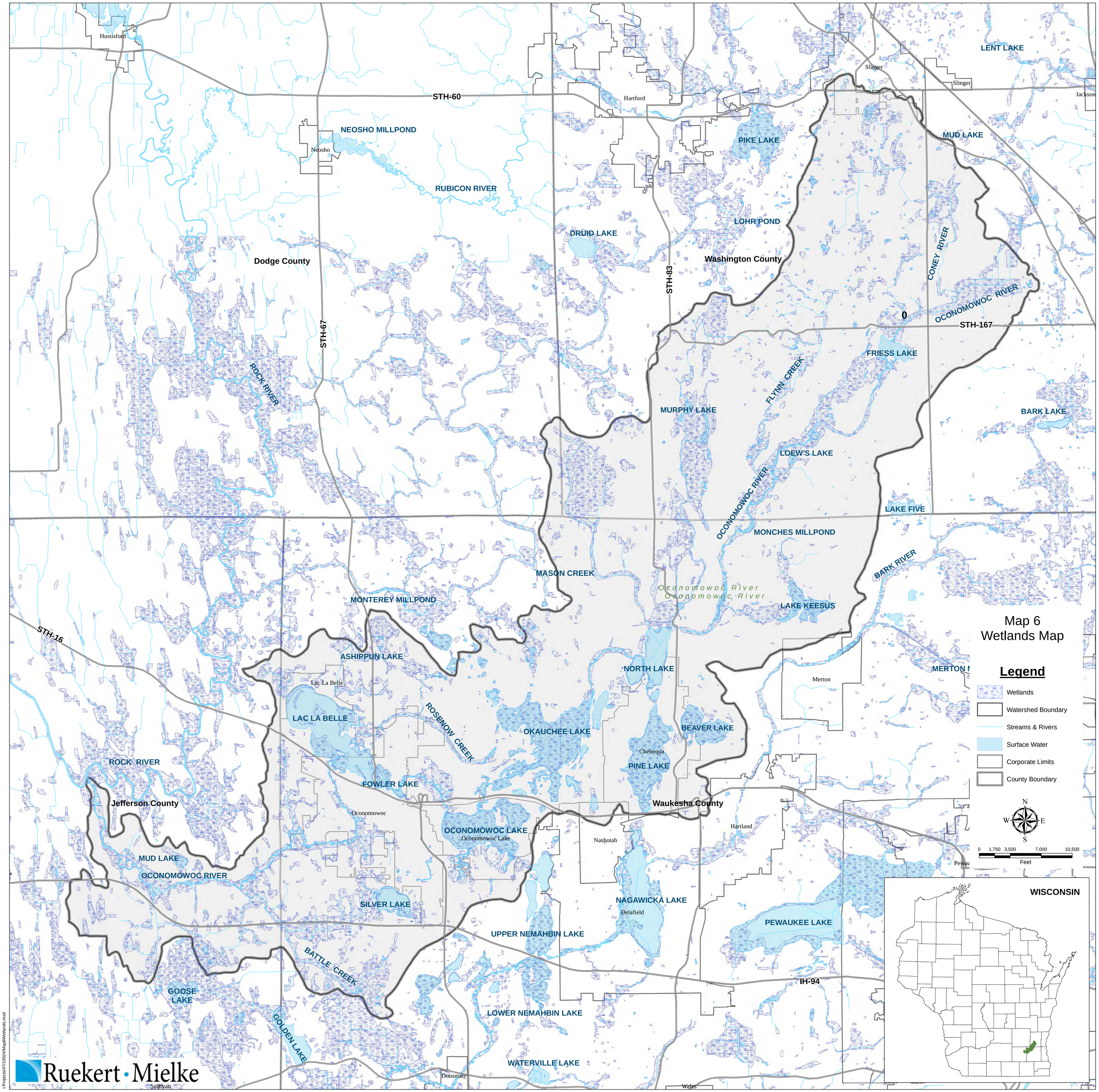
Source: Tiger, WiDNR


Map 6
Wetlands Map
Legend
Wetlands
Watershed Boundary
Streams & Rivers
Surface Water
Corporate Limits
County Boundary
N
W
E
S
0 1,750 3,500 7,000 10,500
Feet
WISCONSIN
Ruekert • Mielke
Source: Tiger, WiDNR
Hustisford
Hartford
Slinger
Jackson
Neosho
Merton
Chenequa
Oconomowoc
Oconomowoc Lake
Nashotah
Hartland
Delafield
Pewau
Lac La Belle
Sullivan
Dousman
Wales
STH-60
STH-67
STH-83
STH-167
STH-16
IH-94
LENT LAKE
NEOSHO MILLPOND
RUBICON RIVER
PIKE LAKE
MUD LAKE
LOHR POND
DRUID LAKE
Dodge County
Washington County
CONEY RIVER
OCONOMOWOC RIVER
FRIESS LAKE
ROCK RIVER
FLYNN CREEK
MURPHY LAKE
BARK LAKE
LOEW'S LAKE
LAKE FIVE
MONCHES MILLPOND
BARK RIVER
MASON CREEK
Oconomowoc River
LAKE KEESUS
MONTEREY MILLPOND
ASHIPPUN LAKE
NORTH LAKE
MERTON
LAC LA BELLE
ROSENOW CREEK
OKAUCHEE LAKE
BEAVER LAKE
PINE LAKE
FOWLER LAKE
Jefferson County
Waukesha County
OCONOMOWOC LAKE
MUD LAKE
SILVER LAKE
NAGAWICKA LAKE
PEWAUKEE LAKE
UPPER NEMAHBIN LAKE
BATTLE CREEK
GOOSE LAKE
GOLDEN LAKE
LOWER NEMAHBIN LAKE
WATERVILLE LAKE
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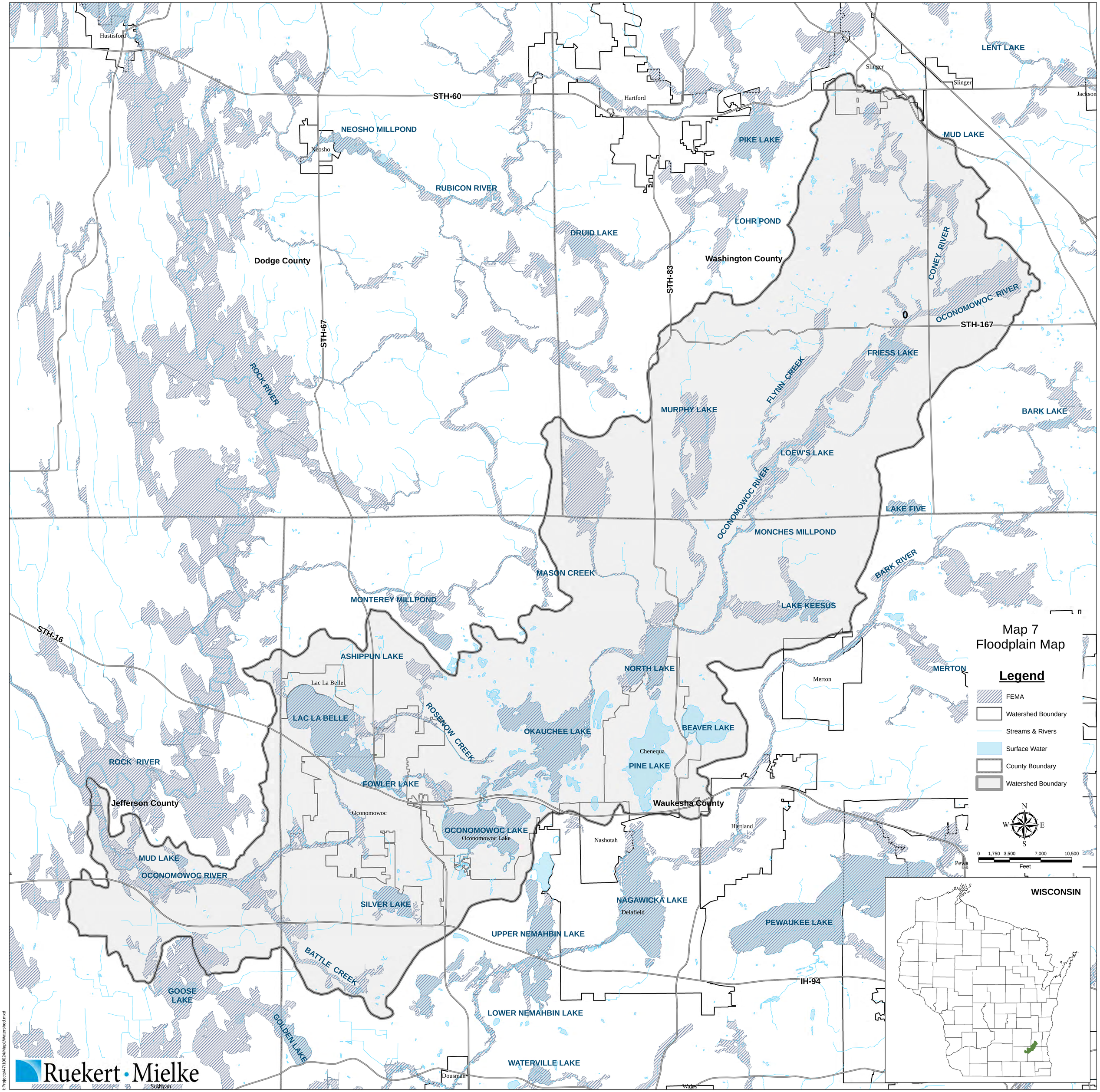
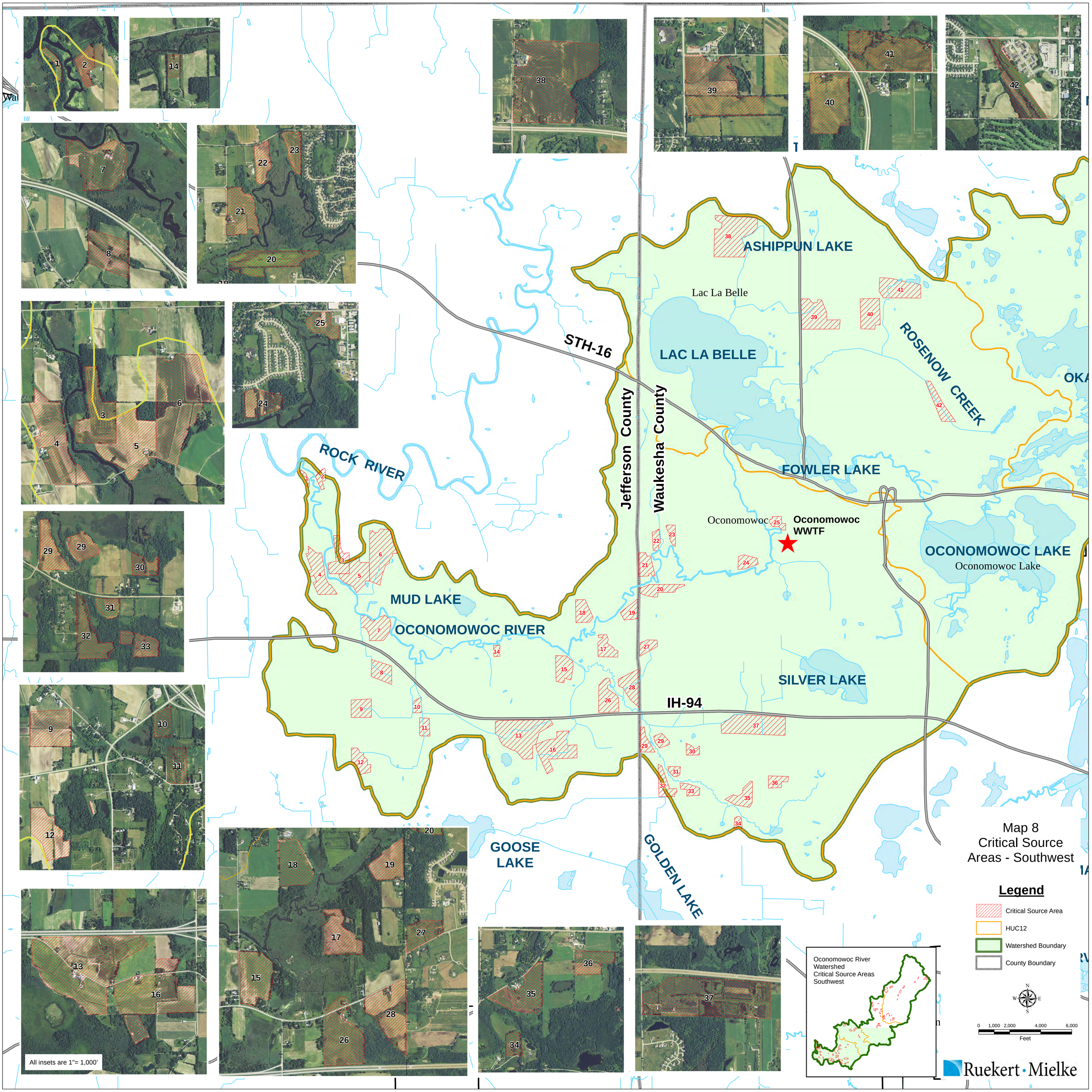


Source: Tiger, WiDNR, FEMA



Source: WiDNR, WisconsinView

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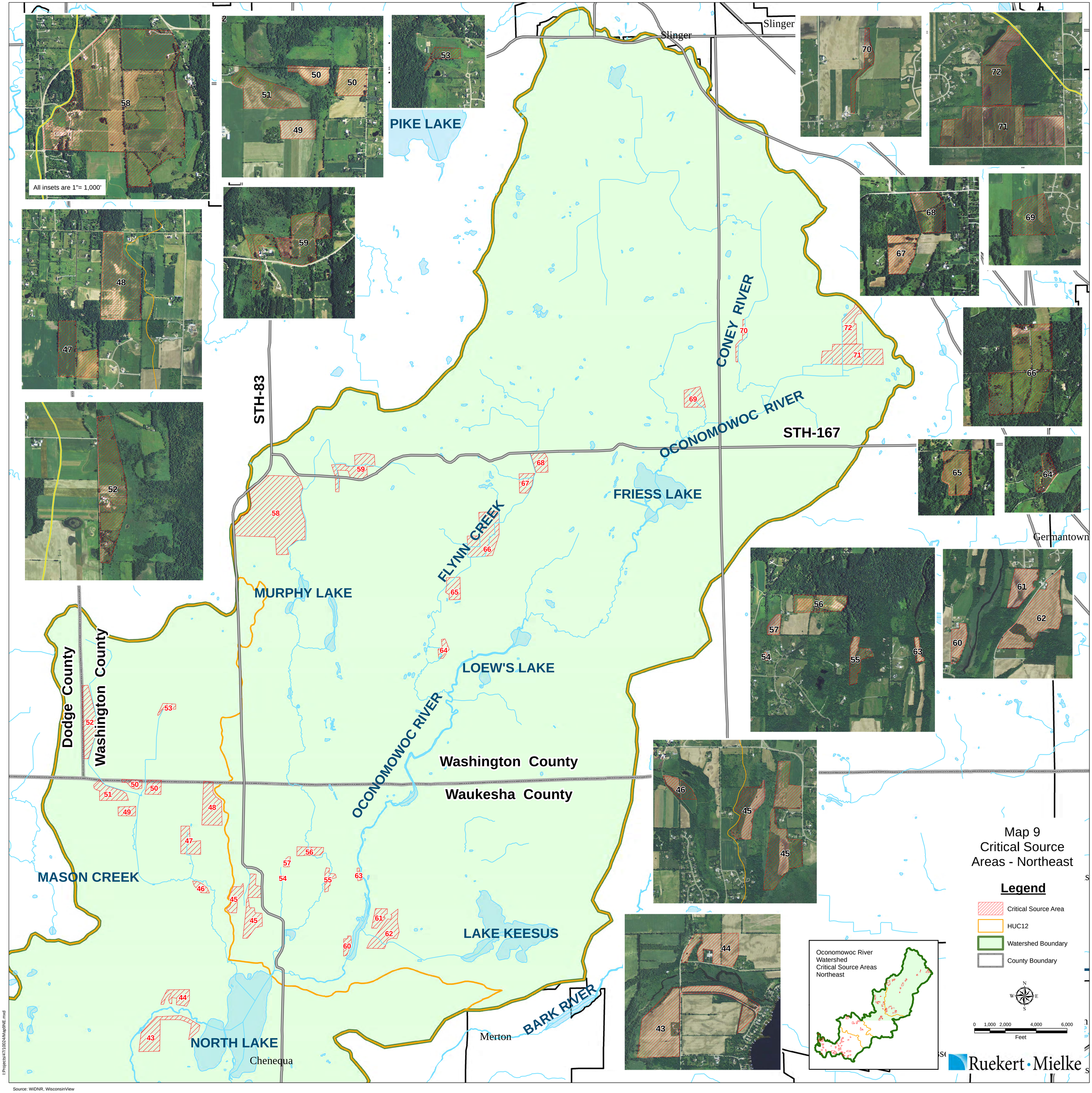

Source: WiDNR, WisconsinView

Appendix C

Phosphorus Monitoring Results

Oconomowoc River Sites	Site #	4/30/2014	5/13/2014	5/27/2014	6/18/2014	7/16/2014	7/30/2014	8/12/2014	9/16/2014	10/16/2014	11/13/2014	12/15/2014	1/2/2015	1/15/2015
Ocon Rvr McNamara Farm	18						0.056	0.137	0.054	0.105	0.064	0.089	0.059	
Ocon Rvr Hwy F	16								0.037	0.031	0.057	0.077		
Ocon Rvr Downstream Plant	14			0.02	0.13	0.04	0.061	0.098	0.139	0.034	0.058	0.045		0.072
Ocon Rvr Upstream Plant	13			0.02	0.04	0.007	0.033	0.026	0.02	0.004	0.018	0.027		0.037
Lac LaBelle Dam	12	0.03					0.014	0.032	0.022	0.008	0.026	0.019		0.056
Fowler Lake Dam	10							0.06	0.019	0.006	0.011	0.017		0.023
Ocon Rvr Cemetary	9							0.029	0.037	0.003	0.011	0.015		
Ocon Lake Dam	8							0.018	0.016	0.026	0.02	0.025		
Okauchee Dam Hwy 16	7							0.026	0.02	0.004	0.042	0.024		0.025
Ocon Rvr Hwy K	6							0.015	0.019	0.003	0.03	0.053		0.067
Ocon Rvr Hwy 83	5	0.04	0.17		0.13		0.028	0.032	0.033	0.007	0.022	0.037		
Hwy Q Monches Pond	2						0.014	0.028	0.052	0.08	0.023	0.037		
Hubertus Rd	0									0.001	0.061	0.093		
Hwy 167	01									0.05	0.063	0.084		0.089

Offshoot and Rock River Sites	Site #	4/30/2014	5/13/2014	5/27/2014	6/18/2014	7/16/2014	7/30/2014	8/12/2014	9/16/2014	10/16/2014	11/13/2014	12/15/2014	1/2/2015	1/15/2015
Rock River Hwy P/E	19							0.371	0.301	0.172	0.178	0.092		
Rock River Hwy F	17							0.381	0.305	0.213	0.205	0.1		
Battle Cr Hwy B	15						0.025	0.051	0.065	0.034	0.03	0.125		
Rosenow Cr Blackhawk	11							0.063	0.071	0.03	0.061	0.053		
Mason Cr N. Woods Dr.	4	0.06			0.5		0.049	0.072	0.054	0.038	0.037	0.056		
Mason Cr CW	3	0.04	0.13		0.38		0.067	0.039	0.143	0.042	0.033	0.041		
Flynn Creek Emerald Rd	1						0.03	0.07	0.041	0.023	0.018	0.039		0.065

* All values reported are for Total Phosphorus expressed in mg/L. See Map 1 in Appendix B for site locations.

Appendix D

Soil Information

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
Ac	Adrian muck	173.59	0.21%	-	-	Yes	A/D	Very poorly drained	None
AcA	Ackmore silt loam, 0 to 3 percent slopes	17.77	0.02%	0.32	-	Yes	C	Somewhat poorly drained	Occasional
Ad	Adrian muck	317.76	0.38%	-	-	Yes	A/D	Very poorly drained	Frequent
Ak	Adrian mucky peat	45.25	0.05%	-	-	Yes	A/D	Poorly drained	None
Am	Alluvial land	6.67	0.01%	0.28	-	Yes	-	Moderately well drained	Frequent
AzA	Aztalan fine sandy loam, 0 to 3 percent slopes	28.61	0.03%	0.24	-	No	C	Somewhat poorly drained	Rare
BaA	Barry silt loam, 0 to 3 percent slopes	27.21	0.03%	0.32	-	Yes	B/D	Poorly drained	Rare
BmB	Boyer loamy sand, 2 to 6 percent slopes	12.21	0.01%	0.15	-	No	A/D	Well drained	None
BmC2	Boyer loamy sand, 6 to 12 percent slopes, eroded	9.64	0.01%	0.15	-	No	A/D	Well drained	None
BnB	Boyer sandy loam, 1 to 6 percent slopes	101.74	0.12%	0.15	-	No	A/D	Well drained	None
BoC	Boyer loamy sand, 6 to 12 percent slopes	21.55	0.03%	0.17	-	No	A/D	Well drained	None
BpB	Boyer sandy loam, 1 to 6 percent slopes	47.61	0.06%	0.17	-	No	A/D	Well drained	None
BrE2	Boyer complex, 12 to 30 percent slopes, eroded	4.86	0.01%	0.15	-	No	A/D	Well drained	None
BsA	Brookston silt loam, 0 to 3 percent slopes	909.79	1.09%	0.32	-	Yes	B/D	Poorly drained	None
CaB2	Casco loam, 2 to 6 percent slopes, eroded	121.84	0.15%	0.32	Class 3	No	B	Somewhat excessively drained	None
CaC2	Casco loam, 6 to 12 percent slopes, eroded	104.28	0.12%	0.32	-	No	B	Somewhat excessively drained	None
CcB	Casco loam, 2 to 6 percent slopes	67.39	0.08%	0.28	Class 1	No	B	Somewhat excessively drained	None
CcC2	Casco loam, 6 to 12 percent slopes, eroded	68.50	0.08%	0.32	Class 2	No	B	Somewhat excessively drained	None
CcD2	Casco loam, 12 to 20 percent slopes, eroded	52.61	0.06%	0.24	Class 2	No	B	Somewhat excessively drained	None
CeB	Casco loam, 2 to 6 percent slopes	897.03	1.07%	0.32	Class 1	No	B	Somewhat excessively drained	None
CeB2	Casco loam, 2 to 6 percent slopes, eroded	471.46	0.56%	0.32	Class 3	No	B	Somewhat excessively drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
CeC2	Casco loam, 6 to 12 percent slopes, eroded	2487.55	2.97%	0.32	Class 2	No	B	Somewhat excessively drained	None
CeD2	Casco loam, 12 to 20 percent slopes, eroded	2134.83	2.55%	0.32	Class 2	No	B	Somewhat excessively drained	None
CfC3	Casco soils, 6 to 12 percent slopes, severely eroded	34.20	0.04%	0.28	-	No	B	Well drained	None
CkC2	Casco-Fox loams, 6 to 12 percent slopes, eroded	282.25	0.34%	0.32	-	No	B	Well drained	None
CrC2	Casco-Rodman complex, 6 to 12 percent slopes, eroded	62.83	0.08%	0.32	Class 2	No	B	Somewhat excessively drained	None
CrD	Casco-Rodman complex, 12 to 20 percent slopes	512.52	0.61%	0.32	-	No	B	Well drained	None
CrD2	Casco-Rodman complex, 12 to 20 percent slopes, eroded	474.06	0.57%	0.32	Class 2	No	B	Somewhat excessively drained	None
CrE	Casco-Rodman complex, 20 to 30 percent slopes	2961.01	3.54%	0.32	Class 1	No	B	Somewhat excessively drained	None
CrF	Casco-Rodman complex, 30 to 45 percent slopes	813.43	0.97%	0.32	Class 1	No	B	Somewhat excessively drained	None
CtB	Chelsea loamy fine sand, 1 to 6 percent slopes	1.19	0.00%	0.1	-	No	A	Excessively drained	None
Cv	Clayey land	0.79	0.00%	-	-	No	D	Moderately well drained	None
Cw	Colwood silt loam, 0 to 2 percent slopes	145.21	0.17%	0.32	None - deposition	Yes	C/D	Poorly drained	None
DdA	Dodge silt loam, 0 to 2 percent slopes	281.98	0.34%	0.43	-	No	B	Well drained	None
DdB	Dodge silt loam, 2 to 6 percent slopes	999.29	1.19%	0.43	-	No	B	Well drained	None
DsA	Dresden silt loam, 1 to 3 percent slopes	133.97	0.16%	0.32	-	No	B	Well drained	None
Dt	Drummer silt loam, gravelly substratum	327.28	0.39%	0.32	-	Yes	B/D	Poorly drained	None
EbA	Elburn silt loam, 0 to 3 percent slopes	0.01	0.00%	0.32	-	No	C	Somewhat poorly drained	None
Ev	Elvers silt loam	6.43	0.01%	0.55	-	Yes	B/D	Very poorly drained	Frequent
FaA	Fabius loam, 1 to 3 percent slopes	57.88	0.07%	0.32	-	Yes	B	Somewhat poorly drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
FmA	Fox sandy loam, 0 to 2 percent slopes	113.77	0.14%	0.24	-	No	B	Well drained	None
FmB	Fox sandy loam, 2 to 6 percent slopes	108.68	0.13%	0.24	-	No	B	Well drained	None
FmC2	Fox sandy loam, 6 to 12 percent slopes, eroded	45.46	0.05%	0.24	-	No	B	Well drained	None
Fn	Fluvaquents	5.73	0.01%	-	-	Yes	D	Poorly drained	Frequent
FoA	Fox loam, 0 to 2 percent slopes	646.60	0.77%	0.37	-	No	B	Well drained	None
FoB	Fox loam, 2 to 6 percent slopes	848.46	1.01%	0.37	-	No	B	Well drained	None
FoC2	Fox loam, 6 to 12 percent slopes, eroded	256.88	0.31%	0.37	-	No	B	Well drained	None
FsA	Fox silt loam, 0 to 2 percent slopes	6055.01	7.23%	0.43	-	No	B	Well drained	None
FsB	Fox silt loam, 2 to 6 percent slopes	8688.88	10.37%	0.32	Class 1	No	B	Well drained	None
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	412.63	0.49%	0.43	-	No	B	Well drained	None
FsD2	Fox silt loam, 12 to 18 percent slopes, eroded	8.46	0.01%	0.43	-	No	B	Well drained	None
FtB	Fox silt loam, loamy substratum, 2 to 6 percent slopes	6.64	0.01%	0.43	-	No	B	Well drained	None
Gd	Gilford sandy loam	93.14	0.11%	0.1	-	Yes	A/D	Very poorly drained	Frequent
GP	Gravel pit	312.22	0.37%	0.02	-	Yes	-	-	None
GrA	Grays silt loam, 0 to 2 percent slopes	50.24	0.06%	0.37	-	No	B/D	Moderately well drained	None
GrB	Grays silt loam, 2 to 6 percent slopes	31.12	0.04%	0.37	-	No	C	Moderately well drained	None
HeB	Hebron loam, 1 to 6 percent slopes	20.15	0.02%	0.37	-	No	C	Well drained	None
HmB	Hochheim loam, 2 to 6 percent slopes	433.16	0.52%	0.32	-	No	D	Well drained	None
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	1270.66	1.52%	0.32	-	No	D	Well drained	None
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	4121.40	4.92%	0.32	Class 2	No	D	Well drained	None
HmD2	Hochheim loam, 12 to 20 percent slopes, eroded	2294.84	2.74%	0.37	Class 2	No	D	Well drained	None
HmE	Hochheim loam, 20 to 30 percent slopes	253.79	0.30%	0.37	Class 2	No	D	Well drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
HmE2	Hochheim loam, 20 to 30 percent slopes, eroded	280.22	0.33%	0.37	Class 2	No	D	Well drained	None
HnB	Hochheim silt loam, 2 to 6 percent slopes	0.61	0.00%	0.43	Class 2	No	C	Well drained	None
HnC2	Hochheim silt loam, 6 to 12 percent slopes, eroded	0.55	0.00%	0.49	Class 2	No	C	Well drained	None
HnD2	Hochheim silt loam, 12 to 20 percent slopes, eroded	2.32	0.00%	0.49	Class 2	No	D	Well drained	None
HoC3	Hochheim soils, 6 to 12 percent slopes, severely eroded	105.02	0.13%	0.17	-	No	B	Well drained	None
HoD3	Hochheim soils, 12 to 20 percent slopes, severely eroded	210.76	0.25%	0.17	-	No	B	Well drained	None
HoE3	Hochheim soils, 20 to 30 percent slopes, severely eroded	10.50	0.01%	0.17	-	No	B	Well drained	None
HrD	Hochheim-Hennepin complex, 12 to 20 percent slopes	152.05	0.18%	0.32	-	No	B	Well drained	None
HrE	Hochheim-Hennepin complex, 20 to 30 percent slopes	120.41	0.14%	0.32	-	No	B	Well drained	None
HrF	Hochheim-Hennepin complex, 30 to 45 percent slopes	145.43	0.17%	0.32	-	No	B	Well drained	None
Ht	Houghton muck	999.74	1.19%	-	-	Yes	A/D	Very poorly drained	Frequent
HtA	Houghton muck, 0 to 2 percent slopes	2167.48	2.59%	-	-	Yes	A/D	Very poorly drained	None
HtB	Houghton muck, 2 to 6 percent slopes	2.96	0.00%	-	-	Yes	A/D	Very poorly drained	None
Hu	Houghton muck	2990.43	3.57%	-	-	Yes	A/D	Very poorly drained	Frequent
Hv	Houghton peat, acid variant	6.98	0.01%	-	-	Yes	A/D	Very poorly drained	Rare
IoA	Ionia silt loam, 0 to 3 percent slopes	51.62	0.06%	0.43	-	No	C	Moderately well drained	None
JuA	Juneau silt loam, 1 to 3 percent slopes	466.56	0.56%	0.49	-	No	B/D	Well drained	Occasional
JuB	Juneau silt loam, 1 to 6 percent slopes	21.55	0.03%	0.49	-	No	B	Well drained	Occasional
Kb	Keowns silt loam	270.42	0.32%	0.28	-	Yes	B/D	Poorly drained	Frequent
KdA	Kibbie fine sandy loam, 0 to 3 percent slopes	62.54	0.07%	0.2	-	No	B/D	Somewhat poorly drained	Rare
KfB	Kidder loam, 2 to 6 percent slopes	82.65	0.10%	0.32	-	No	B	Well drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
KfC2	Kidder loam, 6 to 12 percent slopes, eroded	58.49	0.07%	0.32	-	No	B	Well drained	None
KgB	Kidder loam, moderately well-drained, 2 to 6 percent slopes	0.83	0.00%	0.32	-	No	B	Moderately well drained	None
KlA	Kendall silt loam, 1 to 3 percent slopes	438.64	0.52%	0.43	-	Yes	B/D	Somewhat poorly drained	None
Km	Keowns silt loam	4.90	0.01%	0.32	-	Yes	B/D	Poorly drained	None
LaB	Lamartine silt loam, 2 to 6 percent slopes	510.97	0.61%	0.32	None - deposition	No	C	Somewhat poorly drained	None
LDF	Landfill	1.96	0.00%	-	-	-	-	-	-
LmA	Lamartine silt loam, 0 to 2 percent slopes	573.60	0.68%	0.32	-	Yes	C	Somewhat poorly drained	None
LmB	Lamartine silt loam, 2 to 6 percent slopes	174.72	0.21%	0.32	None - deposition	Yes	C	Somewhat poorly drained	None
Lu	Loamy land	108.33	0.13%	-	-	No	B	Moderately well drained	None
LyB2	Lorenzo loam, 2 to 6 percent slopes, eroded	10.32	0.01%	0.24	-	No	B	Well drained	None
Mf	Marsh	175.97	0.21%	-	-	Yes	-	Very poorly drained	None
MgA	Martinton silt loam, 1 to 3 percent slopes	56.42	0.07%	0.28	-	Yes	C/D	Somewhat poorly drained	None
MhA	Matherton sandy loam, 1 to 3 percent slopes	214.26	0.26%	0.15	-	No	B/D	Somewhat poorly drained	None
MmA	Matherton silt loam, 0 to 3 percent slopes	2141.18	2.56%	0.32	-	No	B/D	Somewhat poorly drained	Rare
MoA	Mayville silt loam, 0 to 2 percent slopes	100.61	0.12%	0.43	-	No	C	Moderately well drained	None
MoB	Mayville silt loam, 2 to 6 percent slopes	821.11	0.98%	0.43	-	No	C	Moderately well drained	None
MtA	Mequon silt loam, 1 to 3 percent slopes	3.44	0.00%	0.43	-	No	C/D	Somewhat poorly drained	None
MxD2	Miami loam, sandy loam substratum, 12 to 20 percent slopes, eroded	23.34	0.03%	0.37	-	No	B	Well drained	None
MxE	Miami loam, sandy loam substratum, 20 to 30 percent slopes	1.99	0.00%	0.37	-	No	B	Well drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
Mzb	Montgomery silty clay loam	18.42	0.02%	0.24	-	Yes	C/D	Poorly drained	Frequent
MzfA	Mundelein silt loam, 1 to 3 percent slopes	55.62	0.07%	0.32	-	No	B/D	Somewhat poorly drained	None
Mzk	Mussey loam	114.48	0.14%	0.24	-	Yes	B/D	Poorly drained	None
MzkA	Mussey loam, 0 to 3 percent slopes	88.65	0.11%	0.28	-	Yes	B/D	Poorly drained	None
Na	Navan silt loam	17.69	0.02%	0.37	-	Yes	C/D	Poorly drained	Rare
NnA	Nenno silt loam, 1 to 3 percent slopes	22.78	0.03%	0.2	-	No	B/D	Somewhat poorly drained	None
Oc	Ogden muck	83.63	0.10%	-	-	Yes	C/D	Very poorly drained	None
OnB	Oshtemo sandy loam, 1 to 6 percent slopes	99.02	0.12%	0.28	-	No	A	Well drained	None
Ot	Otter silt loam	40.36	0.05%	0.28	-	Yes	B/D	Poorly drained	Frequent
OuB	Ozaukee silt loam, 2 to 6 percent slopes	8.06	0.01%	0.43	-	No	C	Well drained	None
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	13.38	0.02%	0.43	-	No	C	Well drained	None
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	18.97	0.02%	0.43	-	No	C	Well drained	None
OuD2	Ozaukee silt loam, 12 to 20 percent slopes, eroded	4.72	0.01%	0.43	-	No	C	Well drained	None
Pa	Palms muck, 0 to 2 percent slopes	878.20	1.05%	-	None - deposition	Yes	B/D	Very poorly drained	None
Pc	Palms mucky peat, 0 to 2 percent slopes	1224.28	1.46%	-	-	Yes	B/D	Very poorly drained	None
Pg	Pits, gravel	15.69	0.02%	0.02	-	Yes	-	-	None
Ph	Pella silty clay loam, cool, 0 to 2 percent slopes	1355.02	1.62%	0.32	None - deposition	Yes	C/D	Poorly drained	None
PrA	Pistakee silt loam, 1 to 3 percent slopes	299.67	0.36%	0.49	-	No	C	Somewhat poorly drained	Occasional
RaA	Radford silt loam, 0 to 3 percent slopes	392.79	0.47%	0.43	-	No	C	Somewhat poorly drained	Frequent
RtB	Rotamer loam, 2 to 6 percent slopes	129.26	0.15%	0.37	-	No	B	Well drained	None
RtC2	Rotamer loam, 6 to 12 percent slopes, eroded	287.93	0.34%	0.37	-	No	B	Well drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
RtD2	Rotamer loam, 12 to 20 percent slopes, eroded	122.46	0.15%	0.37	-	No	B	Well drained	None
RtE2	Rotamer loam, 20 to 30 percent slopes, eroded	5.30	0.01%	0.37	-	No	B	Well drained	None
Ru	Rollin muck, deep	18.74	0.02%	-	-	Yes	B/D	Very poorly drained	None
RxD2	Rodman-Casco complex, 12 to 30 percent slopes, eroded	46.61	0.06%	0.17	-	No	A	Excessively drained	None
ScA	St. Charles silt loam, 0 to 2 percent slopes	384.96	0.46%	0.37	None - deposition	Yes	B	Well drained	None
ScB	St. Charles silt loam, 2 to 6 percent slopes	373.42	0.45%	0.43	None - deposition	Yes	B	Well drained	None
SdA	St. Charles silt loam, moderately well drained, 0 to 2 percent slopes	2.14	0.00%	0.37	Class 1	No	B	Well drained	None
SeA	St. Charles silt loam, gravelly subtratum, 0 to 2 percent slopes	1931.15	2.31%	0.37	-	No	B	Well drained	None
SeB	St. Charles silt loam, gravelly subtratum, 2 to 6 percent slopes	379.24	0.45%	0.43	Class 1	No	B	Well drained	None
Sf	Sandy and gravelly land	159.14	0.19%	-	-	No	D	Moderately well drained	None
SfB	St. Charles silt loam, moderately well-drained, gravelly substratum, 2 to 6 percent slopes	12.40	0.01%	0.32	-	No	C	Moderately well drained	None
Sg	Sawmill silt loam, calcareous variant	0.85	0.00%	0.37	-	Yes	C/D	Poorly drained	Frequent
Sm	Sebewa silt loam	1752.10	2.09%	0.37	-	Yes	B/D	Poorly drained	Frequent
Sn	Sebewa silt loam, clayey substratum	17.70	0.02%	0.32	-	Yes	B/D	Poorly drained	Frequent
SoB	Sisson fine sandy loam, 1 to 6 percent slopes	15.77	0.02%	0.24	-	No	B	Well drained	None
SoC2	Sisson fine sandy loam, 6 to 12 percent slopes, eroded	11.57	0.01%	0.24	-	No	B	Well drained	None
SuD2	Sisson fine sandy loam, 12 to 25 percent slopes, eroded	0.39	0.00%	0.24	-	No	B	Well drained	None
SvB2	Sisson-Casco-Hochheim complex, 2 to 6 percent slopes, eroded	20.02	0.02%	0.43	-	No	B	Well drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
SvC2	Sisson-Casco-Hochheim complex, 6 to 12 percent slopes, eroded	68.01	0.08%	0.32	-	No	B	Well drained	None
SvD2	Sisson-Casco-Hochheim complex, 12 to 20 percent slopes, eroded	225.48	0.27%	0.32	-	No	B	Well drained	None
SvE	Sisson-Casco-Hochheim complex, 20 to 30 percent slopes	284.87	0.34%	0.32	-	No	B	Well drained	None
ThA	Theresa silt loam, 0 to 2 percent slopes	517.19	0.62%	0.49	Class 1	No	C	Well drained	None
ThB	Theresa silt loam, 2 to 6 percent slopes	4997.07	5.97%	0.49	None - deposition	No	C	Well drained	None
ThB2	Theresa silt loam, 2 to 6 percent slopes, eroded	2995.43	3.58%	0.49	Class 2	No	C	Well drained	None
ThC2	Theresa silt loam, 6 to 12 percent slopes, eroded	1318.55	1.57%	0.49	Class 2	No	C	Well drained	None
TuA	Tuscola silt loam, 0 to 2 percent slopes	4.34	0.01%	0.37	-	No	C	Moderately well drained	None
TuB	Tuscola silt loam, 2 to 6 percent slopes	4.17	0.00%	0.37	-	No	C	Moderately well drained	None
Ud	Udorthents	76.73	0.09%	-	-	No	A	Well drained	None
VrB	Virgil silt loam, 2 to 6 percent slopes	10.67	0.01%	0.43	-	Yes	C	Somewhat poorly drained	None
VsA	Virgil silt loam, gravelly substratum, 0 to 3 percent slopes	156.38	0.19%	0.37	-	No	B/D	Somewhat poorly drained	Occasional
VwA	Virgil silt loam, gravelly substratum, 0 to 3 percent slopes	33.49	0.04%	0.43	-	No	C	Somewhat poorly drained	Frequent
W	Water	6435.96	7.68%	-	-	-	-	-	-
Wa	Wacousta silty clay loam, 0 to 2 percent slopes	373.17	0.45%	0.32	-	Yes	B/D	Very poorly drained	None
WeB	Warsaw loam, 2 to 6 percent slopes	37.72	0.05%	0.24	-	No	B	Well drained	None
WhA	Warsaw silt loam, 0 to 2 percent slopes	528.38	0.63%	0.28	-	No	B	Well drained	None
WmA	Wasepi sandy loam, 0 to 3 percent slopes	188.93	0.23%	0.15	-	No	A/D	Somewhat poorly drained	Rare
WtA	Watseka variant loamy sand, 0 to 3 percent slopes	6.52	0.01%	0.05	-	Yes	A	Somewhat poorly drained	None

Soil Symbol	Soil Name	Area (ac)	% Cover	K factor (K.w)	Class of Accelerated Erosion (SSM)	Hydric Rating	Hydrologic soil group	Drainage Condition	Frequency of flooding
WvA	Wauconda silt loam, 0 to 2 percent slopes	2.57	0.00%	0.37	-	No	C	Somewhat poorly drained	None
WvB	Wauconda silt loam, 2 to 6 percent slopes	2.14	0.00%	0.37	-	Yes	C	Somewhat poorly drained	None
Ww	Wet alluvial land	128.17	0.15%	0.28	-	Yes	-	Poorly drained	Frequent
WxC2	Whalan loam, 6 to 12 percent slopes, eroded	1.05	0.00%	0.32	-	No	C	Well drained	None
ZuA	Zurich silt loam, 0 to 2 percent slopes	51.57	0.06%	0.43	-	No	B	Well drained	None
ZuB	Zurich silt loam, 2 to 6 percent slopes	0.46	0.00%	0.43	-	No	B	Well drained	None
ZuC2	Zurich silt loam, 6 to 12 percent slopes, eroded	4.27	0.01%	0.43	-	No	B	Well drained	None

Appendix E

Modeling Information

This section of the report will discuss the development and outputs of modeling software used to characterize the Oconomowoc River Watershed. Two main models were considered – the STEPL model and the SWAT model. The STEPL model was downloaded and utilized by the project team. Information about SWAT modeling done in the action area was obtained from the Rock River TMDL (The Cadmus Group, Inc., 2011). In this report, the WDNR used the SWAT model (for nonpoint sources) in conjunction with the SLAMM model (for point and urban sources) to generate baseline loading information and load allocations for the TMDL reaches in the Oconomowoc River Watershed. Our group utilized this information as a check for the results generated from the STEPL model.

Input data for the STEPL model was gathered from two main sources. First, all input fields were populated with sample data from the STEPL Model Input Data Server. Due to the organization of this data, the watershed was divided into each of the four HUC-12 areas represented in the Oconomowoc River Watershed for analysis (Watersheds W1, W2, W3, and W4 starting from the confluence with the Rock River). From this point, the input data was refined using the more accurate data received from partners of the project, particularly the county LWC Departments, and the most current GIS data. These revisions resulted in a significantly greater cropland to urban land use ratio and a greater amount of beef and dairy cattle incorporated in the model compared to the STEPL Model Input Data Server.

The sample data from the STEPL Input Data Server was used to populate the septic system information for the watershed as well as most of the default parameters for the USLE and Curve Number Method inputs. These default parameters included the soil and runoff concentrations of nitrogen, phosphorus, and biological oxygen demand. Some areas where the defaults were customized included the land use, agricultural statistics, and manure application rate. In particular, the user-defined land use column was used to reflect the large amount of wetlands in the action area. The model parameters for this custom wetland land use category were selected to reflect a meadow-type land area with relatively conservative soil and runoff nutrient concentrations. It was also assumed that manure was applied to cropland four months out of the year. While some amount of manure is applied to land throughout the year in this watershed, we assumed that the principal months of manure application occurred in the fall after harvest and in the spring before planting.

As mentioned in the body of the report, Table 1 was developed for the purpose of generating a single reduction efficiency for each pollutant and watershed in the model. This table can be seen below, and is organized based on increasing phosphorus reduction efficiency per land area. The approach used in developing this table involved considering several combinations of management measures that may be implemented on a field scale, and modeling them in the STEPL BMP (Best Management Practice) calculator. The various outputs of the BMP Calculator were then averaged, yielding the removal efficiencies used in the STEPL model. This approach was suggested by WDNR representatives during a nonpoint modeling training session. They referenced a similar approach taken by the Outagamie County Land Conservation

Department (2014), which was seen as an effective means of approximating removal efficiencies in the planning stages of a watershed restoration plan.

In addition to combinations of the default management measures in the STEPL program, two custom nutrient management reduction factors were considered in the development of Table 1. These nutrient management options were also adopted from the Outagamie County Land Conservation Department Report, with original authors being Evans and Corradini (2001). The first nutrient management option is a balanced plan, with reductions in nitrogen and phosphorus averaging 19% and 28%, respectively. The second option is a phosphorus-based plan with phosphorus reduction of about 75%. Several more combinations were considered in developing the average removal efficiencies used in the STEPL model than in the approach taken by the Outagamie County Land Conservation Department, reflecting the flexibility to be given to farmers when working with them. However, the overall results were very similar to the Outagamie County Land Conservation Department Report, which used values of 71% and 84% for phosphorus and sediment reduction, respectively.

Table 1. Average Nitrogen, Sediment, and Phosphorus Reductions for Various Management Measure Combinations

Management Measure	N Reduction	Sediment Reduction	P Reduction	P Reduction (lb/acre-year)
Nutrient Management (Balanced)	19.0%	0.0%	28.0%	0.44
Cover Crop	30.0%	35.0%	25.0%	0.58
Diversion	10.0%	35.0%	30.0%	0.65
Nutrient Management (Balanced), Cover Crop	43.3%	35.0%	46.0%	0.90
Diversion, Cover Crop	37.0%	57.7%	47.5%	1.05
Reduced Tillage	55.0%	75.0%	45.0%	1.10
Contour Farming	48.5%	40.5%	55.0%	1.07
Cover Crop, Reduced Tillage	68.5%	83.7%	58.7%	1.36
Nutrient Management (Balanced), Reduced Tillage	63.6%	75.0%	60.4%	1.34
Nutrient Management (P-Based)	0.0%	0.0%	75.0%	1.17
Diversion, Reduced Tillage	59.5%	83.7%	61.5%	1.40
Contour Farming, Cover Crop	64.0%	61.3%	66.3%	1.36
Filter Strip	70.0%	65.0%	75.0%	1.51
Nutrient Management (Balanced), Cover Crop, Contour Farming	70.8%	61.3%	75.7%	1.51
Nutrient Management (P-Based), Cover Crop	30.0%	35.0%	81.3%	1.45
Contour Farming, Reduced Tillage	76.8%	85.1%	75.2%	1.62
Nutrient Management (Balanced), Filter Strip	75.7%	65.0%	82.0%	1.62
Filter Strip, Cover Crop	79.0%	77.2%	81.3%	1.68

Management Measure	N Reduction	Sediment Reduction	P Reduction	P Reduction (lb/acre-year)
Diversion, Filter Strip	73.0%	77.2%	82.5%	1.70
Nutrient Management (P-Based), Reduced Tillage	55.0%	75.0%	86.3%	1.74
Filter Strip, Diversion, Cover Crop	81.1%	85.2%	86.9%	1.81
Filter Strip, Reduced Tillage	86.5%	91.3%	86.3%	1.83
Contour Farming, Filter Strip	84.5%	79.2%	88.7%	1.80
Nutrient Management (P-Based), Filter Strip	70.0%	65.0%	93.8%	1.81
Nutrient Management (Balanced), Reduced Tillage, Filter Strip	89.1%	91.3%	90.1%	1.89
Filter Strip, Reduced Tillage, Cover Crop	90.5%	94.3%	89.7%	1.90
Filter Strip, Diversion, Reduced Till	87.8%	94.3%	90.4%	1.91
Filter Strip, Diversion, Contour Farming	86.1%	86.5%	92.1%	1.89
Nutrient Management (P-Based), Reduced Tillage, Filter Strip	86.5%	91.3%	96.6%	1.99
Average:	**61.8%**	**65.6%**	**70.8%**	**1.45**

The average removal efficiencies developed in Table 1 were applied to the cropland and pastureland management measure areas for each of the four HUC-12s modeled in the action area. It was assumed that an average of 44% of the cropland and pastureland CSAs identified in Table 14 of the main body of the report would participate in the OWPP. With this assumption, the outputs shown below were generated from the STEPL model.

Table 2. Pollutant Loading and Reduction Before and After BMP Implementation.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	90287.4	19988.7	192846.5	3787.1	85440.6	18664.5	191197.9	3529.5
W2	50903.2	10269.0	127596.8	1884.9	50213.6	10080.6	127362.2	1848.2
W3	83608.2	17543.0	189510.4	3320.8	82894.5	17348.0	189267.6	3282.9
W4	182178.5	41087.3	360970.5	7867.1	180597.2	40667.2	360448.4	7785.6
Total	406977.3	88888.0	870924.2	16859.9	399145.9	86760.2	868276.0	16446.1

Watershed	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	4846.8	1324.2	1648.7	257.6	5.4	6.6	0.9	6.8
W2	689.6	188.4	234.6	36.7	1.4	1.8	0.2	1.9
W3	713.7	195.0	242.8	37.9	0.9	1.1	0.1	1.1
W4	1581.3	420.1	522.1	81.6	0.9	1.0	0.1	1.0
Total	7831.4	2127.7	2648.2	413.8	1.9	2.4	0.3	2.5

Table 3. Pollutant Loading Distribution By Land Use After Modeled Bmp Implementation.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	30393.64	4679.68	117464.66	697.29
Cropland	287087.37	70245.03	514370.24	14497.79
Pastureland	62857.87	5778.33	200209.62	1073.30
Forest	2724.09	1328.30	6663.51	91.70
Feedlots	8440.16	1688.03	11253.55	0.00
User Defined	6188.82	2471.40	12377.64	86.07
Septic	1453.92	569.45	5936.82	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	399145.87	86760.22	868276.04	16446.15

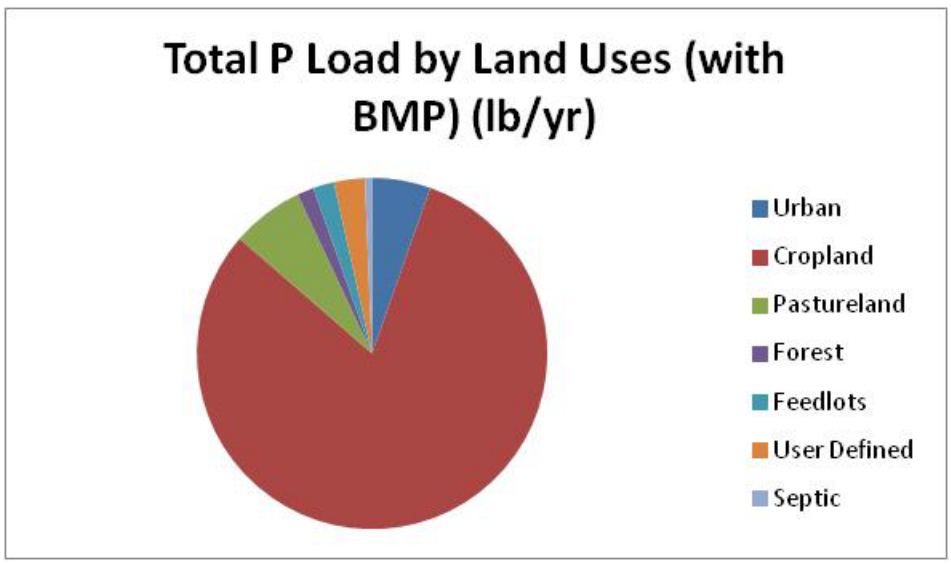

Figure 1. Total Phosphorus Load By Land Use After Modeled BMP Implementation

In the context of the existing monitoring data and the SWAT modeling results discussed later in this section of the report, the total baseline phosphorus load shown in Table 2 is high. Existing monitoring data shows an average phosphorus concentration of 0.08 mg/L at the point of compliance, which translates to an average load of about 18,750 lb P/year compared to the baseline STEPL output of 88,888 lb P/year. However, it is interesting to note that the baseline phosphorus load shown for Watershed 1 (the most downstream HUC-12 area) is about 20,000 lb/year, which is much closer to the monitoring results. This may illustrate the hydrological effect of the chain of lakes existing just upstream of Watershed 1, which are not accounted for in the STEPL model. These lake systems likely serve as nutrient sinks, which effectively reduce the loading seen downstream. With this in mind, the output of the STEPL model may be more meaningful when considered for each of the modeled watersheds instead of a single system.

The SWAT and SLAMM modeling results taken from the Rock River TMDL Report are summarized below in Tables 4 and 5 for phosphorus and TSS. Please note that the data is organized based on TMDL reach, with reach designations remaining the same as in the original report. Reach 27 is the most downstream reach in the watershed, and reach locations move upstream as the designation number decreases.

Table 4. Baseline Phosphorus Loading and Allocation Based on the Rock River TMDL.

TMDL Reach	Reach Description	Baseline P Load (lb/year)	Allocated P Load (lb/year)	Total Reduction (lb/year)	Total % Reduction
22	Flynn Creek	3083	446	2637	86%
23	Oconomowoc River (Mason Creek to Flynn Creek)	8986	3430	5556	62%
24	Mason Creek	6011	476	5535	92%
25	Oconomowoc River (Battle Creek to Mason Creek)	20447	4317	16130	79%
26	Battle Creek	2004	746	1258	63%
27	Oconomowoc River (Rock River to Battle Creek)	582	841	0	0%
	Total:	41113	10255	31117	75%

Table 5. Baseline TSS Loading and Allocation Based on the Rock River TMDL.

TMDL Reach	Reach Description	Baseline TSS Load (tn/year)	Allocated TSS Load (tn/year)	Total Reduction (tn/year)	Total % Reduction
22	Flynn Creek	506	67	439	87%
23	Oconomowoc River (Mason Creek to Flynn Creek)	1079	446	633	59%
24	Mason Creek	963	70	893	93%
25	Oconomowoc River (Battle Creek to Mason Creek)	946	545	401	42%
26	Battle Creek	212	121	92	43%
27	Oconomowoc River (Rock River to Battle Creek)	25	121	0	0%
	Total:	3732	1371	2457	63%

The total baseline load generated by SWAT and SLAMM models for the Oconomowoc River Watershed is about 41,100 lb/year, which falls between the total STEPL estimate and the loading seen at the point of confluence. This result is intuitive, as the SWAT model is more comprehensive, and better reflects the presence of bodies of water in the watershed. This disparity between model results may also be a result of the relatively flat terrain of the watershed, which would be taken into account in the SWAT model and not the STEPL model. Interestingly, the distribution of loads across land uses in each model is effectively reversed.

The STEPL model had the greatest phosphorus contributions in the agricultural areas of the watershed, namely the areas south and north of the City of Oconomowoc and the surrounding lakes. On the other hand, the SWAT model reduced the relative impact of nonpoint source contributions, instead emphasizing large loads from urban storm water and the WWTF in the City of Oconomowoc. In general, the STEPL model better reflects the load distribution based on the results of the official monitoring data shown in Figure 1 of the main body of the report.

The distribution of phosphorus loads from the Rock Rive TDML is reflected in the load allocation breakdown included in that report and shown in Table 6. The bolded categories are the sum of the sources below it, quantifying both the load (non-point sources) and waste load (point and urban sources) allocations. Table 6 also includes the average monthly reductions necessary to achieve the load allocations.

Table 6. Phosphorus Load Allocations Broken Down Into Load Allocation and Waste Load Allocation.

Source	Reach 22 (lb/year)	Average Monthly P Reduction (%)	Reach 23 (lb/year)	Average Monthly P Reduction (%)	Reach 24 (lb/year)	Average Monthly P Reduction (%)
Load Allocation	446	-	2085	-	318	-
Background	6	-	189	-	9	-
Agricultural/Non-Permitted Urban	439	30%	1896	29%	309	39%
Wasteload Allocation	0	-	1345	-	158	-
General Permit Sources	0	-	13	-	0	-
MS4	0	0%	1332	12%	158	11%
WWTF	0	0%	0	0%	0	0%

Source	Reach 25 (lb/year)	Average Monthly P Reduction (%)	Reach 26 (lb/year)	Average Monthly P Reduction (%)	Reach 27 (lb/year)	Average Monthly P Reduction (%)
Load Allocation	469	-	266	-	741	-
Background	43	-	68	-	22	-
Agricultural/Non-Permitted Urban	426	52%	197	32%	719	10%
Wasteload Allocation	3848	-	480	-	100	-
General Permit Sources	61	-	6	-	3	-
MS4	987	64%	474	35%	97	0%
WWTF	2800	77%	0	0%	0	0%