Storm Water Quality Master Plan

CITY OF OCONOMOWOC
WAUKESHA COUNTY, WISCONSIN

DECEMBER, 2015
REVISED JANUARY, 2016

RUEKERT & MIELKE, INC.
W233 N2080 Ridgeview Parkway
Waukesha, Wisconsin 53188-1020

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CHAPTER 1 -- INTRODUCTION

Municipal officials have long recognized the hazards to public health and safety and the economic losses caused by inadequate storm water management and flood control. More recently, municipal officials have also recognized the need to protect and improve the water quality within watercourses throughout the region, including the City of Oconomowoc. At the same time, there has been an intense desire from City staff and officials to link the City's existing and planned storm water management activities to the other amenities which make the City a desirable place to live, work and recreate.

Previous Master Planning Efforts

In November of 2006, the City of Oconomowoc was issued their first permit from the Wisconsin Department of Natural Resources (WDNR) to discharge storm water from the Municipal Separate Storm Sewer System (MS4). Among other things, the MS4 permit required the City to complete a multitude of activities aimed at improving the quality of storm water runoff entering the nearby rivers, lakes and wetlands.

In preparation for this initial MS4 permit, City staff hired MSA Professional Services, Inc. to complete a Storm Water Management System Plan in 2009. The study identified actual and potential storm water capacity, flood control and water quality concerns within the City and recommended needed corrective measures. Capital and operation and maintenance costs attendant to the recommended corrective measures were estimated, and a plan implementation program developed.

Total Maximum Daily Loads in the Rock River Watershed

Section 303(d) of the Federal Clean Water Act requires each state to identify those waters within its boundaries which are not meeting their designated uses due to exceedance of water quality standards for any applicable pollutant. Essentially, the Clean Water Act required Wisconsin to identify which waterways are too polluted to function as originally intended. Section 303(d) also requires the United States Environmental Protection Agency (EPA) to develop Total Maximum Daily Loads (TMDLs) for all pollutants exceeding applicable water quality standards. There are currently over 1,050 water bodies on Wisconsin's 303(d) list of impaired waters.

A TMDL determines the maximum amount of pollutant that a water body is capable of accommodating while continuing to meet the existing water quality standard. For all pollutant sources, such loads are established at levels necessary to meet the applicable standard, with consideration given to seasonal variations and margins of safety. TMDLs provide the framework that allows states to establish and implement pollution control and management plans with the ultimate goal, as defined by the Clean Water Act, of "water quality which provides for the protection and propagation of fish, shellfish and wildlife, and recreation in and on the water wherever attainable."

The Wisconsin Department of Natural Resources, working in conjunction with the EPA, is responsible to implement Wisconsin's TMDL process. Several major TMDLs have recently been completed, including the Lower Fox River and the Lake St. Croix TMDLs. Several more are currently under development, including the Milwaukee River, the Wisconsin River and Upper Fox/Wolf watersheds.

The Rock River has been listed as an impaired water on the State's 303(d) list for many years. The primary pollutants of concern are excessive phosphorus and sediment concentrations which lead to nuisance algae growth, oxygen depletion, reduced submerged aquatic vegetation, water clarity problems and degraded habitat. These impairments adversely impact fish and other aquatic life, water quality, recreation and navigation. The Rock River TMDL was completed and approved by EPA in September of 2011, addressing 62 of Wisconsin's impaired waters. A copy of the Rock River Basin Map is shown on Exhibit 1A.

There are 4 specific drainage areas that received TMDL wasteload allocations in the city of Oconomowoc: Reach 25, Reach 26, Reach 27 and Reach 55.

Pollutants of Concern & Sources

Although phosphorus is an essential nutrient for plant growth, excess phosphorus is a concern for most aquatic ecosystems. Where human activities do not dominate the landscape, phosphorus is generally in short supply, limiting the growth of algae and aquatic plants. When a large amount of phosphorus enters a waterway, it essentially fertilizes the aquatic system, allowing more plants and algae to grow, leading to excessive aquatic plant growth, often referred to as an algae bloom. This condition of nutrient enrichment and high plant productivity is referred to as eutrophication.

Eutrophication can be detrimental to aquatic life, reduce recreational opportunities, and affect the economic well-being of the surrounding community. Overabundant aquatic plant growth in a water body can lead to a number of undesirable consequences. Excessive growth of vegetation in a water body blocks sunlight from penetrating the water, choking out beneficial submerged aquatic vegetation. Large areas of excessive vegetation growth can inhibit or prevent access to a waterway, which restricts use of the water for fishing, boating, and swimming. A bloom of aquatic plants may include toxic blue-green algae or cyanobacteria, which are harmful to fish and pose health risks to humans. Algal blooms, particularly those that form surface scums, are visually unappealing and can have unpleasant odors. This makes recreational use of the water body undesirable, impacting the everyday quality of life for people who live close to the affected waterway. When the large masses of aquatic plants from the bloom die, the decomposition of organic matter depletes the supply of dissolved oxygen in the water, suffocating fish and other aquatic life. Depending on the severity of the low dissolved oxygen event, large fish kills can occur. Nearly all of these environmental impacts have direct economic and quality of life impacts to the City of Oconomowoc.

Many water bodies in the Rock River watershed are also impaired by excess sediment loading. Sediment that is suspended in the water scatters and absorbs sunlight, reducing the amount of light that reaches submerged aquatic vegetation, which reduces its photosynthetic rate and growth. Bottom-rooted aquatic plants (called macrophytes) produce oxygen, provide food and habitat for fish and other aquatic life, stabilize bottom sediments, protect shorelines from erosion and take up nutrients that would otherwise contribute to nuisance algae growth. As photosynthetic rates decrease, less oxygen is released into the water by the plants. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die. As the plants are decomposed, bacteria will use up even more oxygen from the water. Reduced water clarity can also have direct impacts on aquatic fauna including fish, waterfowl, frogs, turtles, and insects. Suspended sediments interfere with the ability of fish and waterfowl to see and catch food and can clog the gills of fish and invertebrates, making it difficult for them to breathe. When sediments settle to the bottom of a river, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Settling sediments can also fill in spaces between rocks, which could have been used by aquatic organisms for homes. Excess sediments can also cause an increase in surface water temperature. As the sediment particles absorb heat from sunlight, dissolved oxygen levels can fall even farther (warmer waters hold less dissolved oxygen), and further harm aquatic life.

In addition to its direct effects, sediment may also carry nutrients, heavy metals and other pollutants into water bodies. A large proportion of the phosphorus that moves from land to water is attached to sediment particles. This phenomenon can be seen in both spatial and temporal patterns of phosphorus and sediment movement. In general, this means that managing sediment sources can help manage phosphorus sources.

A municipal separate storm sewer system (MS4) discharges directly into local streams, lakes and wetlands without being treated to remove pollutants first, letting the sediment and attached pollutants reach the waterway unimpeded. Urban runoff consists of a variety of pollutants, including sediment, excess nutrients (including phosphorus), metals, chlorides, PAHs, grease and oil, and more. Many of these attach to small soil particles, which wash off roads, parking lots, sidewalks, parks and lawns and into the storm sewer system.

Construction sites have traditionally been a source of a significant portion of the sediment reaching the local waterways in an urban area. The impact of past land uses can affect the quality of the soil on site, such as past contamination from industrial uses, spills and underground fuel tanks. Inorganic pollutants and metals attached to sediment are transported to streams, lakes and wetlands during rain events and springtime snow melt. In the past 10-20 years, significant strides have been made to control sediment and erosion on construction sites. New products and practices to keep sediment on site have become routine for many contractors, developers, engineers, inspectors and reviewers. As more people recognize the benefit of using these practices, construction sites will have less of an overall impact on these waterways.

Other sources of pollutants found in urban runoff include excess nutrients and inorganic materials which accumulate on roads, parking lots, sidewalks, lawns, and other areas that drain to the storm sewer system. Tiny exhaust particles, bits of tire rubber, rust pieces and dripping oil or

grease are examples of residue from cars, trucks and other vehicles that are deposited on the ground until rain or melting snow wash these pieces down the road and into the sewer. Excess nutrients from lawn fertilizers, urban wildlife such as geese, raccoons and sea gulls, and pet waste can accumulate in the waterways in concentrations that are unhealthy for fish and aquatic organisms. At times the runoff from these areas can be unhealthy for humans as well as animal life. Excessive runoff events can send high flows of water from storm sewers to small creeks, picking up sediments from bank erosion and depositing that sediment in calm, shallow pools downstream.

Many traditional sources of runoff pollution in an urban area are permitted through the local, state or federal authorities. Industrial waste products, construction sites, and community –wide municipal storm sewer systems are entities that are required to obtain permit coverage from the appropriate governing body in Wisconsin. In addition to permit conditions to minimize the discharge of pollutants for these entities, there are a number of practices individuals can do to minimize the overall impact of pollutants to the local waters.

Total Maximum Daily Loads in the City of Oconomowoc

The City of Oconomowoc's MS4 storm water discharge permit was reissued in May of 2014, incorporating the recommendations from the Rock River TMDL study. In accordance with this permit, the City is required to review their local drainage boundaries in conjunction with the watersheds developed as part of the TMDL study. The City is also required to complete an updated water quality study to determine how close the City is to achieving the water quality objectives and pollutant allocations set forth in the TMDL study. If the City is not achieving the desired objectives, a plan outlining how compliance will be achieved is also required.

This report is intended to comply with this portion of the City's MS4 permit. It also updates the water quality portion of the City's 2009 Storm Water Management System Plan.

Planning Area

The area considered in this planning effort is shown on Exhibit 1. The planning area consists of all of the area within the corporate limits of the City of Oconomowoc, and has an area of about 12.2 square miles. Water resources in the City of Oconomowoc include, but are not limited to, the Oconomowoc River, Rosenow Creek, Battle Creek, Fowler Lake, Lac la Belle, Silver Lake, and various large and small wetlands. As shown on Exhibit 1, the City is located within the Upper Rock River Watershed, and is covered by four distinct "reachsheds" – Oconomowoc River (#25), Battle Creek (#26), Rock River (#27) and Upper Nemahbin Lake (#55).

Plan Objective

The updated storm water quality master plan is intended to guide the city in cost effectively managing and improving the quality of the water resources in the City; progressively meet current and future permit requirements in a stepped approach, and provide opportunities for

individuals who live, work and play in the City of Oconomowoc to benefit from the nearby lakes and rivers. More specifically, the plan and this report:

1. Describe the City's existing storm water quality management system.

2. Describe existing municipal storm water permit requirements, anticipated future permit requirements and subsequent water quality improvement efforts.

3. Present alternative water quality best management practices which meet the requirements developed in items 1 and 2 above.

4. Provide a comparative evaluation of the technical, economic and environmental features of the alternative best management practices.

5. Recommend a cost-effective, comprehensive storm water quality master plan for the City of Oconomowoc.

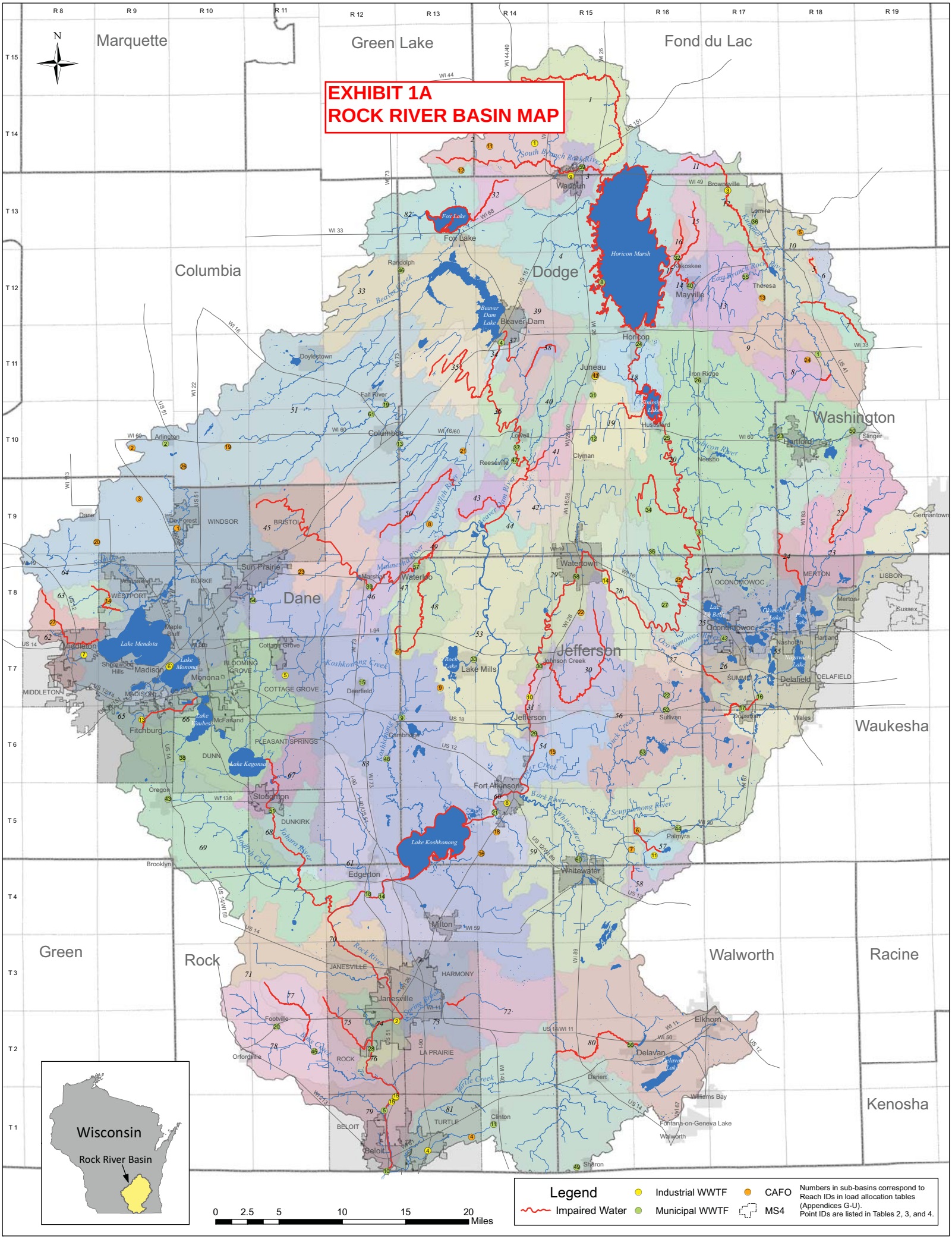
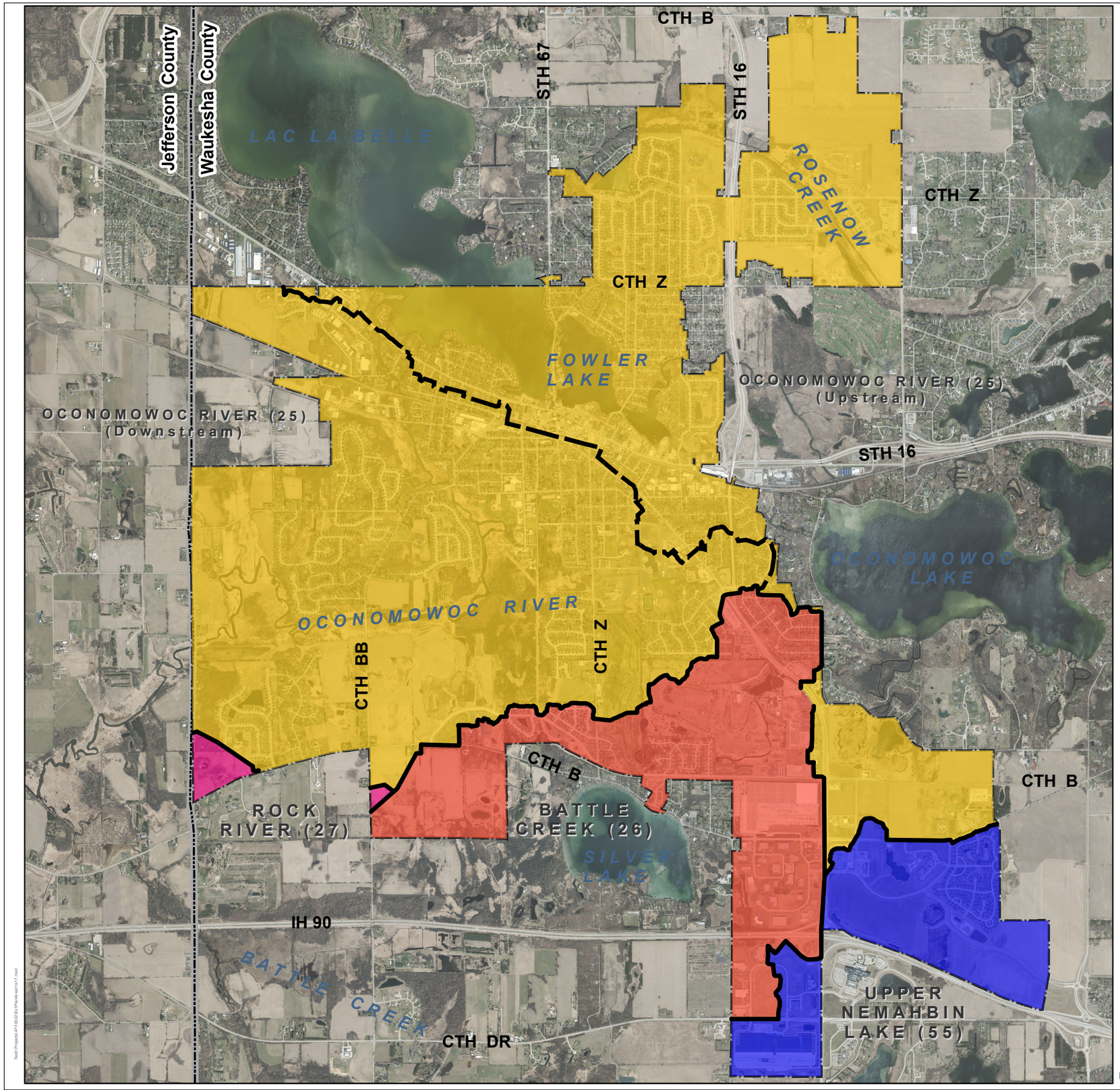


EXHIBIT 1A
ROCK RIVER BASIN MAP
Marquette
Green Lake
Fond du Lac
Columbia
Dodge
Washington
Dane
Jefferson
Waukesha
Green
Rock
Walworth
Racine
Kenosha
Wisconsin
Rock River Basin
Legend
Impaired Water
Industrial WWTF
Municipal WWTF
CAFO
MS4
Numbers in sub-basins correspond to Reach IDs in load allocation tables (Appendices G-U).
Point IDs are listed in Tables 2, 3, and 4.
0 2.5 5 10 15 20
Miles



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Storm Water Management System Planning Map Exhibit 1

Legend

- Oconomowoc River Reachshed (25)
- Battle Creek Reachshed (26)
- Rock River Reachshed (27)
- Upper Nemahbin Lake Reachshed (55)
- Reachshed Boundary
- Upstream/Downstream Reachshed Boundary
- Oconomowoc Boundary - City Limits

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Date: December, 2015

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CHAPER 2 -- WATER QUALITY OBJECTIVES AND STANDARDS

MS4 Storm Water Permit Requirements

In November of 2006, the City of Oconomowoc was issued their first MS4 storm water discharge permit from the Wisconsin Department of Natural Resources. This permit was reissued in May of 2014 and contains the following conditions:

- Update the City's storm water management maps to match the TMDL reachshed maps by March 31, 2016. Calculate the performance of the City's existing storm water management facilities in comparison to the pollutant allocations presented in the Rock River TMDL by March 31, 2018. If not in compliance, prepare a plan also by March 31, 2018 outlining how the City intends to comply with the TMDL allocations.
    - The TMDL components described above are the focus of this planning effort.
- Continue the existing public and City staff education, outreach and involvement programs to increase the awareness of storm water impacts on waters of the state. Measureable goals must be established, tracked and evaluated and the program must comply with at least the 8 specific requirements listed in the MS4 permit.
    - This program is ongoing in conjunction with Waukesha County, with review and modifications at least once per year.
- Develop an illicit discharge detection and elimination program to locate and remove illegal connections to the City's storm sewer system. At a minimum, this program must include on-going dry weather field screening at all priority outfalls at least once per year, dry weather field screening at all other major (non-priority) outfalls at least once every five years, subsequent follow-up investigations if discharge is present, including removal of illicit connections and enforcement of the City's illicit discharge ordinance.
    - This program is ongoing. Modifications will be made as needed to complete priority outfall inspections every year and major, non-priority outfall inspections every five years.
- Enforce the City's construction site pollutant control ordinance, including plan review, permit issuance, compliance inspections and enforcement actions.
    - This program is ongoing. Updates will need to be made to the City's erosion control ordinance by May 1, 2016 to match recent changes to Chapters NR 151 and NR 216 of the Wisconsin Administrative Code.
- Enforce the City's post-construction storm water management ordinance, including plan review, maintenance inspections and enforcement actions.

  - This program is ongoing. Updates will need to be made to the City's storm water management ordinance by May 1, 2016 to match recent changes to Chapters NR 151 and NR 216 of the Wisconsin Administrative Code.

- Develop a pollution prevention program, including measureable goals, which includes the following:

  - Develop an inventory of all City owned or operated storm water management facilities.

  - Complete routine inspections (including any required maintenance) of each storm water management facility owned or operated by the City to maintain their pollutant removal operating efficiency.

  - Complete routine catch basin cleaning and street sweeping, including proper disposal. This plan may be modified if supported by further analysis and approved by the Department.

  - Revise the winter road deicing management plan to include contact information, truck routes, equipment descriptions, disposal locations, anti-icing and deicing strategies and actions, and monthly records of product used and weather data prior to March 31, 2016.

  - Proper collection and disposal of leaves, brush and grass clippings.

  - Develop a storm water pollution prevention plan for municipal garages, storage areas and other municipally-owned sources of storm water pollution prior to March 31, 2016. Complete annual full inspections of these facilities thereafter.

  - Development of site-specific nutrient application schedules for fertilizer applications on any City-controlled properties with more than 5 acres of pervious surface.

  - Consideration of environmentally sensitive land development designs for municipal projects, including green infrastructure and low impact development.

- Implement and maintain storm water management practices that were in place on or before July 1, 2011 to achieve a reduction in total suspended solids of at least 20%.

  - This program is ongoing.

- Maintain an updated storm sewer system map.

  - This program is ongoing.

- Complete an annual report evaluating the various storm water programs, documenting compliance with measureable goals and recommending program modifications.
    - Due March 31 of each year.

The City of Oconomowoc has decided to use the adaptive management program option to meet the phosphorus reduction goals for reachshed #25, as described in the Rock River TMDL. This project will be conducted through both the city's wastewater treatment plant permit and the MS4 permit. The City's adaptive management program was submitted to the Department of Natural Resources and accepted on conditionally approved on September 15, 2015. The adaptive management program, and the timelines associated with it, will be incorporated into the city's wastewater treatment plant permit at the start of program implementation. The city has requested the Department revoke coverage under the MS4 General Permit no. WI-S050075-2, and re-issue coverage under a new Individual Permit specifically for the City of Oconomowoc. Having the 2 permits on the same timeframe will simplify the implementation of the adaptive management program, including developing interim goals, evaluating progress, and the tracking and reporting of expenditures of funds, project implementation and maintenance. Simplifying these aspects of the program will make it more efficient, with less time devoted to administration and more time spent on program implementation.

To facilitate the revocation and reissuance of the MS4 permit, the City of Oconomowoc submitted a letter requesting this action to the Department in December 2015. It is anticipated that the Department will approve this request in early 2016.

In the above-mentioned letter, the city also requested Department staff considered the issuance of one WPDES permit covering both the wastewater treatment plant and the municipal storm sewer system at the end of the upcoming 5–year permit term. A single, comprehensive WPDES permit regulating both of the city's major wastewater discharges would enhance the ability of city staff to prioritize the water quality projects to be constructed / installed, allocate staff time to water quality initiatives in- and outside the city borders, and to reduce duplications in tracking, documenting, reporting and maintenance efforts necessary for the success of the adaptive management program. Having a single permit regulating both discharges would further commit the City of Oconomowoc as a leader in the comprehensive effort of improving water quality throughout the Oconomowoc River Watershed and communicate this commitment to the citizens of the watershed.

Expiration of Delayed Implementation Exemption

The issue of excess pollutants reaching local lakes, rivers and wetlands via the storm sewer system is a byproduct of development patterns over many decades. Minimizing the impact of pollutants such as sediment and phosphorus was not considered in the design and development of buildings and properties until the latter parts of the twentieth century. In Wisconsin, statewide regulations did not go into effect requiring post-construction storm water controls for new and

redevelopment sites until 2004. This leaves the majority of our cities and villages without storm water controls in the historically developed areas.

State and federal authorities understand that controlling pollution that flows through storm sewers will take time and money. Municipalities are encouraged to implement projects in efficient and cost-effective ways, including implementing post-construction storm water controls when private or public redevelopment projects occur. By adding storm water treatment facilities to road reconstruction projects, municipalities can save money rather than constructing a stand-alone water quality facility at a different time. This should be considered for projects that are required by state and federal requirements to implement storm water controls, as well as minor reconstruction projects that may be exempt from those requirements.

An exemption from post-construction water quality requirements was given to municipalities permitted through the Department's Municipal Separate Storm Sewer System (MS4) program in the revised NR 151, Wisconsin Administrative Code, effective January 1, 2011.

> NR 151.242 (3) DELAYED IMPLEMENTATION. For municipalities that are regulated under subch. I of ch. NR 216 and for transportation facilities under the jurisdiction of the department of transportation for maintenance purposes that are located within municipalities regulated under subch. I of ch. NR 216, the highway reconstruction total suspended solids performance standard first applies January 1, 2017.

NR 151.242(3) encouraged municipalities to look at regional storm water practices to control runoff from roads, rather than requiring practices to be designed and constructed with each individual project. This exemption expires at the end of 2016, so projects will need to incorporate storm water management practices into the design and construction if they do not meet a different exemption from post-construction storm water requirements. Small scale practices, such as bioretention trenches and basins, will be considered for future road projects.

Two different road cross section designs are included in this plan. Other storm water control concepts, such as permeable pavement, road narrowing, neighborhood–wide rain garden or rain barrel programs and more are also proposed for evaluation on a site-by-site basis. Site conditions will need to be evaluated prior to determining which type of practice best suits the project, so the descriptions of these designs are purposely being general.

One alternative to offset the additional cost of including storm water controls on a road reconstruction project is to obtain grant funding. Projects are typically eligible for grant funding for elements of the project that go beyond the regulatory requirements. For example, a proposed project that includes a storm water facility that will control more pollution than is required could be eligible for the difference between the required controls and the proposed facility. A second example would be road projects that meet exemptions from the need for storm water controls, but controls are being proposed anyways. In that case, the whole storm water pollutant control system could be considered a grant project.

Total Maximum Daily Load Pollutant Allocations

There are two general types of water pollution: point source and nonpoint source. Point source pollution comes from identifiable, localized sources that discharge directly into a water body, usually through a distinct outfall. Industries and wastewater treatment facilities are two common point sources. Storm water runoff from certain urban areas is also considered a point source.

Nonpoint source pollution comes from land use activities such as agriculture and other non-localized sources. Most nonpoint source pollution occurs as a result of runoff. When rain or melted snow moves over and through the ground, the water carries any pollutants it comes into contact with into nearby waterways. Sources of phosphorus and sediment loading in the Rock River watershed include discharges from regulated wastewater treatment facilities, regulated industrial sites and runoff from agricultural land, urban land (both regulated and non-regulated areas), and natural areas (i.e., forests and wetlands).

As part of the Rock River TMDL, each of these sources is given specific allowable discharge limits. With regards specifically to the City of Oconomowoc, that includes the municipal wastewater treatment facility and the municipal separate storm sewer system (MS4). The MS4 allocation is the focus of this analysis. All allocations are also broken down by reachshed (or sub-watershed), and different reachsheds may have drastically different allocations depending on the existing loadings and the ability of that section of the waterway to assimilate pollutants.

The City of Oconomowoc is covered by the following reachsheds:

- Oconomowoc River (#25)
- Battle Creek (#26)
- Rock River (#27)
- Upper Nemahbin Lake (#55)

The pollutant reduction goals specified for the three reachsheds are summarized on Table 1:

Table 1

Reachshed	Required Sediment Reduction From No Controls	Required Phosphorus Reduction From No Controls
Oconomowoc River (#25)	59%	74%
Battle Creek (#26)	57%	53%
Rock River (#27)	40%	27%
Upper Nemahbin Lake (#55)	66%	77%

Pollutant reduction goals are also specified in terms of annual, monthly and daily loadings. To ease implementation and address any potential bias associated with differing acreages within each reachshed, WDNR has recommended the average annual percent reductions, as presented above, be the primary compliance measure.

CHAPTER 3 -- EXISTING CONDITIONS

In any storm water system planning effort, definitive knowledge is required of the existing storm water management system. Inventories and analyses are required of such factors as the land use conditions, existing storm water ordinances, topography, drainage patterns, geology, conditions of receiving waters, and existing storm water facilities within the City of Oconomowoc.

Land Use

The existing land use pattern is an important consideration in the preparation of a storm water management systems plan and is the primary data input in the water quality modeling efforts completed as part of this analysis. The City of Oconomowoc utilizes the Southeastern Wisconsin Regional Planning Commissions (SEWRPC) land use information, and this data is shown on Exhibit 2.

Existing Storm Water Ordinance

The City's current storm water management ordinance (Chapter 19 of the City of Oconomowoc Municipal Code) largely follows previous versions of Chapters NR 151 and NR 216 of the Wisconsin Administrative Code, necessitating significant water quality control (80% sediment reduction for new development, 40% for redevelopment, infiltration considerations, etc.). The ordinance also requires that the rate of runoff generated by the 100 year recurrence interval rainfall event under proposed development conditions be restricted to the rate of runoff generated by the 2 year event under existing land use conditions.

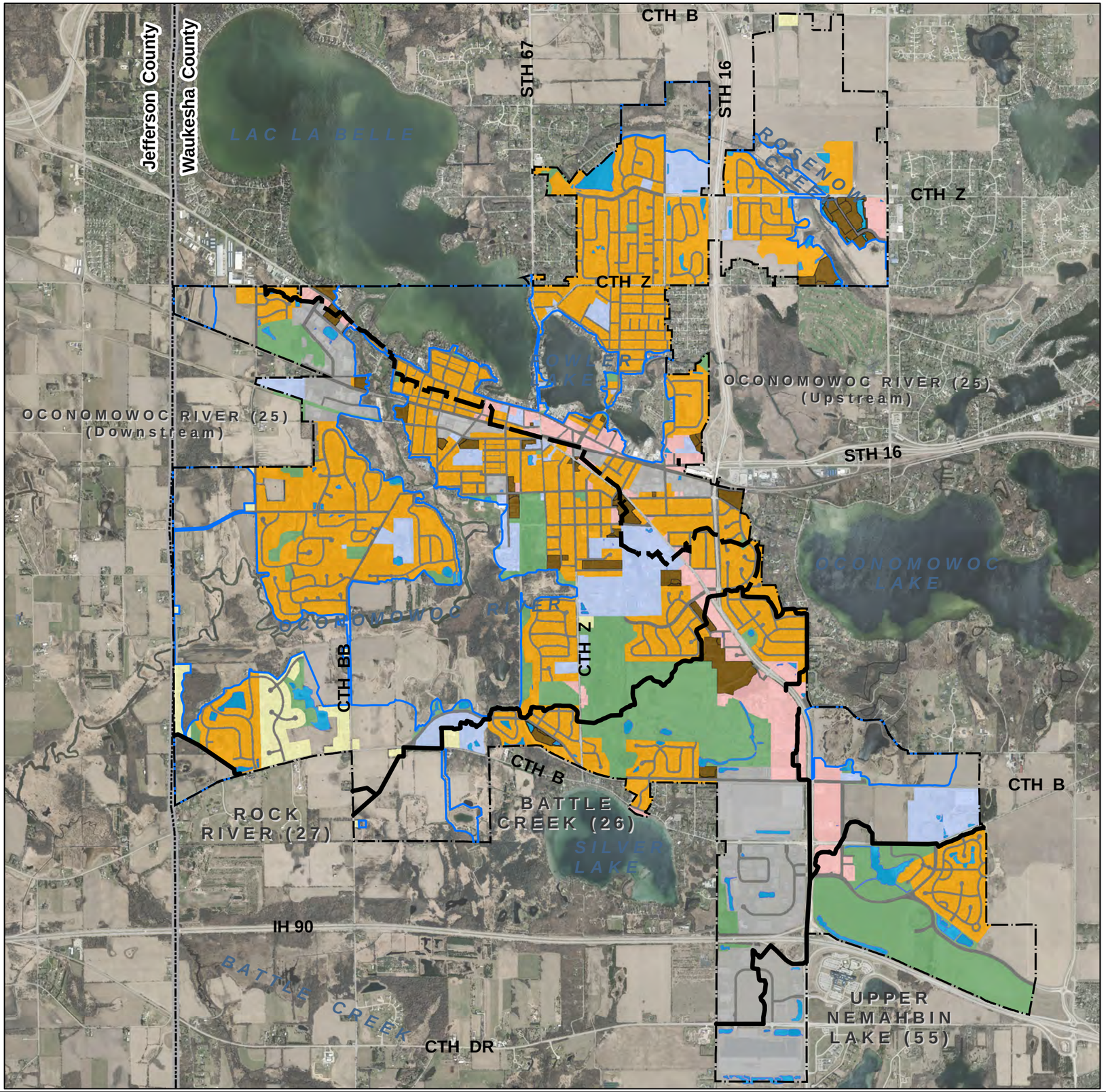
In accordance with this ordinance, the redevelopment of lands currently built without storm water facilities may be expected to reduce pollutant loadings within the corresponding storm water runoff.

Topography and Surface Drainage Patterns

As already noted, the City of Oconomowoc is located completely within the Rock River watershed, with most of the City draining via storm sewer or directly to the Oconomowoc River. Drainage basins for the storm water planning effort were carried forward from the 2009 analysis and updated as appropriate to reflect recent drainage system modifications.

Soil Conditions, Geology and Depth to Bedrock

The geologic conditions of an area, including depth to bedrock and depth to the groundwater table, are important considerations in any storm water management system planning effort. The dominant overlying hydrologic soil group in the City is type "B", which generally indicates soil types that have moderate infiltration. The bedrock depth for the City is also generally deep. The City generally has moderate to good suitability for on-site infiltration, with areas of concern primarily due to high groundwater or unsuitable soil in or around the primary waterways.



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Existing Land Use Map
Exhibit 2

Legend

- Reachshed Boundary
- Upstream/Downstream Reachshed Boundary
- Low Density Residential (LDR)
- Medium Density Residential (MDRNA)
- High Density Residential (HDRNA)
- Commercial
- Other Urban
- Industrial
- Institutional
- Transportation
- Surface Water
- Waters of the State Boundary
- Oconomowoc Boundary - City Limits

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Date: December, 2015

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The City is also located in an area of generally shallow depths to the groundwater table with high recharge potential. The groundwater reservoir provided by the glacial till deposits and underlying undifferentiated limestone bedrock formations is the source of supply for the municipal wells used within the City as a source of potable water.

Water Resources

The major waterways located in the City of Oconomowoc are: Fowler Lake, Lac la Belle, the Oconomowoc River, Rosenow Creek, and Silver Lake.

Fowler Lake is located in the middle of Oconomowoc. Many homes, a cemetery, a church and a park are situated on the banks. Fowler Lake is over 50 feet deep, and is popular for boating, canoeing, kayaking, fishing, swimming, and more. The city of Oconomowoc has 15 storm sewer outfalls discharging into Fowler Lake; 3 of those outfalls have manufactured treatment systems installed in the storm sewer manhole closest to the discharge point to reduce the amount of runoff pollution that would otherwise enter the lake after a rain or snow melt event.

Lac la Belle is located on the northwest side of downtown Oconomowoc, and with Fowler Lake, is a focal point of the community. Lac la Belle has a maximum depth of 45 feet, but is really very shallow over most of the lake. On average, the lake is only 11 feet deep, with a very sandy bottom. The Village of Lac la Belle and the Town of Oconomowoc are also located on the northwest and north sides of the lake, respectively. Many homes and businesses have frontage on Lac la Belle, with golf courses and some farms nearby. The lake is popular for swimming, fishing, sailing, ice fishing, hockey, ice-sailing and more.

The Oconomowoc River flows through the city from east to west, entering Fowler Lake, then flowing into Lac la Belle, then flowing south through the city and continuing on through farm fields until the confluence with the Rock River in Jefferson County. The river itself is popular for kayaking, canoeing, boating, fishing and swimming.

Rosenow Creek is a tributary to Lac la Belle that discharges into the northeast side of the lake. It is a cold water stream supporting a naturally reproducing population of brook trout. Many efforts have been undertaken over the years to protect the stream and the trout population. Recent development pressure in the Rosenow Creek watershed has been offset by development designs that include infiltration practices that exceed the requirements for post-construction storm water controls.

Silver Lake is a 217 acre seepage lake (not on a riverine system) located on the south side of the city of Oconomowoc near CTH B. Maximum depth is 40 feet, and the lake is very susceptible to impacts from runoff. As a groundwater-fed lake, groundwater level fluctuations and pollutants in groundwater are a serious concern.

Existing Storm Water Management System and Water Quality BMPs

The existing storm water management system within the City of Oconomowoc consists of a network of pipes, inlets, catch basins, detention and infiltration ponds, culverts, drainage ditches and associated overland flow paths. The location and configuration of this system is shown on Exhibit 3. The system consists of approximately 130 individual water quality devices and 6 grass swale basins.

The City of Oconomowoc is acutely aware of the need to protect the valuable natural resource base located throughout the planning area while also complying with their MS4 storm water discharge permit. To reach this goal, the City is actively involved in numerous best management practices designed at protecting water quality. The current activities include:

The City uses vacuum street sweepers and sweeping is typically completed every 4 weeks throughout the entire City except the downtown area where sweeping is performed once every week. Waste from these sweepers is disposed via landfill.

The City does not allow leaves to be stored in the terrace or roadway. The City hires a service to pick up leaves around the City that have been raked up and bagged for disposal.

Existing storm water facilities are inspected on a semi-regular basis, and maintenance is completed as needed.

City staff administers an erosion control and storm water management program.

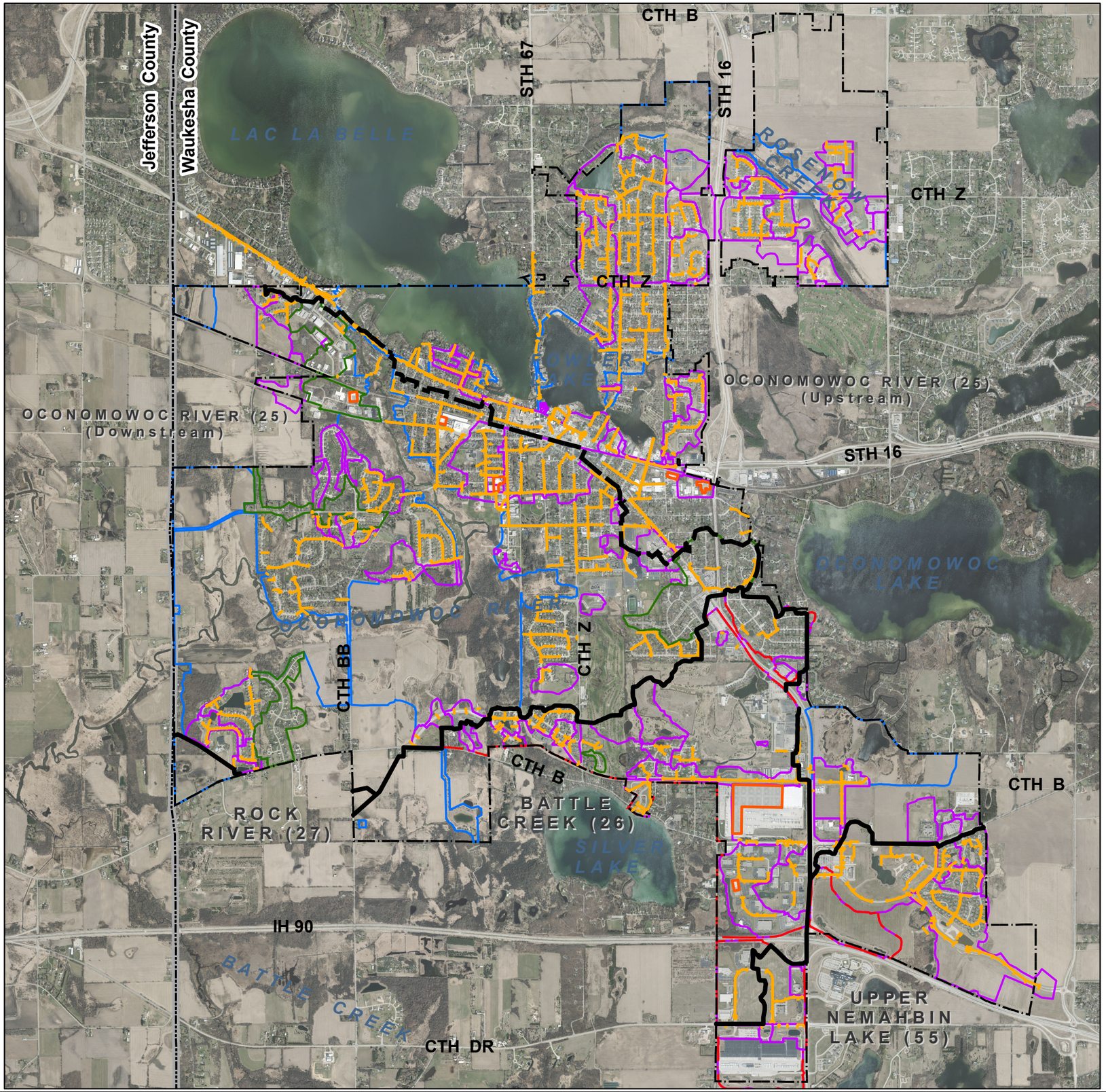
The City completes an annual illicit discharge inspection program. This program is expected to be updated following WDNR's illicit discharge guidance.

The City inspects and maintains catch basins annually.

The City is a member of the public information, education and involvement program administered through Waukesha County.

Existing Conditions Water Quality Modeling

The updated water quality analysis was completed using the Source Loading and Management Model (WinSLAMM, Version 10.1). The land use was based on SEWRPC's 2010 land use, updated to reflect recent development. The multitude of land use codes from SEWRPC were synthesized down to align with the model's more general categories. Parameter files for WinSLAMM were used following WDNR's guidance, including use of the Milwaukee five year rainfall data which has been determined by the WDNR to be representative of a typical period of rainfall within the developed area of the City of Oconomowoc.



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Existing Storm Water Management System Exhibit 3

Legend

- Reachshed Boundary
- Upstream/Downstream Reachshed Boundary
- Storm Sewer
- Waters of the State Boundary
- WPDES
- Internally Drained Areas
- Grass Swales
- Water Quality Boundary
- Oconomowoc Boundary - City Limits

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Date: December, 2015

Ruekert · Mielke

To replicate the City's existing development and build-out patterns, WinSLAMM standard land use files that are representative of the City's land use categories were utilized to generate pollutant loadings for the existing conditions. The standard land used files used in the modeling process are as follows:

Low Density Residential (LDR)

Medium Density Residential No Alleys (MDRNA)

High Density Residential No Alleys (HDRNA)

Hospital

Institutional

School

Downtown

Strip commercial

Office Park

Light Industrial

Parks

Open

Cemetery

All areas within the municipal boundary were included within the water quality model with the exception of the following areas:

- Lands zoned for agricultural use and currently being utilized as such.
- Riparian areas that directly drain to waters of the state without passing through the City's MS4.
- State and County highways that are not maintained by the City.

These excluded areas can be seen as the areas without land use overlays on Exhibit 2.

All storm water facilities were included in the existing condition model, regardless of ownership. The City recognizes that they will need to enforce maintenance provisions on those facilities which it does not own.

In-field infiltration testing was completed on the six grass swale basin areas. The resulting infiltration rates from these tests were then divided in half to represent the dynamic infiltration

rate for each grass swale. For example, a measured infiltration rate of 2.5 inches per hour would result in a modeled dynamic infiltration rate of 1.25 inches per hour of infiltration for that grass swale in the WinSLAMM model. The detailed infiltration rate field test reports can be found in the Appendix.

The WinSLAMM model was used to calculate the probable pollutant loadings under existing land use conditions with no storm water controls. The reduction in Total Suspended Solids (TSS) for all existing storm water controls developed as of October 1, 2004 were taken from the 2010 water quality analysis prepared by MSA Professional Services for the City of Oconomowoc. These reductions were recommended for use within the updated report by the WDNR. The Phosphorus loadings for these water quality devices were determined by utilizing the other device control in WinSLAMM allowing a TSS reduction percentage to be entered for the contributing land use acreage, which is used by the model to determine a Phosphorus loading reduction for the same contributing acreage.

The pollutant loading reductions for storm water quality devices that were developed after October 1, 2004 were taken from approved Storm Water Management Plans for that corresponding facility. The Phosphorus loadings for these water quality devices were also determined by utilizing the other device control in WinSLAMM allowing a TSS reduction percentage to be entered for the contributing land use acreage, which is then used by the model to determine a Phosphorus loading reduction for the same contributing land use area.

All devices that were not modeled as part of the 2010 MSA report nor had a Storm Water Management Plan associated with them, were then analyzed for TSS and Phosphorus using the WinSLAMM model.

The pollutant loadings are given in pounds and are equal to the amount of that pollutant that may be expected to runoff from the area concerned over the course of a year. Generally, pollutant loadings increase when the amount of critical land use (industrial, commercial, high density residential, governmental, institutional, and highways) increases; the length of curb increases; the length of grass swales decreases; the number of times catch basins are cleaned decreases; and the number of times streets are swept decreases. With the construction of best management practices, particulate solids loadings may be expected to decrease for the drainage areas that are tributary to the control measures. The results of the modeling are summarized on Table 2.

Table 2 – Summary of Annual Pollutant Loadings Under Existing Conditions

Reachshed	Area (acres)	Total Suspended Solids (TSS)				Total Phosphorus (P)			
		TSS Loading – No Controls (Pounds)	TSS Loading – With Controls (Pounds)	Actual TSS Reduction	Required TSS Reduction Per TMDL	Phosphorus Loading – No Controls (Pounds)	Phosphorus Loading – With Controls (Pounds)	Actual Phosphorus Reduction	Required Phosphorus Reduction Per TMDL
Oconomowoc River #25 (Upstream)	1,265	340,155	165,006	51.49%	59%	1,058	627	40.79%	74%
Oconomowoc River #25 (Downstream)	1,864	434,486	298,119	31.39%	59%	1,401	1,042	25.65%	74%
Subtotal	**3,129**	**774,640**	**463,125**	**40.21%**	**59%**	**2,460**	**1,668**	**32.16%**	**74%**
Battle Creek (#26)	932	308,261	66,816	78.32%	57%	750	307	59.07%	53%
Rock River (#27)	26	1,576	0	100%	40%	8.34	0	100%	27%
Upper Nemahbin (#55)	542	127,681	10,782	91.56%	66%	347	46	86.80%	77%
Overall	**4630**	**1,212,158**	**540,723**	**55.39%**	**--**	**3565**	**2021**	**43.31%**	**--**

CHAPTER 4 -- ALTERNATIVE PLANS

The goal of the Clean Water Act, the corresponding Total Maximum Daily Load Studies, and Chapters NR 151 and 216 of the Wisconsin Administrative Code is to reduce pollutant loads carried by storm water runoff to waters of the State. Pollutants may be generated in all areas of land use, and include decomposing materials such as leaves deposited in the gutters and storm sewers, fertilizers and pesticides, heavy metals from automobiles, rooftops, and buildings; and pet litter and animal waste. These pollutants create water quality problems that not only affect the look, feel and smell of the surface waters, but also the health and safety of plants, animals and people that come in contact with the polluted waters.

As noted in Table 2, the existing storm water controls in the Oconomowoc River Reachshed are not sufficient to meet the goals set forth in the Rock River TMDL and the City's MS4 storm water permit. To help move the City closer to compliance, alternative nonpoint source pollutant abatement measures were evaluated on the basis of the ability to comply with the City's TMDL/MS4 permit requirements and the specific needs of the receiving waterways. To the extent feasible, the water quality control measures considered were combined with other City goals such as pedestrian walkability or public education, to provide multiple benefits to a single water quality facility while also minimizing costs.

As previously described, the Source Loading and Management Model (WinSLAMM Version 10.1) was used to estimate average annual pollutant loadings under existing land use conditions with no control measures and existing control measures. A summary of the probable annual pollutant loadings under existing land use and both no control measures and existing control measures, organized by reachshed, is set forth in Table 3. In addition, the table presents estimated reductions for certain additional alternative control measures considered. The alternatives are presented graphically on Exhibit 4.

Table 3 – Summary of Recommended Alternative BMPs for Oconomowoc River Reachshed (#25)

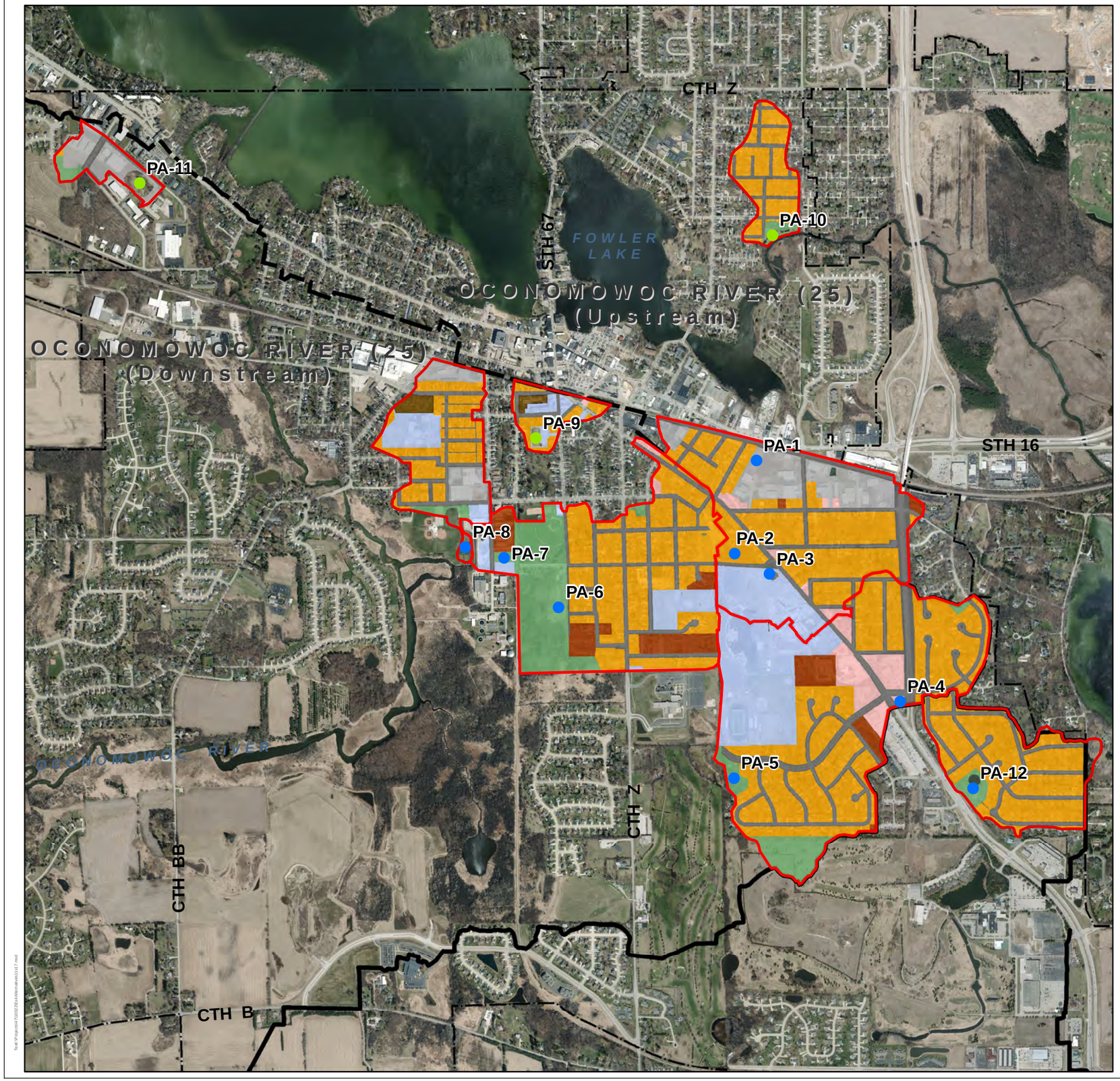
Control Measure	Total Suspended Solids (Pounds)		Total Phosphorus (Pounds)		Estimated Project Cost (Structural BMP) or Annual Cost (Sweeping)	Estimated 50 Year Present Worth	Cost Per Pound of Pollutant Removal	
	Existing Land Use	Reduction from No Controls	Existing Land Use	Reduction from No Controls			Total Suspended Solids	Phosphorus
No Controls (Reachshed #25)	774,640	0%	2,460	0%	N/A	N/A	N/A	N/A
Existing Storm Water Controls	311,515	40.21%	791	32.16%	N/A	N/A	N/A	N/A
Street Sweeping Every 2 Weeks	32,148	4.15%	70	2.83%	$185,400	$3,663,876	$113.97	$52,341
Street Sweeping Every Week	65,070	8.40%	140	5.69%	$370,800	$7,327,752	$112.61	$52,341
PA-1 (Industrial Park)	25,730	3.32%	44	1.67%	$557,090	$1,151,829	$45	$26,178
PA-2&3 (Summit Avenue)	5,544	.72%	9.5	.39%	$450,161	$774,768	$140	$81,555
PA-3 (Hospital Pond)	4,566	.59%	9	.37%	$236,218	$410,505	$90	$45,612
PA-4 (Gas Station Pond)	13,405	1.73%	34	1.38%	$665,366	$991,483	$74	$29,161
PA-5 (Whitman Park Pond)	17,643	2.28%	46	1.87%	$301,274	$528,622	$30	$11,492
Thackeray Trail Alternative (Biofiltration)	14,936	1.93%	45	1.83%	$2,792,463	$3,555,457	$238	$79,010
PA-6 (Serve Facility Pond)	16,325	2.11%	38	1.55%	$441,379	$725,057	$44	$19,080
PA-7 (Forest Street Pond)	20,383	2.63%	53	2.15%	$484,703	$846,995	$42	$15,981
PA-8 (Champion Field Pond)	17,187	2.22%	34	1.38%	$597,240	$1,036,083	$60	$30,473
PA-9 (Church Wet Pond)	4,675	.60%	11	.45%	$177,720	$285,092	$61	$25,918
PA-9 (Church Biofiltration Device)	4,646	.60%	12	.49%	$405,465	$592,045	$127	$49,337
PA-10 (Riverside Park Wet Pond)	4,709	.61%	13	.53%	$33,560	$62,285	$13	$4,791
PA-10 (Riverside Park Biofiltration Device)	5,789	.75%	18	.73%	$299,065	$447,425	$77	$24,857
PA-11 (Armory Wet Pond)	5,025	.65%	6	.24%	$488,000	$847,243	$169	$141,207
PA-11 (Armory Biofiltration Device)	3,793	.49%	6	.24%	$123,200	$192,734	$51	$32,122

Table 3 – Summary of Recommended Alternative BMPs for Battle Creek Reachshed (#26)

Control Measure	Total Suspended Solids (Pounds)		Total Phosphorus (Pounds)		Estimated Project Cost (Structural BMP) or Annual Cost (Sweeping)	Estimated 50 Year Present Worth	Cost Per Pound of Pollutant Removal	
	Existing Land Use	Reduction from No Controls	Existing Land Use	Reduction from No Controls			Total Suspended Solids	Phosphorus
No Controls (Reachshed #26)	308,261	0%	750	0%	N/A	N/A	N/A	N/A
Existing Storm Water Controls	241,446	78.32%	443	59.11%	N/A	N/A	N/A	N/A
Street Sweeping Every 2 Weeks	12,793	4.15%	21	2.83%	$36,000	$711,432	$56	$33,878
Street Sweeping Every Week	25,894	8.40%	43	5.69%	$72,000	$1,422,865	$55	$33,090
PA-12 (Heritage Heights Pond Retrofit)	1,489	.48%	6	.80%	$598,220	$1,086,694	$730	$181,116

Table 3 – Summary of Recommended Alternative BMPs for Upper Nemahbin Reachshed (#55)

Control Measure	Total Suspended Solids (Pounds)		Total Phosphorus (Pounds)		Estimated Project Cost (Structural BMP) or Annual Cost (Sweeping)	Estimated 50 Year Present Worth	Cost Per Pound of Pollutant Removal	
	Existing Land Use	Reduction from No Controls	Existing Land Use	Reduction from No Controls			Total Suspended Solids	Phosphorus
No Controls (Reachshed #55)	127,681	0%	347	0%	N/A	N/A	N/A	N/A
Existing Storm Water Controls	116,899	91.56%	301	86.80%	N/A	N/A	N/A	N/A
Street Sweeping Every 2 Weeks	5,299	4.15%	9.8	2.83%	$25,200	$498,003	$94	$50,817
Street Sweeping Every Week	10,725	8.40%	20	5.69%	$50,400	$996,005	$93	$49,800



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Alternative Storm Water Quality Facilities Exhibit 4

Legend

- Proposed Combination Alternative
- Proposed Alternative
- Drainage Area to Proposed Alternative
- Reachshed Boundary
- Upstream/Downstream Reachshed Boundary
- Medium Density Residential (MDRNA)
- High Density Residential (HDRNA)
- Commercial
- Institutional
- Light Industrial (LI)
- Open Space
- Transportation
- Oconomowoc Boundary - City Limits

N
W E
S

0 750 1,500 3,000 4,500

Feet

Date: December, 2015

Ruekert · Mielke

SITE SPECIFIC ALTERNATIVES:

Oconomowoc River Reachshed (#25)

This reachshed extends from east to west and from the central part of the City to the northern most extents of the City of Oconomowoc including the City's downtown corridor. Based on the existing storm water controls, this reachshed is currently experiencing a 40.21% reduction in total suspended solids (versus a 59% TMDL goal) and a 32.16% reduction in Phosphorus (versus a 74% TMDL goal). Two street sweeping alternatives and thirteen new facilities were analyzed within this reachshed. As the existing storm water quality devices within this reachshed generally performed well, no improvements to those existing facilities were reviewed.

Street Sweeping Alternatives – Oconomowoc River Reachshed

Under the schedule currently in effect within the City of Oconomowoc, all City roadways are swept once every four weeks using high efficiency vacuum sweeping equipment. With a sweeping cost estimated at $100 per mile, the existing annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation are approximately $92,700. The resulting 50 year present worth would approximate $1,831,938. Two street sweeping alternatives were considered to provide additional pollutant reductions.

It should be noted that there are significant seasonal variations in street sweeping efficiencies. During the summer months, approximately 80 percent of the sediment load is found within 3 feet of the curb, where street sweepers are designed to operate. In the spring, when sediment loads are the heaviest, sediment loads are spread more evenly across the entire street cross section. Weekly street sweeping efficiency can range from a low of approximately 30 percent during the spring, to a high of approximately 80 percent during the summer as measured by mass removal from the street surface. The street sweeping calculations performed using the Source Loading and Management Model includes these seasonal variations.

The street sweeping alternatives were also calculated independently of any other proposed improvements. If street sweeping is increased in areas that drain to other storm water facilities, the benefits of the increased sweeping may be lessened.

The first alternative would consist of increasing the schedule of sweeping throughout each reachshed to once every 2 weeks, other than the Rock River Reachshed which has no associated street sweeping within it. This alternative would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 4.15% sediment reduction and an additional 2.83% phosphorous reduction. With a sweeping cost of $100 per mile, this alternative may be expected to increase the annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation from $92,700 to $185,400 The resulting 50 year present worth would approximate $3,663,876 or $114 per pound of additional sediment removed and $20,818 per pound of additional phosphorous removed.

The second alternative would consist of increasing the schedule of sweeping throughout the entire reachshed to once every week. This alternative would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 8.40% sediment reduction and an additional 5.69% phosphorous reduction. With a sweeping cost of $100 per mile, this alternative may be expected to increase the annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation from $92,700 to $370,800. The resulting 50 year present worth would approximate $7,327,752, or $113 per pound of additional sediment removed and $20,700 per pound of additional phosphorous removed.

The modeling has shown that more frequent street sweeping dramatically increases the cost, while only providing minimal further sediment reductions. As a result, no additional street sweeping options were pursued.

New Storm Water Quality Control Facilities - Oconomowoc River Reachshed

Well-maintained storm water quality control facilities, including but not limited to wet ponds, artificial wetlands, infiltration basins, bioretention / biofiltration facilities and rain gardens are an effective way to reduce pollutant loadings in a watershed. Typically, the area contributing to these facilities may benefit by 80 to 100 percent reductions in the annual loadings of sediment and 40 to 100 percent reductions in phosphorus.

Regional storm water facilities are constructed and operated with significant efficiency advantages over individual onsite facilities. Based on these benefits, the City of Oconomowoc will pursue the implementation of regional facilities wherever practical. Construction costs for regional facilities are generally borne by the City, although these costs may be charged back to developers and landowners that contribute or benefit from the facility.

This series of alternatives would consist of constructing eleven total facilities. Eight new wet detention facilities and three facilities that could be constructed as either wet detention or biofiltration facilities which ever the existing site conditions renders to be more effective at providing improved water quality benefits. The locations of these ponds, numbered PA-1 through PA-11 are shown on Exhibit 4.

- Alternative PA-1 (Industrial Park Wet Pond) is located east of Lyman Street near the railroad tracks. This facility is located near the outlet of the basin and receives significant flows. In addition, the area is prone to flooding because of surcharging from the lake. For this reason, the pond was conceptually designed with only water quality benefits in mind. The design also includes a cost for a basic pumping station to convey excess quantities of storm water to the lake. The Industrial Park Pond is a conical design, fitting the surrounding area which has wetlands in the northeast corner of the site, a shallow water table, and hydric soils. This pond is approximately 1.4 acres in size The pond would reduce total suspended solids from the contributing 160 acre drainage area by 53%

and total phosphorus by 32%. This facility has an estimated project cost of $557,090 and a total present worth of approximately $1,151,829.

- Alternative PA-2 (Summit Avenue Wet Pond) is located across the street from the hospital on Forest Street. This particular facility was considered for implementation to augment the storage of the Hospital Pond if the water quality and quantity effects were found to be significant; thus, the pond was only incorporated into the model in conjunction with PA-3. The conceptual design is conical, fitting the surrounding landscape, with approximately 2.2 acres of surface area. The pond in conjunction with the Hospital Pond would reduce total suspended solids from the contributing 43 acre drainage area by 41% and total phosphorus by 23%. This facility would require land acquisition, as the property is not owned by the City. There are no special environmental conditions to be considered in the design process. This facility has an estimated project cost of $450,161 and a total present worth of approximately $774,768.

- Alternative PA-3 (Hospital Wet Pond) is located on Forest Street at the northeast corner of the hospital property. With Forest Street having recently been realigned just north of the hospital campus, there is an additional open area to augment the storage capacity of the existing pond. This facility would be a wet pond located south of the intersection of Forest Street and Summit Avenue. The conceptual design is a trapezoidal shape approximately 1.0 acre in size. The pond would reduce total suspended solids from the contributing 29 acre drainage area by 69% and total phosphorus by 44%. This facility would require land acquisition, as the property is currently owned by Oconomowoc Memorial Hospital. There are no special environmental conditions to be considered in the design process. This facility would have an estimated project cost of $236,218 and a total present worth of approximately $410,505.

- Alternative PA-4 (Gas Station Wet Pond) This alternative is located near the split of Highway 67 and Summit Avenue at the vacant lot of a former gas station. It receives flow from the neighborhoods north and west of the location including both major roadways. This facility would be a wet pond with a conceptual design that is a triangular in shape to fit the lot. It is approximately 0.95 acres in size and would reduce total suspended solids from the contributing drainage area by 68% and total phosphorus by 51%. This facility does require land acquisition, as the property was recently sold to a private owner. Also, the site is suspected to have contaminated soils as a result of its former use as a gas station. The estimated project cost for this alternative is $665,366 (including additional costs for contaminated soil disposal) and a total present worth of approximately $991,483.

- Alternative PA-5 (Whitman Park Wet Pond) is located near the outlet of the basin on the southwestern end of Thackeray Trail. This pond was conceptually designed with only water quality benefits in mind because of its location near the outlet and adjacent wetlands. The conceptual design is conical, fitting the surrounding landscape, with approximately 1.5 acres of surface area. The alternative would reduce total suspended solids from the contributing 163 acre drainage area by 57% and total phosphorus by 39%. Environmental conditions in this area are a significant concern as preliminary investigation shows that the proposed facility is adjacent to wetlands and the park contains hydric soils. Further investigation would need to be conducted before the design of this wet pond would be recommended. This facility has an estimated project cost of $301,274 and a total present worth of approximately $528,622.

- Thackeray Trail Biofiltration Alternative. A conceptual design was made for the reconstruction of Thackeray Trail which can be seen in Exhibit 18 in the appendix. The road reconstruction would include the narrowing of the trail and installation of curb and gutter on all sides of the boulevard. The trail would contain a number of storm inlets to collect water that accumulates on the road itself, conveying it to biofiltration facilities with underdrains on either side. The upstream flow contributions would be captured in a storm pipe and conveyed under the biofiltration facilities on the north side of the road to the outlet of the basin. Additional water quality reductions could also be achieved if permeable pavement was installed on the outside edges of the reconstructed road. The estimated project cost and total present worth of the reconstruction of Thackeray Trail is $2,792,463 and $3,555,457, respectively.

- Alternative PA-6 (Serve Facility Wet Pond) The Serve Facility is to be constructed near the intersection of Forest Street and Main Street on the former Department of Public Works (DPW) yard site. The storm water facility would be a wet pond located south of the proposed Serve Facility just west of Jean Street. The conceptual design is a triangular shape fitting the surrounding area which has wetlands directly to the west, a shallow water table, and hydric soils. These features make this proposed pond location another which would require further investigation of the soils and surrounding environmental corridors before design. The proposed pond is approximately 1.0 acre in size and would reduce total suspended solids from the contributing 121 acre drainage area by 58% and total phosphorus by 37%. This facility has an estimated project cost of $441,379 and a total present worth of approximately $725,057.

- Alternative PA-7 (Forest Park Pond) This facility is located just west of Forest Park Street in the open area north of the DPW garage. For the purposes of this conceptual design, the pond was assumed to cover most of the open area. The pond shape is trapezoidal with a size of approximately 1.9 acres and would reduce total suspended solids from the contributing 148 acre drainage area by 62% and total phosphorus by 44%. There are no special environmental conditions to be considered in the design process. This facility has an estimated project cost of $484,703 and a total present worth of approximately $846,995.

- Alternative PA-8 (Champion Field Wet Pond) is located southwest of the intersection of Jefferson Street and Worthington Street. There is sufficient open area in the southeastern area of Champion field to construct a sizeable storm water facility. This facility would be a wet pond that is contoured to fit the area east of the sports facilities. The conceptual design is approximately 3.0 acres in size and could reduce the total suspended solids from the contributing 64 acre drainage area by 96% and total phosphorus by 67%. This facility would not require land acquisition as the property is currently owned by the City; however, the site contains hydric soils and has a high water table due to its proximity to the Oconomowoc River. These environmental conditions should be assessed more thoroughly before design would occur for this alternative. This facility has an estimated project cost of $597,240 and a total present worth of approximately $1,036,083.

- Alternative PA-9 (Church Wet pond or Biofiltration Device) is located between Main and Franklin Streets and south of Third Street. This facility was modeled as both a wet pond and a biofiltration device that would be contoured to fit the open area west of Dr. Martin Luther Church. The conceptual wet pond design is approximately .8 acres in size. Both alternatives were sized to reduce total suspended solids from the contributing drainage area by 89% and total phosphorus by an average of 72%. This facility would require land acquisition, but there are no known special environmental conditions to be considered in the design process. The wet detention facility has an estimated project cost of $177,720 and a total present worth of approximately $285,092 and the biofiltration facility has an estimated project cost of $405,465 and a total present worth of approximately $592,045.

- Alternative PA-10 (Riverside Park Wet pond or Biofiltration Device) is located adjacent to the Oconomowoc River near the intersection of Harding and Washington Streets. This facility was modeled as both a wet pond and a biofiltration device that would be contoured to fit the small area available in Riverside Park. The conceptual wet pond design is approximately .5 acres in size and could reduce total suspended solids from the contributing 32 acre drainage area by 68% and total phosphorus by about 47%. The biofiltration device would achieve greater reductions at 83% total suspended solids and

64% total phosphorus. This facility would not require land acquisition as the property is currently owned by the City; however, the facility's proximity to the river and the adjacent wetlands should be investigated more thoroughly before design occurs. The wet detention facility has an estimated project cost of $33,560 and a total present worth of approximately $62,285 and the biofiltration facility has an estimated project cost of $299,065 and a total present worth of approximately $447,425.

- Alternative PA-11 (Armory Wet pond or Biofiltration Device) is located in between Wall Street and Capitol Drive and west of the Oconomowoc Armory. This facility was modeled as both a wet pond and a biofiltration device that is roughly rectangular in shape to fit the empty lot in this area. The conceptual wet pond design is approximately 2.5 acres in size. The wet pond would reduce total suspended solids from the contributing drainage area by 98% and total phosphorus by about 65%. The biofiltration device would achieve reductions at 74% total suspended solids and 60% total phosphorus. This facility would require land acquisition, but there are no known special environmental conditions to be considered in the design process. The wet detention facility has an estimated project cost of $488,000 and a total present worth of approximately $847,243 and the biofiltration facility has an estimated project cost of $123,200 and a total present worth of approximately $192,734.

Battle Creek Reachshed (#26)

This reachshed encompasses the south central portion of the City of Oconomowoc. Based on the existing storm water controls, this reachshed is currently experiencing a 78.32% reduction in total suspended solids (versus a 57% TMDL goal) and a 59.11% reduction in Phosphorus (versus a 53% TMDL goal). In addition, Appendix G includes some additional Phosphorus monitoring results from the Battle Creek and Rosenow Creek watersheds. The modeling results show this reachshed being in compliance with the goal of the TMDL, making the development of specific alternatives within this area unnecessary. Even with this reachshed being in compliance, two street sweeping alternatives were evaluated to provide the City with a cost benefit comparison if they choose to increase the frequency of their street sweeping within this area.

Street Sweeping Alternatives – Battle Creek Reachshed

Under the schedule currently in effect within the City of Oconomowoc, all City roadways are swept every four weeks using high efficiency vacuum sweeping equipment. With a sweeping cost estimated at $100 per mile, the existing annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation are approximately $18,000. The resulting 50 year present worth would approximate $355,716. Two street sweeping alternatives were considered to provide additional pollutant reductions.

The first street sweeping alternative would consist of increasing the schedule of sweeping throughout the entire City to once every 2 weeks. This alternative would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 4.15% sediment reduction and an additional 2.83% phosphorous reduction. With a sweeping cost of $100 per mile, this alternative may be expected to increase the annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation from $18,000 to $36,000. The resulting 50 year present worth would approximate $711,432, or $56 per pound of additional sediment removed and $33,878 per pound of additional phosphorous removed.

The second alternative would consist of increasing the schedule of sweeping throughout the entire City to once every week. This alternative would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 8.40% sediment reduction and an additional 5.69% phosphorous reduction. With a sweeping cost of $100 per mile, this alternative may be expected to increase the annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation from $18,000 to $72,000. The resulting 50 year present worth would approximate $1,422,865, or $55 per pound of additional sediment removed and $33,090 per pound of additional phosphorous removed.

The modeling has shown that more frequent street sweeping dramatically increases the cost, while only providing minimal further sediment reductions. As a result, no additional street sweeping options were pursued.

New Storm Water Quality Control Facilities – Battle Creek Reachshed

With this reachshed being in compliance with the TMDL, there was only one additional alternative storm water quality device developed and evaluated, PA-12. In addition, there is language in the Recommended Plan section of this report describing green infrastructure alternatives that are recommended for implementation during redevelopment and road reconstruction projects within this reachshed.

- Alternative PA-12 (Heritage Heights Park Pond Retrofit). This facility is located just west of Forest Park Street in the open area north of the DPW garage. For the purposes of this conceptual design, the pond was assumed to cover most of the open area. The pond shape is trapezoidal with a size of approximately 1.9 acres and would reduce total suspended solids from the contributing 148 acre drainage area by 62% and total phosphorus by 50%. There are no special environmental conditions to be considered in the design process. This facility has an estimated project cost of $598,220 and a total present worth of approximately $1,086,694.

Rock River Reachshed (#27)

This reachshed encompasses a very small area of land (26 acres) on the far west central part of the City. The entire reachshed also drains directly to waters of the state without passing through the City's MS-4; therefore it receives a 100% reduction in total suspended solids (versus a 40% TMDL goal) and a 100% reduction in Phosphorus (versus a 27% TMDL goal). With no street sweeping within this reachshed due to it being surrounded by County Highway and a 100% reduction in both sediment and Phosphorus, no additional alternatives were developed or evaluated for this area.

Upper Nemahbin Reachshed (#55)

This reachshed encompasses the southeastern portion of the City of Oconomowoc. Based on the existing storm water controls, this reachshed is currently experiencing a 91.56% reduction in total suspended solids (versus a 66% TMDL goal) and an 86.80% reduction in Phosphorus (versus a 77% TMDL goal). The modeling results show this reachshed being in compliance with the goal of the TMDL, making the development of specific alternatives within this area unnecessary. Even with this reachshed being in compliance, two street sweeping alternatives were evaluated to provide the City with a cost benefit comparison if they choose to increase the frequency of their street sweeping within this area.

Street Sweeping Alternatives – Upper Nemahbin Reachshed

Under the schedule currently in effect within the City of Oconomowoc, all City roadways are swept every four weeks using high efficiency vacuum sweeping equipment. With a sweeping cost estimated at $100 per mile, the existing annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation are approximately $12,600. The resulting 50 year present worth would approximate $249,001. Two street sweeping alternatives were considered to provide additional pollutant reductions.

The first street sweeping alternative would consist of increasing the schedule of sweeping throughout the entire City to once every 2 weeks. This alternative would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 4.15% sediment reduction and an additional 2.83% phosphorous reduction. With a sweeping cost of $100 per mile, this alternative may be expected to increase the annual street sweeping costs, including labor, benefits, equipment, operation, maintenance and depreciation from $12,600 to $25,200. The resulting 50 year present worth would approximate $498,003 or $94 per pound of additional sediment removed and $50,817 per pound of additional phosphorous removed.

The second alternative would consist of increasing the schedule of sweeping throughout the entire City to once every week. This alternative would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 8.40% sediment reduction and an additional 5.69% phosphorous reduction. With a sweeping cost of $100 per mile, this alternative may be expected to increase the annual street sweeping costs,

including labor, benefits, equipment, operation, maintenance and depreciation from $12,600 to $50,400. The resulting 50 year present worth would approximate $996,005, or $93 per pound of additional sediment removed and $49,800 per pound of additional phosphorous removed.

The modeling has shown that more frequent street sweeping dramatically increases the cost, while only providing minimal further sediment reductions. As a result, no additional street sweeping options were pursued.

New Storm Water Quality Control Facilities – Upper Nemahbin Reachshed

With this reachshed being in compliance with the TMDL, no alternative storm water quality devices were developed or evaluated. There is however, language in the Recommended Plan section of this report describing green infrastructure alternatives that are recommended for implementation during redevelopment and road reconstruction projects within this reachshed.

Catch Basin Cleaning

Under the schedule currently in effect within the City of Oconomowoc, catch basins are inspected annually and cleaned as needed, resulting in minimal pollutant reductions. Since the water quality modeling guidance published by the Department does not allow communities to take credit for both street sweeping and catch basin cleaning and minimal pollutant reductions, no changes to the existing cleaning schedule were analyzed. Catch basins should still be maintained, as needed, to prevent the resuspension of trapped sediment.

COMMUNITY WIDE ALTERNATIVES:

Impacts of Future Development / Storm Water Ordinance Updates

The densely developed urban sections of the City of Oconomowoc have seen a recent uptick in redevelopment. It can be reasonably assumed that 0.5% of the city will redevelop in any given year. With the City's current storm water ordinance requiring 40% sediment control during all significant redevelopments, redevelopment activities may be expected to improve sediment loadings by approximately 0.20% annually. The City's current ordinance is silent on phosphorous control for redevelopment scenarios.

The City may desire to revise their ordinance to a level more stringent than current WDNR regulations. If the redevelopment ordinance was modified to require 80% sediment control and 50% phosphorous control, redevelopment activities may be expected to improve sediment loadings by approximately 0.40% annually and phosphorous loadings by approximately 0.25% annually. While there would be no direct cost to the City for these modifications, the more stringent ordinances would increase developer costs and likely dissuade certain redevelopment activities.

Similarly, the City may desire to revise their new development ordinance to require something above 80% sediment control and also require a to-be-determined level of phosphorous control on new development sites.

Green Streets Designs

Green infrastructure concepts, including "green streets", are designed to capture and treat storm water runoff on individual sites. Rain and snow melt from a small drainage area, such as a segment of road, driveways, and sidewalks, can be directed to a small basin behind the curb where it is infiltrated into the ground. The basins are commonly planted with native plants that are tolerant of both standing water and periods of drought. Using native plants also benefits the long-term operations of the basin, as the long root structures produce pores for water to flow down through to the underlying parent material where it can infiltrate into the ground. During large rain events, water can flow into a bypass system under the basin, leading to existing storm sewer and out to the nearest waterway. A storm system inlet or a curb cut can direct water from the road to the basin area behind the curb.

There are a variety of practices that can be used in conjunction with each other to optimize pollutant removal and enhance functionality of the systems. Optional additions to this design include curb extensions, which involves replacing portions of a parking lane with planted basins in strategic areas along the street. This provides a larger surface area in a basin for runoff to enter and soak into the ground, which means less runoff from road surfaces to flow directly to the storm sewer. Permeable pavement options such as pavers, asphalt or concrete in parking lanes, can capture additional runoff during rain or snow melt events, before discharging the water to a biofilter. Runoff flows across and into the permeable pavement, into a reservoir underground before directing the water to a biofilter via underground pipe.

Another design involves allowing runoff to flow across roads, sidewalks and driveways into small depressed basins or trenches, where the water soaks in and infiltrates into groundwater. Existing soils below the basins or trenches determine whether the water can infiltrate at a high rate or if an underdrain system is necessary. Similar to basins behind curbs, these depressions are typically planted with native plants that can live through different moisture conditions and which enhance infiltration capabilities of the constructed basin or trench. In a situation without a curb, the runoff is directed toward the basin as sheet flow across the road.

Permeable Pavement

Permeable pavers or blocks, porous asphalt and porous concrete are solutions to areas of a community that has little room for traditional storm water treatment systems. Applications for permeable pavement include installation in recessed parking islands, in parking lanes along roads, through the center of alley ways, and more. Installation of permeable pavement products differs from traditional pavers, asphalt and concrete; the manufacturer's directions should be followed closely. As with any storm water treatment structure, maintenance is very important. Regular inspections should be conducted to identify any areas needing maintenance, and those corrections should be completed and recorded for future evaluations of the practice.

Storm Water Trees

Manufactured planters that can hold trees or other vegetation can be planted along road sides to capture runoff from rain or snow melt events. The planters have overflows that are hooked up to the storm sewer system for large rain events. Tree Planters can be installed in series on a sloped street or hillside to slow down runoff and allow areas for runoff to be captured on site. Storm water trees offer improved water quality, air quality, and enhanced aesthetics for everyone in the area.

Neighborhood Rain Barrel Program

Rain barrels can be promoted throughout a residential neighborhood, commercial or business district to capture runoff from rooftops, to be used to water gardens or lawns at a future date. Engaged communities and non-profit organizations can lead rain barrel campaigns to educate property owners on the benefits of installing this type of system. Local workshops, installation demonstrations, and volunteers to assist with initial installation are examples of efforts that can occur in a particular area off a city. Property owners can be encouraged to "buy local" when nearby businesses partner with program coordinators to offer and market a selection of barrels. Rain barrels typically hold 55 gallons of water, but larger ones or combining units to hold more water can be used.

Neighborhood Rain Garden Program

A coordinated effort to get rain gardens constructed within a particular drainage area can have a positive impact on water quality in the receiving waterways. Rain water that hits the residential rooftops can be directed to small depressions, rather than flowing downhill toward the nearest storm sewer. Rooftop water is generally clean, as opposed to runoff that flows across roads, parking lots, and lawns where a variety of pollutants accumulate between each rain event. Directing rooftop water to rain gardens can reduce the amount of water flowing through the storm sewer, thus minimizing the fluctuations in stream levels after rain events. A river system should naturally have a fluctuation in water levels throughout a season, but artificially induced fluctuations due to runoff from rain or snow melt events can severely scour stream banks and bed, washing additional sediment downstream. These physical impacts on aquatic habitat can negatively impact reproduction and foraging or feeding patterns of fish and other aquatic organisms. Pollutants such as phosphorus and sediment that flow into rain gardens are captured as water soaks into the ground, thus eliminating additional impacts to downstream receiving waterways.

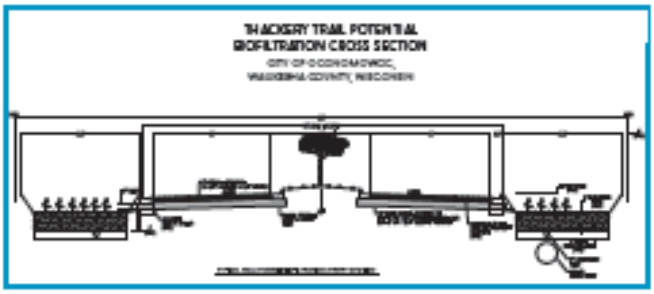
CURBED STREET WITH BIORETENTION TRENCH

BIORETENTION TRENCHES

Bioretention trenches allow road runoff to soak into the ground, instead of flowing through storm pipes to the nearest creek, lake or wetland. Water quickly infiltrates through a filtering soil layer via the long rooted, native plantings. This minimizes the amount of pollution washing off the streets and into the local waterways, and minimizes downstream flooding impact by capturing storm water where it falls.

Studies have shown that neighborhoods with green infrastructure practices such as infiltration trenches and traffic calming street designs are desirable to residents, with social, environmental and economic benefits associated with these improvements.

Infiltration basins behind curb cuts



Biofiltration with Underdrain at Bottom

COST ESTIMATES

- Excavation
- Plantings (salt tolerant recommended)
- Soil amendments
- Retaining wall / riprap materials
- Underdrain

MAINTENANCE

Like any utility structure, maintenance is needed to ensure proper functioning over time. Vegetation will need to be watered, thinned, cut or replaced over time, especially during the first couple years as plantings become established. Inspections and maintenance should occur at regular intervals and after heavy rain events. Debris will need to be removed from overflow pipes to prevent clogging.

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NO CURB INFILTRATION BAY

NO CURB INFILTRATION BAY

Infiltration trenches allow road runoff to soak into the ground, instead of flowing through storm pipes to the nearest creek, lake or wetland. Water quickly infiltrates through a filtering soil layer via a variety of long rooted, native plantings. This minimizes the amount of sediment, nutrients and other pollution washing off the streets and into the local waterways. Infiltration trenches also reduce impacts from flooding as water soaks into the ground where it falls, minimizing the amount of water that flows downstream.

Residents usually look favorably upon green infrastructure practices such as infiltration trenches with native plantings and traffic calming street designs. These measures provide positive social, economic and environmental impacts to a community.

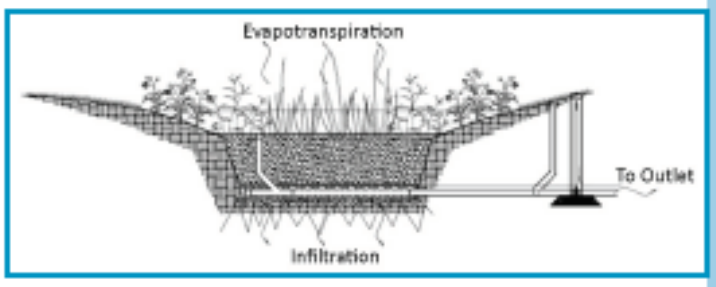

Cross section without underdrain

COST ESTIMATES

- Excavation
- Plantings (salt tolerant recommended)
- Soil amendments / mulch
- Retaining wall / riprap materials
- Underdrain (optional)

MAINTENANCE

The infiltration bay should be watered and weeded, especially in the first 2-3 years while plants become established and during periods of drought. Any plants that die off should be pruned or removed. Mulch may need to be replaced over time or after excessive rain events.



Biofiltration with Underdrain at Bottom

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PERMEABLE PAVEMENT

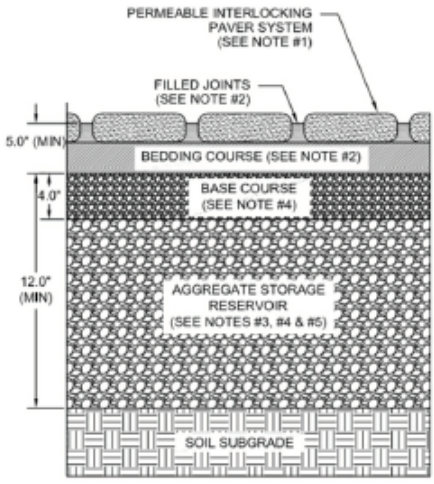
PERMEABLE PAVEMENT SYSTEMS

Permeable concrete, asphalt or pavers allow rain or snow melt to soak into sidewalks, trails, parking areas, or center lanes of alleys. Runoff from adjacent hard surfaces can also be directed to these permeable systems. Water runs through the pores in the pavement to the storage layer below which drains within 72 hours. An underdrain can enhance drainage of the storage layer.

Permeable pavement systems that infiltrate into soils below receive 100% pollutant removal credit; systems with underdrains receive 55% TSS and 35% phosphorus credit, based on specifications in the Wisconsin Department of Natural Resources' Technical Standard 1008. Proper installation is critical; most manufacturers of permeable products have specific installation instructions that should be followed closely.

Wolf Paving
Porous Asphalt Parking Lot.

FIGURE 1. CRITERIA FOR UNDERDRAIN DISCHARGE AND INFILTRATION PRETREATMENT CREDITS



COST ESTIMATES

- Approximately $10/sq. ft. (from MMSD Green Infrastructure Plan, April 2013)
- Excavation/grading
- Aggregate for storage reservoir
- Asphalt / concrete / pavers
- Filler for joints between pavers (if applicable)

MAINTENANCE

Regular maintenance of permeable pavement systems is critical.

- Prevent clogging by removing organics such as leaves and seeds; do not use sand as an anti-icing practice.
- Occasional sweeping with a vacuum assisted sweeper is recommended
- Filler material between pavers may need to be replaced.
- Regular inspections should be documented

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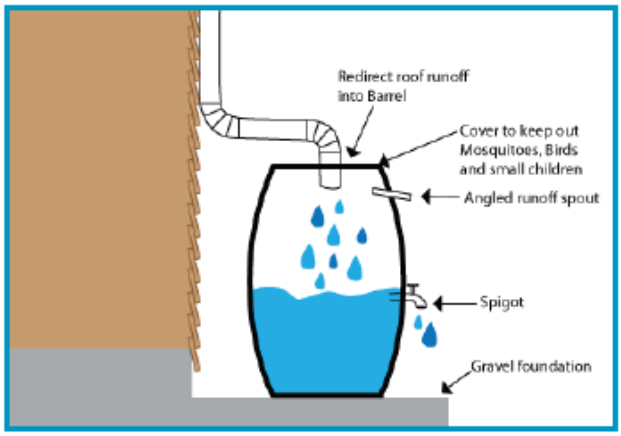
RAIN BARRELS

RAIN BARREL PROGRAMS

A community-wide rain barrel program can bring attention to water quality and drainage problems in a community. Rain barrels can reduce the amount of roof top water flowing into the storm sewer, reducing the impacts of flooding and pollution in waterways downstream. Residents and businesses that install rain barrels can water gardens and lawns with this water.

An engaged community can implement a successful rain barrel program by offering local workshops, on-site demonstrations, and reduced prices for rain barrels through cost sharing. Communities can support local businesses by partnering with hardware stores, nurseries, and other businesses to sell barrels. Different sizes, colors and shapes of rain barrels can also be purchased at retail stores, online, and through the Waukesha County Parks and Land Use Department.



Water captured in barrels can be used later to water gardens and lawns.

COST ESTIMATES

Retail prices typically start around $100 per barrel and can go up, depending on the features. Some do-it-yourself models can be purchased for a lower price. Community or grant related cost-sharing can lower the price of the barrels.

MAINTENANCE

- Barrels should be taken inside during winter months
- Use water within 5-7 days of rain events to prevent algae and mosquito larvae from developing
- A screen or mesh over any inlets for water will prevent mosquitoes from getting inside to lay larvae

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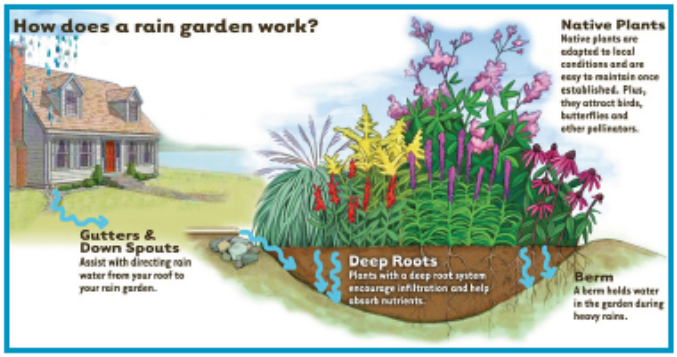
RAIN GARDENS

NEIGHBORHOOD RAIN GARDEN PROGRAMS

Rain gardens are small gardens set in the ground that receive water from downspouts and swales. Native plants typically have longer root systems, which enhances infiltration, and are more accustomed to fluctuations in rainy and dry weather patterns. By taking on water from rooftops and other hard surfaces, rain gardens promote infiltration and groundwater recharge, as well as minimize the impacts of pollutants and excess rain water on the local rivers, lakes and wetlands.

Rain garden programs can be marketed toward particular neighborhoods or areas of a city through local rain garden workshops, demonstration sites, discounted or cost-shared plantings, partnerships with local businesses to make plants and materials available, and volunteer programs to assist property owners with installation.

Rain Garden at New Berlin West Middle/High School New Berlin, WI, 2008.



COST ESTIMATES

- Excavation
- Plantings (native / wet mesic mixes)
- Soil amendments / mulch
- Downspout extensions
- Riprap / rock (at end of downspout extension into rain garden)

MAINTENANCE

The plantings in the rain garden should be watered and weeded, especially in the first 2-3 years and in periods of drought. Plants that spread may need to be thinned, to prevent a particular species from taking over the whole garden. Additional rock may be needed over time at the end of the down spout to prevent scouring.

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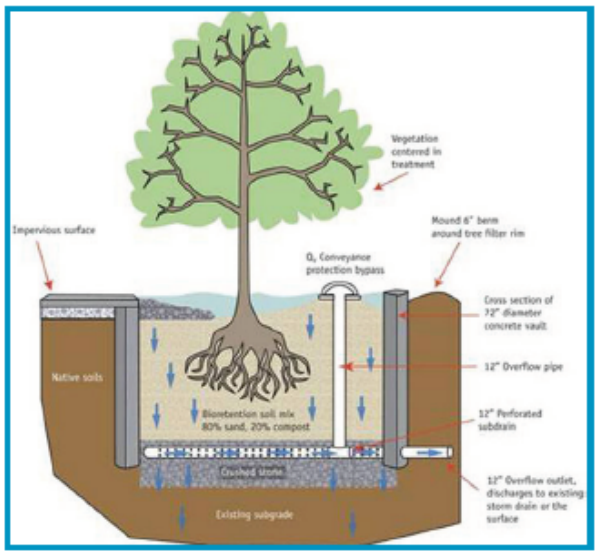
STORM WATER TREES

INSTALLATION OF TREE PLANTERS

Tree planters can be installed along roads to capture road and sidewalk runoff, allowing for infiltration and evapotranspiration of the water. Excess flows enter the storm system under the planter. Trees and vegetation on city blocks improve air & water quality, provide shade, and cool hard surfaces. Trees and vegetation beautify downtown areas, enhancing daily activities for everyone in the area.



COST ESTIMATES

- Planter(s)
- Excavation
- Trees / Plantings (salt tolerant recommended)
- Soil amendments / mulch
- Underdrain / Pipe
- Stone for aggregate layer

GREEN INFRASTRUCTURE

MAINTENANCE

Trees require watering and care, especially in the first few years. Pruning may be needed depending on the species and the location. The planter should be inspected on a routine basis for any wear or needed repairs; the overflow pipe should remain free of debris to prevent clogging. Routine inspections should be documented.

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Water Quality Trading and Adaptive Management

The Wisconsin Department of Natural Resources has developed pollutant trading and adaptive management programs to allow permit holders implement another option to meet their pollutant allocations and regulatory goals. While the programs are somewhat similar, there are several key differentiators:

- Pollutants: Water quality trading can be used to comply with a range of pollutants, whereas adaptive management focuses on compliance with phosphorus water quality based effluent limitations (WQBELs) solely.

- Adaptive management and trading have different end goals: Adaptive management focuses on achieving water quality criterion for phosphorus in the surface water; trading focuses on offsetting phosphorus (or other pollutants) from a discharge to comply with a permit limit.

- Monitoring: Because adaptive management focuses on water quality improvements, in-stream monitoring is required under adaptive management; this is not required under trading.

- Timing: Practices used to generate reductions in a trading strategy must be established before the phosphorus limit takes affect; adaptive management is a watershed project that can be implemented throughout the permit term.

- Quantifying reductions needed: Trading requires trade ratios be used to quantify reductions used to offset a permit limit; the reductions needed for adaptive management are based on the receiving water, not the effluent, and trade ratios are not necessary in this calculation.

- Eligibility: Adaptive management and trading have different eligibility.

Economic Evaluation

It is customary to evaluate plans for water resource development projects on the basis of benefits and costs. This is particularly appropriate if the prospective development represents opportunities for investments to provide economic return to the public and if a comparison of alternative investments is desirable. In the case of storm water management systems, however, it is assumed that such systems must be provided to fulfill a fundamental need of the community, and consequently, they do not compete with alternatives of investment in other economic sectors. Accordingly, it is assumed that the least costly alternative system that meets the storm water management objectives set forth in this plan will be the most desirable alternative economically.

The economic evaluations conducted under this storm water management planning program include capital cost estimates and annual operation and maintenance cost estimates. Capital costs include construction contract costs plus engineering, inspection and contract administration

costs, were estimated on the basis of experience within the greater Milwaukee / Madison area and are expressed in December, 2015 actual dollars.

Information and Education Program

The City of Oconomowoc has been a partner in the Waukesha County Storm Water Education Program since its inception in 2008 to meet the information and education requirements and the public involvement requirements of the WPDES MS4 Permit. Over 20 communities work with Waukesha County staff to implement an outreach program directed at multiple audiences, including general public and interested citizens, non-profit groups, specific industries such as developers, contractors, and engineers, and the educational community (teachers and students). Specific topics and activities addressed through the storm water outreach program include:

- citizen stream monitoring
- presentations and in-field demonstrations about runoff and water quality to students
- workshops for teachers regarding opportunities to involve water quality and conservation issues into the classroom,
- illicit discharges,
- general housekeeping measures to protect water quality,
- fertilizers and leaf collection practices,
- how to manage streambanks adjacent to private property,
- small-scale infiltration practices such as rain gardens for use by homeowners,
- information on construction design and practices to control runoff both during and after construction

The County's storm water program does not formally include internal education activities for municipal staff, but participants have worked together on some particular topics in the past to share expenses and resources for education activities for municipal staff. The County is in the process of preparing a storm water outreach work plan. A copy of the work plan is included in Appendix F.

As the City of Oconomowoc moves into the implementation phase of the Rock River TMDL and the adaptive management plan, general information about the condition of local water resources will need to be stressed with citizens and particular audiences. Infiltration of runoff during rain events will be an important practice for residents to support to help the city meet the goals for phosphorus reductions in the Oconomowoc River and its tributaries. The City of Oconomowoc has the opportunity to work with Waukesha County staff on the benefits and installation of rain gardens to targeted neighborhoods or areas of a city. Workshops and demonstrations of installation techniques, brochures and newspaper articles, and low-cost plantings are elements of a targeted rain garden outreach campaign that the city can work on with county staff. Once a particular area of the city has been identified, city staff should contact county staff to develop a customized rain garden outreach plan.

The city's adaptive management program contains details of watershed-wide outreach efforts. Many of those practices are better suited to owners of large properties or farm fields, where runoff concerns are primarily driven by stream bank erosion and lack of year-long stabilization. The city's partnership with Waukesha County on urban storm water pollution will complement the larger, watershed-wide outreach program already underway.

An important element of any storm water system is the long-term maintenance of the various components to convey and treat the runoff. In recent years, more emphasis has been given to the long-term maintenance needs of these facilities, whom is responsible for that maintenance, and what the consequences are if these facilities are not inspected and maintained. Waukesha County recently developed a series of fact sheets to be shared with property owners, contractors, and inspectors who are tasked with ensuring the facilities function appropriately. A copy of those fact sheets is included in Appendix F. City of Oconomowoc staff can assist county staff by distributing this information to their residents affected by this issue, either through targeted mailings, posting the fact sheets to the city's web-site, or by making the brochures available to the public.

Support from residents for projects and initiatives to improve and protect the lakes, rivers and wetlands in the watershed will also be important for city officials to have confidence in making decisions to implement these measures.

CHAPTER 5 -- RECOMMENDED PLAN

The preparation of the recommended storm water management system plan for the City of Oconomowoc involved a synthesis of corrective measures selected from among the alternatives considered and described in Chapter Four and based primarily upon a comparative economic analysis. In the selection, however, consideration was also given to the level of performance provided, to the anticipated ease of construction, to potential environmental impacts and to fulfillment with other City objectives.

The recommended corrective measures within the City were prioritized, and a capital improvement program developed on the basis of this prioritization and estimates of potentially available funding. Following formal adoption of the recommended plan by the City of Oconomowoc, realization of the plan will require a long-term commitment to the objectives of the plan, and a high degree of coordination and cooperation among City officials and staff, Wisconsin Department of Natural Resources staff, developers and concerned citizens.

The systems-level storm water management plan presented in this report is intended to serve as a guide to the future design and construction of storm water management facilities. Detailed engineering design should examine in greater depth and detail potential variations in the technical, economic and environmental features of the recommended solutions identified in the system plan in order to determine the best means of carrying out the plan. The resulting facility development plans, however, should be fully consistent with the system plan recommendations presented in this report.

The recommended plan encompasses the entire City of Oconomowoc but is broken down by reachshed to match the TMDL pollutant allocations. The recommended plan is presented in summary form on Table 4 based on December, 2015 actual dollars and is graphically summarized on Exhibit 5. The plan recommendations for new facilities are shown in greater detail on Exhibit 6 through 18.

Compliance with Total Maximum Daily Load Pollutant Allocations

It is clear that compliance with the City's TMDL allocations within reachshed (#25) will be challenging to achieve, but should not be considered impossible. It will require creative thinking, innovation, patience and collaboration will all stakeholders (neighboring governmental agencies, regulatory agencies, the development community, public officials, residents, staff, etc.). It will also require incredible diligence from the City of Oconomowoc's staff to champion the City's new storm water program.

The recommendations presented herein shall not be considered absolute. As technology and regulations change, the plan will need to be periodically updated. That said, the current plan will allow the City to begin their compliance journey with a clear picture of the initial steps, and an understanding of the journey the City is about to embark on.

Table 4 – Recommended Large Scale Storm Water Management Improvements

Oconomowoc River Reachshed (#25)

Priority	Control Measure	Total Suspended Solids (Pounds)		Total Phosphorus (Pounds)		Estimated Project Cost (Structural BMP) or Annual Cost (Sweeping)	Estimated 50 Year Present Worth	Cost Per Pound of Pollutant Removal	
		Existing Land Use	Reduction from No Controls	Existing Land Use	Reduction from No Controls			Total Suspended Solids	Phosphorus
1	Water Quality Devices with Road Reconstruction	0.40% Annually		0.25% Annually		-	-		
2	Promote Green Redevelopment	0.40% Annually		0.25% Annually		-	-		
3	PA-10 (Riverside Park Wet Pond)	4,709	.61%	13	.53%	$33,560	$62,285	$13	$4,791
4	PA-7 (Forest Street Pond)	20,383	2.63%	53	2.15%	$484,703	$846,995	$42	$15,981
5	PA-1 (Industrial Park)	25,730	3.32%	44	1.67%	$557,090	$1,151,829	$45	$26,178
6	PA-8 (Champion Field Pond)	17,187	2.22%	34	1.38%	$597,240	$1,036,083	$60	$30,473
7	PA-4 (Gas Station Pond)	13,405	1.73%	34	1.38%	$665,366	$991,483	$74	$29,161
8	Street Sweeping Every Week	65,070	8.40%	140	5.69%	$370,800	$7,327,752	$113	$52,341
OCONOMOWOC RIVER REACHSHED TOTALS		**152,681**	**19.71%**	**327**	**13.30%**	**$2,708,759.00**	**$11,416,427.00**	**$58**	**$26,488**

Table 4 – Recommended Large Scale Storm Water Management Improvements

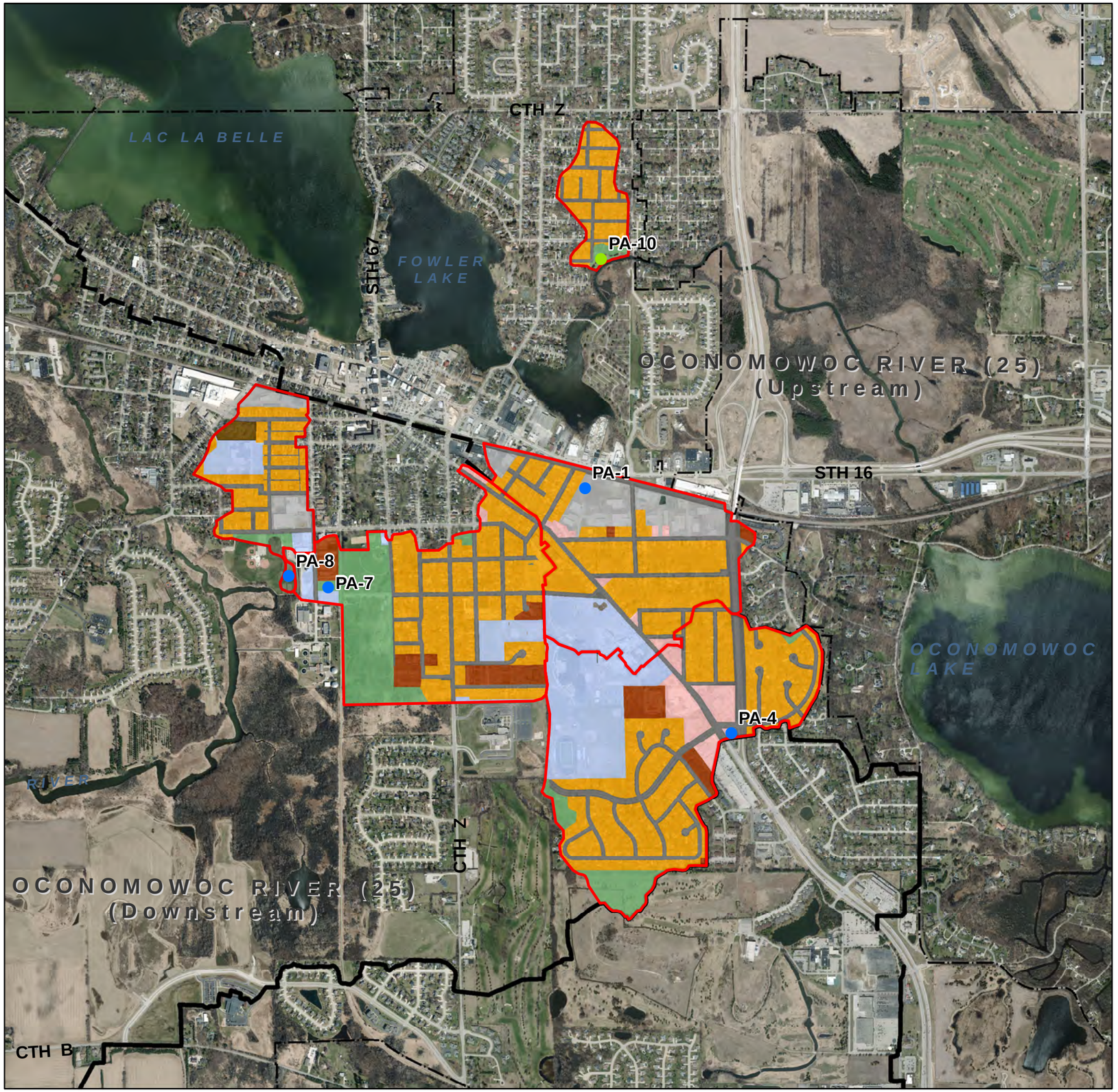
Battle Creek Reachshed (#26)

Priority	Control Measure	Total Suspended Solids (Pounds)		Total Phosphorus (Pounds)		Estimated Project Cost (Structural BMP) or Annual Cost (Sweeping)	Estimated 50 Year Present Worth	Cost Per Pound of Pollutant Removal	
		Existing Land Use	Reduction from No Controls	Existing Land Use	Reduction from No Controls			Total Suspended Solids	Phosphorus
1	Water Quality Devices with Road Reconstruction	0.40% Annually		0.25% Annually		-	-	-	-
2	Promote Green Redevelopment	0.40% Annually		0.25% Annually		-	-	-	-
BATTLE CREEK REACHSHED TOTALS		**2,466**	**.80%**	**4**	**.50%**	**$0**	**$0**	**$0**	**$0**

Table 4 – Recommended Large Scale Storm Water Management Improvements

Upper Nemahbin Reachshed (#55)

Priority	Control Measure	Total Suspended Solids (Pounds)		Total Phosphorus (Pounds)		Estimated Project Cost (Structural BMP) or Annual Cost (Sweeping)	Estimated 50 Year Present Worth	Cost Per Pound of Pollutant Removal	
		Existing Land Use	Reduction from No Controls	Existing Land Use	Reduction from No Controls			Total Suspended Solids	Phosphorus
1	Water Quality Devices with Road Reconstruction	0.40% Annually		0.25% Annually		-	-	-	-
2	Promote Green Redevelopment	0.40% Annually		0.25% Annually		-	-	-	-
UPPER NEMAHBIN REACHSHED TOTALS		**1,022**	**.80%**	**2**	**.5%**	**$0**	**$0**	**$0**	**$0**



Life comes NATURALLY here

Recommended Large Scale Storm Water Quality Facilities Exhibit 5

Legend

- Proposed Combination Alternative
- Proposed Alternative
- Drainage Area to Proposed Alternative
- Reachshed Boundary
- Upstream/Downstream Reachshed Boundary
- Medium Density Residential (MDRNA)
- High Density Residential (HDRNA)
- Commercial
- Institutional
- Light Industrial (LI)
- Open Space
- Transportation
- Oconomowoc Boundary - City Limits

N
W E
S

0 750 1,500 3,000 4,500

Feet

Date: December, 2015

Ruekert · Mielke

Recommended Plan – Oconomowoc River Reachshed (#25)

The City of Oconomowoc is currently obtaining a 40.21% reduction in total suspended solids loading and a 32.16% reduction in phosphorous within the Oconomowoc River Reachshed based on the existing storm water controls currently in place. The recommended plan summarized below moves the City to a 59% reduction in total suspended solids loading and a 45% reduction in phosphorous; which is in compliance with the TMDL's requirement for total suspended solids but still significantly below the 74% phosphorous reduction goal.

To meet the phosphorous TMDL goals in Reachshed 25, the City is adopting an adaptive management strategy. The adaptive management approach is to look at meeting Phosphorous goals on a watershed basis. Additional planning to meet the phosphorous TMDL would only occur if the adaptive management plan is not successful. Additional information on the adaptive management strategy can be found on Page 56.

Street Sweeping Recommendations – Oconomowoc River Reachshed

Under the schedule currently in effect, all City roadways are swept every 4 weeks using high efficiency vacuum sweeping equipment at an annual cost of approximately $92,700, including labor, benefits, equipment, operation, maintenance and depreciation.

The recommended street sweeping schedule consists of sweeping the entire reachshed once every week. This recommendation would provide a pollutant loading reduction when compared to the current sweeping program in the reachshed of an additional 8.40% sediment reduction and an additional 5.69% phosphorous reduction. With a sweeping cost of $100 per mile, this recommendation is expected to increase the annual street sweeping costs to $370,800.

It is also recommended that alternative street sweeping technologies be evaluated as they are developed for application throughout the City. These technologies will likely include more efficient street sweepers and the application of polymers to the roadways prior to sweeping. The City should also continue to track the sweeping routes completed throughout the City for inclusion in their annual report.

New Storm Water Facility Recommendations – Oconomowoc River Reachshed

Five new storm water quality facilities are recommended within this reachshed.

- PA-10 (Riverside Park Wet Pond) Shown in detail on exhibit #15. This recommended facility is located adjacent to the Oconomowoc River near the intersection of Harding and Washington Streets. This facility was modeled as both a wet pond and a biofiltration device that would be contoured to fit the small area available in Riverside Park. The conceptual wet pond design is approximately .5 acres in size and has a significantly lower construction cost than the biofiltration device alternative, therefore, the wet pond will be the recommendation for construction. If constructed, this wet pond could reduce total suspended solids from the contributing 32 acre drainage area by 68% and total

phosphorus by about 47%. This facility would not require land acquisition as the property is currently owned by the City, and there are no known special environmental conditions to be considered in the design process other than the facility's proximity to the river. This wet detention facility has an estimated project cost of $33,560 and a total present worth of approximately $62,285.

- PA-7 (Forest Park Pond) Shown in detail on exhibit #12. This facility is located just west of Forest Park Street in the open area north of the DPW garage. For the purposes of this conceptual design, the pond was assumed to cover most of the open area. The pond shape is trapezoidal with a size of approximately 1.9 acres and would reduce total suspended solids from the contributing 148 acre drainage area by 62% and total phosphorus by 44%. There are no special environmental conditions to be considered in the design process. This facility has an estimated project cost of $484,703 and a total present worth of approximately $846,995.

- PA-1 (Industrial Park Wet Pond) Shown in detail on exhibit #6. This wet pond is located east of Lyman Street near the railroad tracks. This facility is located near the outlet of the basin and receives significant flows. In addition, the area is prone to flooding because of surcharging from the lake. For this reason, the pond was conceptually designed with only water quality benefits in mind. The design also includes a cost for a basic pumping station to convey excess quantities of storm water to the lake. The Industrial Park Pond is a conical design, fitting the surrounding area which has wetlands in the northeast corner of the site, a shallow water table, and hydric soils. This pond is approximately 1.4 acres in size The pond would reduce total suspended solids from the contributing 160 acre drainage area by 53% and total phosphorus by 32%. This facility has an estimated project cost of $557,090 and a total present worth of approximately $1,151,829.

- PA-8 (Champion Field Wet Pond) Shown in detail on exhibit #13.This facility is located southwest of the intersection of Jefferson Street and Worthington Street. There is sufficient open area in the southeastern area of Champion field to construct a sizeable storm water facility. This facility would be a wet pond that is contoured to fit the area east of the sports facilities. The conceptual design is approximately 3.0 acres in size and could reduce the total suspended solids from the contributing 64 acre drainage area by 96% and total phosphorus by 67%. This facility would not require land acquisition as the property is currently owned by the City, and there are no known special environmental conditions to be considered in the design process. This facility has an estimated project cost of $597,240 and a total present worth of approximately $1,036,083.

- PA-4 (Gas Station Wet Pond) Shown in detail on exhibit #9. This alternative is located near the split of Highway 67 and Summit Avenue at the vacant lot of a former gas station. It receives flow from the neighborhoods north and west of the location including both major roadways. This facility would be a wet pond with a conceptual design that is a triangular in shape to fit the lot. It is approximately 0.95 acres in size and would reduce

total suspended solids from the contributing drainage area by 68% and total phosphorus by 51%. This facility does require land acquisition, as the property was recently sold to a private owner. Also, the site is suspected to have contaminated soils as a result of its former use as a gas station. The estimated project cost for this alternative is $665,366 (including additional costs for contaminated soil disposal) and a total present worth of approximately $991,483.

Green Infrastructure Recommendation

The green infrastructure options recommended for implementation during road reconstruction projects and as devices to bring redevelopment sites into compliance with the City's storm water ordinance can be found in the Community Wide Alternatives portion of Section 4.

Recommended Large Scale Storm Water Facilities List

The recommended large scale storm water facilities listed above are sufficient enough to bring the Oconomowoc River Reachshed #25 into compliance with the 59% TMDL sediment reduction goal, yet these facilities will not reduce the level of phosphorus enough to bring the reachshed into compliance with the TMDL phosphorus goal. The City will need to look to a combination of adaptive management, green infrastructure implementation during road reconstruction and redevelopment projects, along with implementation of additional storm water device alternatives to meet the required TMDL phosphorus goal in the future.

We also recommend that the water quality analysis be updated as additional development, road reconstruction and redevelopment takes place within the City in order to document the increased sediment and phosphorus reductions taking place within all reachsheds and especially reachshed #25.

Recommended Plan – Battle Creek Reachshed (#26)

The City of Oconomowoc is currently obtaining 78.32% reduction in total suspended solids loading and a 59.11% reduction in phosphorous within the Battle Creek Reachshed based on the existing storm water controls currently in place. Without the need for any additional reduction of sediment or phosphorus to achieve TMDL compliance, there is no recommended plan with sediment and phosphorus reduction percentages attached to it. The recommended plan for the Battle Creek reachshed is to continually improve sediment and phosphorus reductions by implementing water quality devices with certain proposed road reconstruction and all redevelopment projects in accordance with the City's ordinance.

Green Infrastructure Recommendation

The green infrastructure options recommended for implementation during road reconstruction projects and as devices to bring redevelopment sites into compliance with the City's storm water ordinance can be found in the Community Wide Alternatives portion of Section 4.

Recommended Plan – Rock River Reachshed (#27)

This reachshed encompasses a very small area of land (26 acres) and the entire reachshed drains directly to waters of the state without passing through the City's MS-4; therefore it receives a 100% reduction in total suspended solids (versus a 40% TMDL goal) and a 100% reduction in Phosphorus (versus a 27% TMDL goal). With no street sweeping within this reachshed due to it being surrounded by County Highway and with a 100% reduction in both sediment and Phosphorus, there are no additional recommendations for this area.

Recommended Plan – Upper Nemahbin Reachshed (#55)

The City of Oconomowoc is currently obtaining 91.56% reduction in total suspended solids loading and a 86.80% reduction in phosphorous within the Battle Creek Reachshed based on the existing storm water controls currently in place. Without the need for any additional reduction of sediment or phosphorus to achieve TMDL compliance, there is no recommended plan with sediment and phosphorus reduction percentages attached to it. The recommended plan for the Upper Nemahbin reachshed is to continually improve sediment and phosphorus reductions by implementing water quality devices with certain proposed road reconstruction and all redevelopment projects in accordance with the City's ordinance.

Green Infrastructure Recommendation

The green infrastructure options recommended for implementation during road reconstruction projects and as devices to bring redevelopment sites into compliance with the City's storm water ordinance can be found in the Community Wide Alternatives portion of Section 4.

COMMUNITY WIDE RECOMMENDATIONS:

Storm Water Ordinance Updates

As part of their MS4 storm water discharge permit, the City of Oconomowoc is required to update their erosion control and storm water management ordinances to match NR 151 and NR 216 no later than May 7, 2016. To help move the City closer to compliance with the TMDL pollutant allocations, it is recommended that the City consider modifications to their ordinances beyond what is required by WDNR.

The densely developed urban sections of the City of Oconomowoc have seen a recent uptick in redevelopment. It can be reasonably assumed that 0.5% of each reachshed will redevelop in any given year. With the City's current storm water ordinance requiring 40% sediment control during all significant redevelopments, redevelopment activities may be expected to improve sediment loadings by approximately 0.20% annually. The City's current ordinance is silent on phosphorous control for redevelopment scenarios. To maximize the potential water quality benefits of this development activity, the following modifications should be considered:

- Require that redevelopment sites provide 80% sediment control and 50% phosphorous control on the entire redevelopment site. This potential change may be expected to improve sediment loadings by approximately 0.40% annually and phosphorous loadings by approximately 0.25% annually. While there would be no direct cost to the City for these modifications, the more stringent ordinances would increase developer costs and likely dissuade certain redevelopment activities.

- Require that new development sites provide 90% sediment control and 40% to 60% phosphorous control.

- Require new development and redevelopment sites to strive for 74% phosphorus control, which is the phosphorus reduction the city needs to meet per the Rock River TMDL report for Reach 25. This level of phosphorus control would most likely be accomplished through infiltration practices. New development and redevelopment sites have a high likelihood of meeting this target in Oconomowoc due to the nature of the soils and other site conditions in this area.

- Further analyze whether more stringent stream reach specific TSS or P post-construction requirements can be implemented, including for Rosenow Creek, Battle Creek and Silver Lake stream reaches. Some of these areas have existing conditions that are conducive to easily meeting higher post-construction control requirements with minimal additional costs.

Water Quality Trading and Adaptive Management

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). 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 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.

Adaptive Management Compliance Alternative

Aside from significant WWTF upgrades to remove additional phosphorous, there are other compliance alternatives available to the City. The main alternatives are variances, implementing a Water Quality Trading program, and implementing an Adaptive Management program. Adaptive Management (AM) is a relatively new program under Wisconsin Administrative Code Chapter NR 217. Under AM, a municipality can work in the watershed to reduce phosphorus source discharges from urban and rural sources. The objective of an AM program is to improve surface water quality. The goal of the Oconomowoc AM plan is to reach a total phosphorus (TP) Water Quality Criterion of 0.075 mg/L or below at the confluence of the Oconomowoc River and the Rock River. Presently, based on monthly City monitoring, the mean value of the TP at this location for the months of May through October, is 0.096 mg/L.

Examples of urban activities to reduce phosphorus discharges are the following: changing leaf collection practices, constructing a storm water detention basin, and using chemical treatment in storm water detention ponds. Examples of rural activities to reduce phosphorus are: constructing riparian filter or buffer strips, changing tillage practices, using cover crops, constructing a grassed waterway, and having controlled livestock grazing. With AM, since the surface water quality is being improved, the phosphorus limits at the WWTF are not as stringent as they would otherwise be without the program. Comprehensive water quality monitoring is required with AM.

The City has identified AM as the preferred compliance alternative. AM was chosen as the compliance alternative for the following reasons: the point of compliance of the Oconomowoc and Rock rivers confluence is relatively close to the WWTF outfall, the needed reductions are considered achievable, the City MS4 could potentially achieve compliance with Reach 25 TP reduction requirements as a program partner, TP is being controlled at the source which will benefit the overall watershed, and because the AM approach is the most cost effective alternative considering both wastewater from the WWTF and storm water. The implications of the AM plan with the City's MS4 and Reach 25 are described subsequently in this section.

Partners

There are many partners in the AM program. Partners include government entities such as municipalities, Wisconsin Department of Natural Resources, Southeastern Wisconsin Regional Planning Commission, Wisconsin Department of Agriculture Trade and Consumer Protection, Natural Resource Conservation Service, and county land and water conservation departments. There are also Lake associations/management districts, environmental groups, land owners, academic institutions and consultants that are partners. The AM plan will bring together the expertise of each partner to improve water quality in the watershed.

Load Reduction Goal

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

Qe - Flow from WWTF

Ce - WWTF Effluent Total Phosphorus Concentration

Qs - Flow of Oconomowoc River at Confluence

Cs - Total Phosphorus Concentration at Confluence

Current Point Source Load = Q_e x C_e x 8.34 x 365 days/year = 2.35 MGD x 0.75 mg/L x 8.34 x 365 days/year = 5,365 lb/year.

Current Load in Receiving Water = Q_s x C_s x 8.34 x 365 days/year = 76.99 MGD x 0.096 mg/L x 8.34 x 365 days/year = 22,499 lb/year.

Allowable Load Credit = (Q_s + Q_e) x WQC x 8.34 x 365 days/year = (76.99 + 2.35) MGD x 0.075 mg/L x 8.34 x 365 days/year = 18,114 lb/year.

Total Reductions Needed = 5,365+22,499-18,114 lb/year = 9,750 lb/year.

MS4

There are several TMDL reaches represented in the AM action area that contain areas where the City of Oconomowoc MS4 operates or drains. These reaches will be monitored as a part of the AM plan to ensure that the appropriate TP reductions are achieved. Reach 25 is the largest portion of the City MS4 system. The intent of the AM program is to achieve compliance with the TP reductions required by the MS4 permit in Reach 25. The WDNR has indicated that if the Water Quality Criterion of 0.075 mg/L is met at the confluence, the MS4 permit requirements will also be met and the conventional percent reduction activities will not be required.

The outlet of Reach 27 coincides with the overall point of compliance described above, and does not contain any portion of the MS4 system. Existing city monitoring near the outlet of Reach 26 which contains a portion of the MS4 shows that the Water Quality Criterion of 0.075 mg/L TP is being met. This site will continue to be monitored to ensure that this reach remains in compliance, but the OWPP will not include the implementation of any phosphorus reduction activities in this area for the time being. Reach 55 also contains a portion of the Oconomowoc MS4, but this area will not be included in the OWPP as it is outside of the project action area.

Therefore, the AM program will only be used to help the City MS4 reach TP compliance in TMDL Reach 25. Any necessary reductions for Reaches 26, 27, and 55 will be met by the City Oconomowoc MS4 outside of the AM Plan using the percent reduction method.

City of Oconomowoc staff collects phosphorus data at multiple points throughout the Oconomowoc River Watershed as part of the AM program to meet phosphorous requirements of both the City's wastewater treatment plant permit and the MS4 permit. This includes a monitoring station at the downstream end of Reach 25, as identified in the Rock River TMDL

Report. This station is identified as 14b, and is located at North Morgan Street Bridge over the Oconomowoc River. Success of the AM project will be demonstrated through in-stream monitoring results. However if, at the end of the AM project time period, the in-stream monitoring results do not reflect the compliance with water quality goals at then downstream end of the overall project area (the confluence of the Oconomowoc River with the Rock River), the MS4 permit can be considered in compliance with the goals of the TMDL if the in-stream monitoring is meeting water quality goals at the downstream end of Reach 25 (monitoring station 14b). If the in-stream monitoring does not meet water quality goals at this location, the city can meet the MS4 permit conditions through a percent-reduction method, shown through storm water modeling tools. To meet the MS4 permit conditions through the percent-reduction approach, the City of Oconomowoc must show a 59% TSS reduction in Reach 25 and a 74% phosphorus reduction in Reach 25, as compared to no storm water controls in the drainage area. TSS will not be sampled at this time

Critical Source Areas

The AM plan contains a listing of agricultural areas where phosphorus reduction activities could be implemented. These areas are termed Critical Source Areas. The areas were identified on a preliminary basis using Geographical Information System tools such as orthophotography and topographic maps. Areas with little buffer and steep slopes to surface waters, dark soils indicating wet areas, and areas showing signs of erosion through gullies were identified. These areas are on maps and listed in tabular format in the AM plan. The AM plan used the STEPL model to estimate an approximate phosphorus reduction for each Critical Source Area if control were put in place to reduction phosphorus runoff.

The AM plan also listed other activities that could be done outside agricultural areas. These include stream bank stabilization and lake reductions.

The AM plan includes an implementation schedule for achieving phosphorus reduction and other project milestone to support the reductions needed.

Oconomowoc Watershed Protection Program

In order to have a more understandable program to the general public, the AM plan is referred to as the Oconomowoc Watershed Protection Program. This non-regulatory term conveys the plan objectives in plain language that should be widely understood by various stakeholders.

The AM plan is located in Appendix H for reference.

Maintenance of Storm Water Quality Control Facilities

The City of Oconomowoc's municipal separate storm sewer system is an inter-connected system of public and private facilities and structures. Storm sewer pipe, swales, inlets, manholes, wet

detention ponds, infiltration basins, and other structures may be publicly or privately owned. Some facilities are located on public property, in roads, in right-of-ways, on private property or in privately-managed outlots. Storm water that originates on private property or flows through privately owned and managed storm water structures discharges to the city's publicly owned storm water infrastructure. This makes inspections and maintenance of both the private and public portions of the system critical to ensure functionality of the entire system.

The City of Oconomowoc is required to develop an inventory of each post-construction storm water management facility within the City and then complete annual inspections of each facility, including any required maintenance thereafter. If these inspections are not completed and the performance of the facilities verified, the City may stand to lose the pollutant reduction credit from the corresponding facilities, necessitating the need for construction of additional facilities to meet the sediment reduction permit requirements. Ruekert & Mielke completed initial inspections of the City's storm water facilities in November of 2008.

Most of the City's residential storm water facilities are located on outlots controlled by homeowners' associations and in common ownership with all subdivision property owners. The City of Oconomowoc will need to determine whether maintenance responsibilities will remain with the homeowners associations or if the City will take them over. If the associations remain in control, a significant amount of staff time will be expended coordinating and enforcing maintenance activities and there will be little assurance maintenance will be done uniformly or correctly throughout the City. Most of the City's commercial, industrial and institutional storm water facilities are located on land owned by the respective business owners and would face a similar decision.

For all storm water quality facilities, it is recommended that the City begin determination of which facilities hold valid maintenance agreements. Once this is understood, City staff can begin working with property owners to facilitate completion of the required maintenance activities until the above issue is resolved.

MS4 Permit Compliance

- Continue the existing public and City staff education, outreach and involvement programs to increase the awareness of storm water impacts on waters of the state. Emphasize elements of the County's storm water education program that focus on phosphorus reduction on private properties, including leaf and grass clippings disposal, yard maintenance such as fertilizer applications, and pet waste removal efforts. Measureable goals must be established, tracked and evaluated and the program must comply with at least the 8 specific requirements listed in the MS4 permit.
    - This program is ongoing with review and modifications at least once per year.
- Develop an illicit discharge detection and elimination program to locate and remove illegal connections to the City's storm sewer system. At a minimum, this program must include on-going dry weather field screening at all priority outfalls at least once per year, dry weather field screening at all other major (non-priority) outfalls at least once every five years, subsequent follow-up investigations if discharge is present, including removal of illicit connections and enforcement of the City's illicit discharge ordinance.
    - This program is ongoing. Modifications will be made as needed to complete priority outfall inspections every year and major, non-priority outfall inspections every five years.
- Enforce and record the City's construction site pollutant control ordinance, including plan review, permit issuance, compliance inspections, enforcement actions and documentation of these efforts
    - This program is ongoing. Updates will need to be made to the City's erosion control ordinance by May 1, 2016 to match recent changes to Chapters NR 151 and NR 216 of the Wisconsin Administrative Code.
- Enforce and record the City's post-construction storm water management ordinance, including plan review, maintenance inspections and enforcement actions and documentation of these efforts
    - This program is ongoing. Updates will need to be made to the City's storm water management ordinance by May 1, 2016 to match recent changes to Chapters NR 151 and NR 216 of the Wisconsin Administrative Code.

- Develop a pollution prevention program, including measureable goals, which includes the following:
    - Develop an inventory of all City owned or operated storm water management facilities. Add privately owned and managed storm water facilities to provide staff with a better understanding of the potential maintenance needs and the influences on the public portion of the MS4 system.
    - Complete and document routine inspections (including any required maintenance) of each storm water management facility owned or operated by the City to maintain their pollutant removal operating efficiency.
    - Complete and document routine catch basin cleaning and street sweeping, including proper disposal. This plan may be modified if supported by further analysis and approved by the Department.
    - Revise the winter road deicing management plan to include contact information, truck routes, equipment descriptions, disposal locations, anti-icing and deicing strategies and actions, and monthly records of product used and weather data prior to March 31, 2016.
    - Evaluate the current approach to leaf disposal. Consider modifications to collection and disposal of leaves, brush and grass clippings that may provide better control of seasonally high phosphorus levels due to decaying leaves reaching the storm sewer system and waterways in the fall.
    - Develop a storm water pollution prevention plan for municipal garages, storage areas and other municipally-owned sources of storm water pollution prior to March 31, 2016. Complete annual full inspections of these facilities thereafter.
    - Development of site-specific nutrient application schedules for fertilizer applications on any City-controlled properties with more than 5 acres of pervious surface.
    - Consideration of environmentally sensitive land development designs for municipal projects, including green infrastructure and low impact development.
- Implement and maintain storm water management practices that were in place on or before July 1, 2011 to achieve a reduction in total suspended solids of at least 20%.
    - This program is ongoing.
- Maintain an updated storm sewer system map.
    - This program is ongoing.

- Complete an annual report evaluating the various storm water programs, documenting compliance with measureable goals and recommending program modifications.
    - Due March 31 of each year.

Plan Costs

The recommended storm water system plan for the City of Oconomowoc has an estimated capital cost of $2.7 million, an increase in annual operation and maintenance costs of $55,100 and an increase in annual street sweeping costs of $278,100. Cost estimates for each recommended improvement are provided in Appendix C.

Indicators to Measure Progress and Monitoring

Observations, citizen-based monitoring and city-sponsored monitoring will be the primary indicators of changes to water quality in the lakes and streams in Oconomowoc. An increase in the public demand for access to lakes and rivers in the city can be an indicator of good water quality, while a decrease in demand can indicate declining water quality. The popularity of the beach on Lac la Belle, boat launch fees, recreational use of the lakes and on the Oconomowoc River, and the amount of aquatic plants and algae blooms on the lakes and the river are all activities that can illustrate trends in the water quality of the lakes and rivers.

As the City implements more water quality practices individually and in conjunction with reconstruction, new and re-development projects, progress will be made toward meeting the water quality goals of the Rock River TMDL. To determine the effectiveness of these projects and initiatives, the revised modeling assessment should be completed at least once during the 5-year WPDES permit term. Site specific modeling results from individual construction projects can be compiled and added to existing practices modeling results. These updated modeling results will be indicators of the progress made over a certain time period, and will be compared to in-stream monitoring results over time. The in-stream monitoring results will be the evaluation of compliance with the ultimate goals of water quality improvements in the TMDL.

Meeting the goals of the TMDL – improving the water quality in the streams and lakes to meet water quality standards – will ultimately be shown through in-stream monitoring. Once the water quality standards have been met, the Department of Natural Resources has a process to remove waterways from the EPA-approved Impaired Waters List. Modeling updates will supplement the in-stream monitoring efforts to gauge the progress made in reaching these goals.

Citizen-based monitoring efforts, coordinated through Waukesha County Department of Parks and Land Use as part of the overall storm water education program, also provide information on the quality of the lakes and rivers. Results of the 2015 monitoring season indicate both Rosenow Creek and Battle Creek are meeting water quality criteria for phosphorus, indicating healthy levels of phosphorus in those systems. Future monitoring of these waterways will help alert

resource managers to problems if sampling results start showing significant changes. Summaries of the data collected for Rosenow Creek and for Battle Creek are included in Appendix G.

City of Oconomowoc staff collects phosphorus data at multiple points throughout the Oconomowoc River Watershed as part of the Adaptive Management program to meet phosphorous requirements of both the City's wastewater treatment plant permit and the MS4 permit. This includes a monitoring station at the downstream end of Reach 25, as identified in the Rock River TMDL Report. This station is identified as 14b, and is located at North Morgan Street Bridge over the Oconomowoc River. Success of the adaptive management project will be demonstrated through in-stream monitoring results. However if, at the end of the adaptive management project time period, the in-stream monitoring results do not reflect the compliance with water quality goals at then downstream end of the overall project area (the confluence of the Oconomowoc River with the Rock River), the MS4 permit can be considered in compliance with the goals of the TMDL if the in-stream monitoring is meeting water quality goals at the downstream end of Reach 25 (monitoring station 14b). If the in-stream monitoring does not meet water quality goals at this location, the city can meet the MS4 permit conditions through a percent-reduction method, shown through storm water modeling tools. To meet the MS4 permit conditions outside of the adaptive management program, the City of Oconomowoc must show a 59% TSS reduction in Reach 25 and a 74% phosphorus reduction in Reach 25, as compared to no storm water controls in the drainage area. TSS will not be sampled at this time

The City will use the TSS % reduction method to show compliance with the TSS requirements of the Rock River TMDL portion of the MS4 permit. Modeling updates will need to be done occasionally after constructing or implementing different practices to estimate the progress made toward meeting the TSS reduction.